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Volume Title: Econometric Models of Cyclical Behavior, Vols. 1 and 2

Volume Author/Editor: Bert G. Hickman, ed.

Volume Publisher: UMI

Volume ISBN: 0-870-14232-1

Volume URL: http://www.nber.org/books/hick72-1

Publication Date: 1972

Chapter Title: An Analysis Of The Forecasting Properties Of U.S. Economet
Models

Chapter Author: Michael K. Evans, Yoel Haitovsky, George I. Treyz, Vincent Su

Chapter URL: http://www.nber.org/chapters/c2790

Chapter pages in book: (p. 949 - 1158)

AN ANALYSIS OF THE FORECASTING PROPERTIES OF U.S. ECONOMETRIC MODELS

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1 GENERAL INTRODUCTION

IN A recent study for the National Bureau of Economic Research, Victor Zarnowitz tabulated and analyzed the records of a great many business forecasts.[1] Zarnowitz' study, while instructive and informative, for the most part excluded forecasts made with econometric models. However, the record should be enlarged to include these models as well. Techniques of model-building have improved, and third generation computers have removed nearly all the drudgery of econometric forecasting. Consequently, such forecasts have recently proliferated.

As recently as 1963, the only econometric forecasts issued on a regular basis were prepared by the Research Center for Quantitative Economics at the University of Michigan. Today such forecasts are computed by the Econometric and Forecasting Unit of the Wharton

NOTE: The authors would like to thank the members of the National Bureau of Economic Research seminar for their helpful comments, Victor Zarnowitz for his careful reading and criticism of an earlier draft, and Malcolm Burns, C. Richard Hathaway, Robert Gonter, and Leon W. Taub for their assistance in replicating the forecasts of the various econometric models. We would like to express our gratitude to George Green, Albert A. Hirsch, and Maurice Liebenberg for the information they provided for the OBE Model. While all of the authors are jointly responsible for the study, it should be noted that Michael K. Evans and George I. Treyz have primary responsibility for calculating the results of the Wharton-EFU and Evans Models, and Yoel Haitovsky, assisted by Vincent Su, has primary responsibility for the OBE Model calculations.

[1] Victor Zarnowitz, *An Appraisal of Short-Term Economic Forecasts*, National Bureau of Economic Research, Occasional Paper No. 104.

School, the Office of Business Economics of the Department of Commerce, and several large private corporations. In addition, the Federal Reserve Board-MIT Model is nearly completed, and even the large-scale Brookings Model has been reestimated for possible use in short-term prediction. Since this method of forecasting has grown rapidly, it certainly deserves further examination.

The analysis of the forecasting record of econometric models can be undertaken in a manner quite different from the procedure used by Zarnowitz. Noneconometric forecasts are not based on a definable algorithm or methodology which enables the ex post examiner to determine in what respects the forecasts might have been changed if the forecaster had possessed more accurate information on various exogenous developments. Econometric forecasts, however, are based on a definite model and explicitly incorporate the exogenous estimates of future values. Thus, while it is possible to analyze the ex ante record of econometric and noneconometric forecasts in the same way, the explicit statement of assumptions by the econometric forecaster enables us to add an extra dimension to the analysis of econometric forecasts.

The obvious alternative to examining ex ante econometric forecasts is to replicate the exact method of solution used by the forecaster, then finding out how his forecast would have been affected had he used the ex post values for the exogenous variables. Despite the superficial attraction of this method, it has become apparent to us that the ex post forecast is not the only test for an econometric forecaster. We have found that detailed appraisal of both the ex ante and the ex post forecasts, as well as other types of forecasts and simulations, is necessary if we wish to obtain a penetrating analysis of the current state of the art of econometric forecasting.

Those unfamiliar with econometric forecasting may believe that all econometric forecasts are made using the model as a "black box" of equations, coefficients, and solution algorithms into which the forecaster enters his best exogenous estimates and then awaits the single, definitive answer. This description is not true, however, for the more sophisticated econometric forecasts. The judgment that is used when forecasts are made with the Wharton and OBE Models is substantial and can be broken into three basic categories.

First, judgment is used to select the values for future exogenous variables. The forecaster must make informed guesses about the path of fiscal and monetary policy during the period to be predicted. He must also estimate economic activity in the foreign sector and in any other sectors which are exogenous to the model. Similar estimates must also be done, of course, by the noneconometric forecaster, but usually not in such explicit detail.

Second, the constants of individual equations are changed to incorporate various factors. They can be changed to reflect information about future exogenous developments not included in the model (such as a strike, a credit crunch, or unusual weather conditions). Constants are altered to incorporate structural changes that have occurred in the real world, but which are not included in the estimated function. Similarly, they are adjusted to reflect unexplained short-run patterns of cyclical behavior or autocorrelation of the residuals. In addition, constants are shifted to recognize substantive data revisions in the level of certain series.

The method used for adjusting the constant terms will be quite different, depending on the source of error. In the case of extraneous information, the explicit adjustment would be entered in the constant term for the duration of the disturbance, and would then return to its previous value. In other cases, the forecaster would use some weighted average of residuals (predicted-actual) for a number of past periods. For data revision, a reasonable alternative to reestimation of the whole model with revised data—if the new revisions are small—is to adjust the constant terms. This assumes that the alterations of the slope coefficients due to the revisions are small, relative to those of the intercepts. Since some of these methods are explained in the following sections, we shall not discuss them here in detail.

Finally, the forecaster may change some of the decisions he has made about constant adjustments or exogenous variables if preliminary forecasts with these assumptions lead to a forecast for some variables that is out of the range of his a priori concept of a reasonable forecast.[2]

[2] Any forecaster will know the multipliers in his model. Thus, he may modify his "exogenous assumptions" so that the forecast will be in line with his a priori ideas of a reasonable forecast, even if he has decided never to alter these assumptions once the preliminary forecast is made.

The first quarter that is "forecast" is the current quarter. Since this first-quarter forecast is made midway through the quarter to be forecast, some of this a priori information is available from interim reports for important economic series, such as employment, consumer prices, and investment anticipations. Other a priori restrictions may come from an implicit model used by the forecaster. Such a model may include qualitative information that is not adequately reflected in quantitative indicators. It must be made clear that using these unstated restrictions is not the same as predetermining the forecast values for all variables. Such restrictions are ranges, and are more important for some variables than for others. They are much the same as the a priori views economists use in deciding whether a regression coefficient is reasonable or not.

The three above adjustments of the model, sometimes known as "fine tuning," have been criticized for destroying the objective nature of econometric forecasting and precluding direct tests of the predictive efficacy of such models. But they preclude only a test with a straw man—an econometric model which has never been adjusted. There may be some interest in examining how well these nonadjusted models perform, and various summary statistics for these experiments are presented later in this study. These results should not be confused with forecasts made by econometricians. They may, however, be regarded as forecasts made by econometric models. A major part of this study is devoted to explaining that these two concepts can be quite different from each other, sometimes bearing little resemblance. This is a separate problem which cannot be analyzed in comparisons of judgmental forecasts; some of the methodological implications of this difference are explored next.

Virtually every econometric forecast involves some judgment, even if it is estimating only the totally exogenous part of the fiscal policy (such as defense spending or change in tax rates). It is unlikely that a totally endogenous econometric model would be a very useful tool. Such a model would be able to issue only one forecast at any given time, regardless of projected changes in government policy. If government expenditures were to double or triple, or even if there were a conflagration or holocaust such that only the computer making the forecast were to be saved, the prediction would not change.[3] In this study we plan to exclude such models—if, indeed, any do exist—and to treat only those econometric models which involve some degree of judgment.

The degree to which econometric methods are used for forecasting in a model depends in part on the relative size of the exogenous sector. In the limiting case, everything would be exogenous; in this case, it would coincide with the pure judgmental forecasts. Most econometric models contain consumption and investment sectors which are both endogenous, although in some cases consumer and producer durables are predicted by survey data within the over-all framework of an econometric model. In the government sector, most (or all) expenditures are exogenous; endogenous revenue functions are estimated but they depend on exogenous tax-rates. There is usually an endogenous monetary sector which depends on certain key exogenous variables, such as unborrowed reserves or the discount rate. Foreign income and prices are almost always exogenous because they depend primarily on events which are independent of this economy. In models of the United States, the agricultural sector is usually treated exogenously, both because it is affected mainly by exogenous variables such as the weather and government farm policy, and because it is quantitatively unimportant. While there are some minor variations from this broad outline, it serves as a general guideline for the type of econometric models which will be considered.

Given the sort of econometric model outlined above, its forecasting record will depend on the estimation structure of the individual equations, the interaction of these equations in a simultaneous solution, and cumulation of error in successive quarters of forecast. Forecasting records compiled from such a system—without adjustment, but with the actual values of the exogenous variables—can be easily tabulated

[3] It is true that certain types of forecasts, such as the National Bureau leading indicators, and various types of anticipations and intentions surveys, give only one forecast at any given time. However, these methods of forecasting presumably have advantages not found in the econometric models, such as simplicity and inclusion of exogenous information not easily predicted by econometric methods. It would seem a great misallocation of resources to estimate complex econometric models which then did not have the flexibility to issue alternative forecasts which reflect policy decisions.

and analyzed. As we have already stated, this kind of record may not be very meaningful, although for future prediction one would generally prefer a model with a better forecasting record (as defined on this basis) to a model with a poorer one.

The question of how well econometricians forecast, given that they have developed a certain model, depends both on their ability to judge future exogenous events correctly and on their success at "fine-tuning" the model. One might want to separate these effects; this is done with the empirical results presented in this study. Errors in predicting exogenous variables are generally less offensive than errors in the model itself.[4] For example, consider two forecasts, both of which have understated *GNP* by $10 billion. The first forecast uses a poor guess at exogenous variables; if the correct ex post values were inserted, the forecast would be correct. The second forecast contains all the correct exogenous variables but nevertheless it is still in error by $10 billion. Most neutral observers would consider the first forecast as the better of the two, even though the actual error was identical. Furthermore, if a third forecast were correct only because it used the incorrect exogenous values, and was found to contain an error of $10 billion when the actual ex post values were supplied, some might argue that this forecast is also inferior to the first one. In many cases, this may be true. For example, the 10 per cent surcharge which went into effect in July, 1968, was widely assumed to be effective during the entire year by those forecasting a year ahead in late 1967. A forecast which underestimated the level of 1968 *GNP* by only the amount directly attributable to the delay in the surcharge would have been a better one than a forecast which was actually correct but assumed no surcharge.

The above example notwithstanding, it may be an unrealistic procedure to enter the correct exogenous values in an ex ante forecast and claim that this is the forecast which would have been released if the correct values of the exogenous variables were known. For instance, if the model had been tuned with the expectation of no surcharge, such a forecast might be quite different from one prepared with the expectation of the surcharge and only a change in the slope-

[4] We assume that the model-builder will try to find the exogenous variable which is easiest to predict in any given class of variables imparting equal predicting information.

coefficient of the tax function. The fine-tuning of the individual equations might have been considerably different for these two forecasts.

In addition, one must consider the interaction of the actual forecasts with government policy. It is possible that monetary and fiscal policy will be partially determined by ex ante forecasts when such models predict undesirable economic developments. In these cases, the forecasts might be incorrect because of incorrect values of the exogenous variables, but this could in no way be considered a poor forecast. In such instances, the econometric model would have performed one of the most important tasks for which it is designed. Thus, the entire question of errors in predicting exogenous variables is one which contains many problems of interpretation, and should, in any event, be analyzed separately from other forecasting errors.

If we wanted to evaluate ex post forecasts for many models, we would have to control the exogeneity in the various models. As an extreme example of a good conditional forecast due to a high dependence on exogenous variables, consider the extremely simple model $GNP = pX$, where p and X are both exogenous. It is clear that the conditional forecasts from this "model," i.e., with the exogenous values known, would always be perfect. However, such a model would be of no use for forecasting. This particular example is clearly unrealistic, and is not representative of econometric models. Yet, it would be possible to construct a model in which all sectors of aggregate demand and supply were closely tied to exogenous variables. The tendency away from this sort of model-making suggests that these types of results are not really very useful, and we do not consider them in this study.

It should be emphasized that the primary purpose of our study is to uncover the various sources of error inherent in ex ante forecasts, and to suggest alternative methods of adjustment, estimation, and specification of the models which might systematically improve their forecasts. Our work is not intended to be a comparison of the predictive records of various models, or to be a study aimed at establishing that one model is "better" than the others. Because each econometric model has so many of its own unique characteristics, it is not possible to treat each set of forecasts anonymously, as was done by Zarnowitz in his study. Thus, each model considered in this study is prominently identified, and its fundamental characteristics are discussed. This is done with a view to providing the reader with a better background for understanding the results which follow, rather than as an invitation to invidious comparisons.

2 THE MODELS INCLUDED IN THIS STUDY

A. THE CHOICE OF MODELS USED

At the outset of this study, our impression was that there were in existence a fairly large number of econometric models which might be included and analyzed. However, upon closer examination, and upon application of various criteria to prospective models, we found that the alleged list was much smaller than we had expected. The four criteria which were used are as follows:

First, the forecasts should be made with a structural econometric model. This study is not concerned with purely extrapolative techniques, even if they are formal and very sophisticated.

Second, the models included must have reasonably long true ex ante forecasting records.

Third, the particular versions of the model used for specific ex ante forecasts, the exogenous assumptions, and the constant adjustments associated with these forecasts, must currently exist. In addition, it is necessary that the ex ante forecasts can be reproduced, and that variations on these forecasts can be performed using alternative assumptions.

Fourth, the models and forecasts must be on a quarterly basis. While we recognize that annual models may be as useful in forecasting and policy analysis as are quarterly models, the method of analysis used in this study would not be applicable.

After applying these criteria and requiring, in addition, that the proprietors of any given model agree to cooperate with this project, it was found that only two models could be included: the Wharton Econometric Forecasting Unit (Wharton-EFU) Model and the Office of Business Economics (OBE) Model. The Evans Model (which was estimated at Brown University but was used for forecasting by the Wharton School for two years) is treated as a subset of the Wharton-EFU Model, as will now be explained.

B. THE WHARTON SCHOOL AND EVANS MODELS

The initial model in this collection was estimated by M. K. Evans as part of his unpublished doctoral dissertation.[5] Forecasts from this model were first made in early 1963; they were genuine ex ante forecasts, in that the first-quarter figures were not yet known, but they were not circulated publicly. These forecasts were made without adjusting the constant terms for any of the equations, owing to a certain naivete of the forecaster at that time, which led him to believe that econometric models should not need any adjustments.[6] This model was improved by Evans and L. R. Klein during the summer of 1963, and regular quarterly forecasts were started at that time. The model underwent continuous revision until the beginning of 1964, when a stabilized version was used for prediction for several quarters. A slightly revised version was used for the fall 1964–summer 1965 predictions.

In August, 1965, the national income data were completely revised, and it was found that the old model, even with some patchwork, was no longer relevant. A completely new model was estimated by Messrs. Evans and Klein, and was first used for forecasting purposes at the end of 1965. While the new model was being constructed, no forecasts were made, leaving a two-quarter break in an otherwise continuous series of predictions. This version was slightly refined early in 1966 and the revised version was used through the spring of 1968.[7] At that time, an enlarged monetary sector was added, but the remaining equations were unchanged. This model was used for forecasting through the end of 1968, at which time it was supplanted by a revised and updated version. All these various versions are referred to

[5] M. K. Evans, "A Quarterly Postwar Model of the United States Economy," unpublished doctoral dissertation, Brown University, 1964.

[6] Experience shows that this sort of naivete is typical of many newcomers to the "business" of econometric forecasting.

[7] This version is found in M. K. Evans and L. R. Klein, *The Wharton Econometric Forecasting Model*, University of Pennsylvania, 1968.

as the Wharton Model in this study, except in those tables where the Evans Model is explicitly accorded separate treatment.

Before proceeding to the empirical record, it may be useful to describe some of the characteristics of the Wharton Models. In spite of the multiplicity of models actually estimated, there are certain basic features which have remained unchanged throughout all versions.

The models have grown in size from approximately 30 to 50 stochastic equations, but the primary emphasis is still centered on the aggregate demand equations in general, and the investment sector in particular. The consumption sector has separate equations for autos and other durables, and treats nondurables and services in a single equation. In that equation, the ratio of nondurables and services to personal disposable income is a function of the lagged dependent ratio and percentage changes in income. Nonauto durables are a function of income, relative prices, and previous stocks. The specification of the automobile equation has changed somewhat because of its poor performance in initial predictions. Income, relative prices, previous stocks, and the rate of unemployment have always been important variables, but the lag structure has been modified. A money-stock variable representing general credit conditions has been replaced by a variable for specific changes in consumer credit regulations, and a dummy variable for supply shortages was added later.

Fixed business investment and inventory investment have always been disaggregated into the manufacturing and nonmanufacturing sectors. Fixed business investment in manufacturing is a function of output, cash flow and capital stock in that sector, and the long-term interest rate. In earlier versions of the model, the "inverted W" distribution was used;[8] separate output terms were included with average lags of 1 and 2 quarters, and 5 and 6 quarters. All other variables entered the function only with the longer (5–6 quarter) lag. Later, this formulation was modified by introducing the Almon lag structure for all independent variables, plus a modifications term—represented by capacity utilization—which is lagged one quarter. In early versions of the model, investment was positively related to the change in the

[8] For a discussion of this distribution, see M. K. Evans, "A Study of Industry Investment Decisions," *Review of Economics and Statistics*, Vol. 49, No. 2 (May, 1967), pp. 151–64.

wholesale price level and negatively related to the variability of retained earnings, but these terms were later dropped. The independent variables in the nonmanufacturing fixed-business-investment function were, originally, the change in the wholesale price level, total sales originating in the private sector, and the long-term interest rate. The function included the change in sales with a short lag, and the level of sales with a longer (5 quarter) lag. The wholesale price level was later dropped, and the Almon lag structure introduced, but the other independent variables are unchanged. Early versions of the model included an endogenous function for farm investment, which depended on farm prices, farm income, and farm capital stock. This equation was later dropped (since all of the independent variables were exogenous), and nonmanufacturing investment was further subdivided into equations for regulated and commercial investment.

The inventory investment functions have changed very little. For the manufacturing-sector equation, sales, lagged inventory stocks, change in unfilled orders, a dummy variable for steel strikes, and changes in the wholesale price level have been the dependent variables. In later versions, the wholesale price level term was dropped, and the lag structure on sales and unfilled orders was slightly modified. For the nonmanufacturing (trade) sector, the change in *manufacturing* output, change in the wholesale price level, purchases of consumer durables, and lagged inventory stocks are the independent variables. There has been virtually no change in this function. A farm inventory investment function, in which the independent variables were the farm price level and lagged inventory investment, was subsequently dropped from the model.

Investment in residential construction contains elements of supply as well as demand, since in the short run the amount of construction put in place measures the amount of housing built, rather than bought. Thus, cost variables, such as the ratio of the price of new housing relative to a rent index, and a variable representing the availability of credit —which is the spread between the long- and short-term interest rates— have always been important. In addition, disposable income has a minor role. Some early attempts to include population and the stock of housing as long-run variables were not continued in more recent versions of the model. The change in the money stock was, at one time, included as a general credit variable. This, too, was subsequently dropped, although it might have helped predict housing in late 1966.

The early versions of the model treated the foreign sector completely exogenously. This omission was rectified in the post-1965 models, when three import equations and an export equation were added. In the import sector, imports of food depend on per capita income and relative prices. Imports of crude materials and semi-manufactured goods depend on sales and inventory investment in the manufacturing sector, and on relative prices. Imports of other goods and services depend on personal disposable income and relative prices. Exports depend on an index of world trade and on the price of exports relative to the price of world trade. In the last two equations, the dependent variable is also included on the right-hand side of the equations, with an average lag of the past four quarters.

It is in the supply side that the older and newer models differ substantially. In the Evans Model, corporate profits were determined directly, as a function of national income, capacity utilization, and (with a negative relationship) lagged capacity utilization. Wage income was thus determined as a residual, which precluded the need for equations explaining employment, hours worked, or wage rates. Unemployment was estimated directly, as a function of capacity utilization, instead of being calculated implicitly as the residual between labor force and total employment.

Later versions of the model followed the approach set forth by Klein in his earlier work, with an expansion to the two-sector approach. Output originating in the manufacturing sector is a function of utilized labor (defined as employment times hours worked per week), utilized capital stock (defined as total manufacturing capital stock times an index of capacity utilization), and a nonlinear trend representing technological improvement. Maximum output in the manufacturing sector can then be made a function of total—rather than utilized—labor and capital in that sector. The ratio between actual and maximum output in manufacturing is then defined as the index of capacity utilization. The nonmanufacturing-sector function is the same, except that no distinction is made between total and utilized capital stock. Furthermore, the concept of capacity utilization is not defined for the nonmanufacturing sector.

Hours worked in the manufacturing sector are a function of the level of output, the change in output, capacity utilization, and the wage rate. The positive relation with output, and the negative relation with the wage rate, represent the tendency of employers to use more labor when demand grows, but to reduce the length of the work week as overtime wages grow. In addition, the wage rate may represent a substitution on the part of workers of more leisure for more overtime pay. The change in output and capacity-utilization terms represent the buffer-stock nature of hours; in the short run, employers prefer to change the length of the workweek rather than the number of employees. Hours in the nonmanufacturing sector do not fluctuate cyclically but, rather, follow a general downward trend. Only the wage rate and a marginally significant capacity-utilization term are included in that equation.

The manufacturing wage-rate function, estimated in annual first differences, is a function of previous changes in the consumer price level and the spread between the over-all unemployment rate and the "prime group" unemployment rate (calculated as the unemployment rate for males aged 25–34). There is a nonlinear relationship between these two rates; they are almost the same during recession, but in booms the prime-group rate falls below 2 per cent, while the over-all rate stays at a much higher level. Thus, the nonlinearity inherent in Phillips-curve analysis is included by using the spread between these two rates. An additional equation in the system tracks the nature of the nonlinearity between these two rates. The nonmanufacturing wage rate follows the manufacturing wage rate; it includes a separate term for the change in consumer prices, but not for the tightness of the labor market.

The factor-share equations are similar for both models and are, in any case, quite straightforward. Taxes are a function of the income on which they are levied, transfer payments depend on the unemployment rate and a time trend (for increased coverage), and depreciation allowances for the various sectors depend on the relevant capital stocks. Dividends are a function of after-tax profits and lagged dividends, and inventory valuation adjustment is a function of changes in the wholesale price level. In the post-1965 models, equations are also provided for unincorporated business income and for rental and interest income;

these variables were not needed in earlier versions of the model because personal income was then calculated directly as national income less corporate savings plus transfer payments. Both models contain equations explaining output originating in the manufacturing sector as a function of various components of aggregate demand. They also include an equation in which unfilled orders is a function of sales, changes in government defense purchases, dummy variables for the Korean War, and (in earlier versions) fixed investment and the lagged level of orders.

The price functions have undergone the greatest changes in the various models, although the wholesale price level has continued to be the central price variable in the model. In the earliest model, changes in the wholesale price level were a linear function of the level of capacity utilization and the money stock, and a nonlinear function of changes in capacity utilization. Other price levels were then related to the wholesale price level and to specific variables important to particular sectors. Later the money stock was dropped and various dummy variables were added for the Korean War period. In the post-1965 versions, levels instead of changes were estimated, unit labor costs were added as the main independent variable, capacity utilization was retained but the nonlinear terms were dropped (for lack of empirical evidence), and the lagged dependent variable was also included. Other sectoral price levels still depended on the wholesale price level and on other specific factors, i.e., the price of food, of nondurables and services, and the ratio of investment to *GNP* for the capital-goods sector. It might be noted that in the post-1968 versions (not used for empirical results here), these equations have again been substantially changed. The equations have been estimated for the period 1954–1967 so that the periods of price controls during the Korean War could be omitted, annual percentage first differences are used, nonlinearities near full employment have again been found to be important, normal unit labor costs have been included successfully in the wholesale price equation, and sector price levels also depend directly on unit labor costs.

Until very recently, the monetary sector consisted of two equations. The short-term interest rate was a function of the discount rate and the lagged short-term rate (later, a term including the required reserve ratio was included, and after that, the free reserve ratio was added), and the long-term rate was a function of the short-term rate and the lagged long-term rate. In the 1968 version of the model, equations have been added for the three components of the money stock. In these equations, the ratio of money to a weighted average of *GNP* depends on differential rates of interest. A time deposit rate has also been added, and the equations for the short and long rates have been somewhat modified.

The brief description above is, of course, not intended to convey all of the theoretical and empirical specifications that serve as background for the estimation of the models and for the areas of future improvement, these being discussed in other publications.[9] It should, however, convey some of the flavor of these models and provide the reader with a useful background for interpreting the statistical results of the next three sections.

C. THE OFFICE OF BUSINESS ECONOMICS MODEL

This model will not be described here, since its outline and a complete equation specification are included in another paper prepared for this Conference.[10] However, it may be useful to sketch the development of this model after 1966, since several different versions have been used to make the forecasts. All of the various respecifications of the OBE Model are based on the May, 1966, published version, which contained 36 stochastic equations. (See the paper by Green, Liebenberg, and Hirsch, present volume.)

Only those versions of the model which were used for making forecasts during the last three quarters of 1967 and during 1968 will be used. All efforts to replicate the forecasts prior to 1967.2 proved to be unsuccessful. There are, basically, three different models to be considered:

(*a*) The 1967.2 version is quite similar to the 1966 published

[9] See Evans and Klein, *op. cit.*, and M. K. Evans, *Macroeconomic Activity: Theory, Forecasting and Control.* New York, Harper & Row, 1969.

[10] Maurice Liebenberg, Albert A. Hirsch, and Joel Popkin, "A Quarterly Econometric Model of the United States: A Progress Report," *Survey of Current Business*, May, 1966, pp. 13–39.

version, the major addition being the inclusion of an employment equation. The price and wage equations were also reestimated.

(*b*) The 1967.3 version incorporated substantial changes. The wage rate, civilian labor force, and compensation of employees equations were respecified. This had a significant effect on price determination, since prices are determined primarily as a markup over unit labor costs.

(*c*) Further substantial changes were made in the 1968.1 version. The number of stochastic equations was increased to 56, with the number of variables now totaling 170. The monetary sector was greatly enlarged, and equations for new orders, unfilled orders, and shipments were introduced. All the consumption and investment functions were restructured and reestimated. The merchandise import equation was changed to include production, capacity utilization, and prices as independent variables. The price equations were again respecified and reestimated. In the 1968.3 version of the model, several equations were reestimated with the revised July, 1968, data, but very few respecifications occurred in either that model or in the 1968.4 version. In the forecasts for 1968.1 and 1968.2, the endogenous equations for fixed nonresidential investment were suppressed for the two quarters of forecasting, and were replaced by realization functions for anticipated investment expenditures from the OBE investment anticipation survey. The endogenous equations were used for the final quarter of the forecasts.

3 HOW WELL DO ECONOMETRIC MODELS FORECAST

A. GENERAL METHODOLOGY

In this section, we will confine our investigation to sample period simulations and ex post mechanical forecasts. Thus, we will be examining the predictive efficacy of econometric models in the unrealistic situation where all of the revised values of the lagged variables are known, and where the future values of the exogenous variables are also known. This procedure is designed to isolate the amount of forecast error that is due to the model alone. We are testing how well the model would forecast in the absence of any interaction between the forecaster and the model, and in the absence of any uncertainty about the values of exogenous variables.

Each model was simulated over both its sample period (with minor exceptions to be noted later) and the postsample period through 1968. In most cases, simulations were calculated six quarters ahead from each starting date. Each six-quarter forecast uses observed values of lagged endogenous variables before the starting date, while using internally generated endogenous variables for all values after that date. In all cases, the actual values of the exogenous variables are used, since we want to isolate the effect of incorrect exogenous values on forecasting error and to discuss this effect at a later point.

In the first set of simulations, we did not adjust the constant terms of the equations. These simulations were carried out to show the sample-period performance of the model itself. They do not reflect the procedure that was used for ex ante forecasting. In particular, they neglect the constant term adjustments which are incorporated in most ex ante forecasts. We then examined the actual adjustments used during the six-year ex ante forecasting record of the Wharton Models to see if any systematic rules for adjustment could be found. While, as will become apparent later, no single rule explains all of the adjustments which were made, it was found that the following mechanical rule explains the adjustments best: for all equations where the dependent variable is not expressed as a first difference (quarterly or annually), add the average of the single-equation residuals for the last two quarters to the constant term in the equation.[11] This rule was also used in the analogous simulation of the OBE Model. This method of making adjustments is referred to as "AR (average residual) constant adjustments" in all of the following tables.

If the equation disturbances are autocorrelated, but it is thought that the structure of the equation has not changed, the forecaster can often take advantage of the information imparted by recent residuals in another way. The appropriate procedure for a first-order auto-

[11] In the Wharton-EFU Model, the equation for the change in unfilled orders was treated as if it were not a first-difference equation.

regressive scheme of the disturbances is given by Goldberger as:[12]

$$A_{i(t+T)} = \rho_i^T e_{it}$$

where A_i is the correction applied to the ith equation, ρ_i is the auto-correlation coefficient of the residuals of the ith equation, t is the latest observed date previous to the generation of the forecast, and e_{it} is the observed single-equation residual for this date.[13]

Goldberger's procedure has been refined by George Green, who calculates a modified correction factor as:[14]

$$A^G_{i(t+T)} = \rho_i^T \frac{e_{it} + \rho_i e_{it-1}}{2}$$

On purely theoretical grounds one might prefer to use a second-order auto-regressive scheme for computing the correction factor.[15] However, this procedure was also tried by George Green for the OBE Model and was not found to be superior to the simpler first-order correction. The purpose of additional Green refinement is to eliminate an overadjustment which might ensue from an exceptionally large residual in the latest observed quarter. Forecasts and simulations for which the A_i^G type adjustments were applied are referred to as "GG (Goldberger-Green) constant adjustments" in all of the following tables.

In addition to reporting the simulation results up to six quarters ahead, we have calculated statistics for simulations one year ahead. These are the root mean square (RMS) statistics computed from the forecasting errors of the various simulations—one, two, three, and four quarters ahead. These forecasts are obtained by simple averaging of the forecasts over a four-quarter period. This statistic is reported in

[12] Arthur S. Goldberger, "Best Linear Unbiased Prediction in the Generalized Linear Regression Model," *Journal of the American Statistical Association*, Vol. 57, No. 2 (June, 1962), pp. 369–375.

[13] Goldberger developed his formula for single equation estimates rather than for model forecasts. Also, his e_t is the last sample-period residual. However, the spirit of his development is not violated by our simple extensions.

[14] An alternative procedure would be to calculate

$$A_{i(t+T)} = \rho_i^T \frac{e_{it} + \rho_i e_{it-1}}{1 + \rho_i}$$

[15] See, for example, Guy H. Orcutt, "A Study of the Autoregressive Nature of the Time Series Used for Tinbergen's Model of the Economic Systems of the U.S., 1919–1932," *Journal of the Royal Statistical Society* (Series B), Vol. 10, No. 1, pp. 1–45.

order to facilitate comparisons with annual forecasts. It is not surprising that occasionally the one year ahead forecasts have a smaller RMS error than the one quarter ahead forecasts. Evidently, many actual short-run fluctuations not captured by the model are canceled when averaged over a longer period.

Two bench mark (or standard of comparison) statistics are also computed for each of the reported variables. These are the so called "naive forecasts." Two naive models were computed. The first, which is termed here Naive Model I is the "no change" forecast, i.e.,

$$F_{i(t+T)} = R_{it}$$

where F_i stands for the forecast of the ith variable and R_i stands for the "realized" (observed) value of the ith variable.

The second is the "same change" naive model (Naive Model II), which is

$$F_{i(t+T)} = R_{it} + T \times (R_{it} - R_{it-1})$$

that is, the trend in the last two observed quarters is extrapolated for T periods.

The RMS statistics for the various simulations are then divided by the corresponding RMS of Naive Model I. The purpose of the new statistic is twofold: (*a*) the performance of the forecasting procedure under investigation can be easily compared to the "no change" forecast. A value larger than unity for the new statistic immediately cautions the reader that the model forecast performance was inferior even to the simplest of all extrapolations; (*b*) the division by Naive Model I RMS can be viewed in some sense as a normalization procedure, normalizing for the erratic behavior of the various series in the period under investigation.

We have followed standard procedure in reporting the RMS error for all these different simulations. In addition, we have decomposed the mean square error (= $(\text{RMS})^2$) into the Theil inequality coefficients. We have

$$UM = (\bar{F} - \bar{R})^2$$

$$US = (S_F - S_R)^2$$

and

$$UC = 2(1 - r_{FR})S_F S_R$$

where $\bar{F}$, $\bar{R}$, S_F, S_R, and r_{FR} are respectively the means and standard errors of the simulated and realized values and the correlation coefficient between them over the period covered in the tables.

UM, *US*, and *UC* are called by Theil[16] the "*partial* coefficient of inequality due to *unequal central tendency,* to *unequal variation,* and to *imperfect covariation,* respectively." This breakdown provides additional information about the source of the forecasting inaccuracies.

B. THE WHARTON-EFU MODEL

The version of the Wharton-EFU Model used for the sample period simulations is the one listed in *The Wharton Econometric Forecasting Model.* This model was estimated with data including the July, 1965 revision of the national income accounts for the sample period 1948.1–1966.4. The Wharton-EFU Model has two separate operating systems: the standard version and the anticipations version. In the anticipations version, equations for purchases of consumer durables, plant and equipment expenditures, and residential construction are expanded to include terms for the Survey Research Center index of consumer attitudes, the OBE-SEC investment anticipations, and housing starts lagged one quarter, respectively. Since the anticipations variables are not generated endogenously, this version can be used to forecast only one or two quarters ahead.

In this section, simulations with both systems of the Wharton-EFU Model are presented, although the emphasis is on the standard version. Sample period simulations were carried out for six-quarter intervals, beginning in 1953.1, and the model was then restarted for each quarter through 1963.3. The 1963.4 simulation was calculated for only five quarters so that it would still end within the sample period; similarly, the 1964 simulations were generated for four, three, two, and one quarters. The starting date of 1953.1 was chosen even though the sample period extends from 1948.1 to 1964.4. The Korean War years are excluded from these simulations, because they include economic fluctuations not adequately captured by an econometric model which is designed primarily for forecasting the post-1964.4 period. As cur-

[16] H. Theil, *Economic Forecast and Policy.* Amsterdam, North-Holland, 1961, p. 35.

rently written, the solution program for the Wharton-EFU Model will not converge to a reasonable answer (e.g., unemployment greater than zero) for more than one quarter ahead during some of the Korean War periods.

As stated earlier, the sample period simulations presented here use revised values for the lagged variables and the actual values of all exogenous variables. In addition, the parameters of the three tax functions are changed whenever there is a corresponding change in the tax laws. The parameters of each tax function are usually estimated by least squares during the duration of any tax law. In some cases, where there were only a few observations, simple inspection sufficed for determining the parameters.

In addition to the types of simulations already described in Section 3A, one additional set of simulations was calculated for the Wharton-EFU Model. These simulations, which are described in much greater detail in Section 5, are called Regression on Simulated Values, or ROS coefficients. Very briefly, the model is first estimated by standard methods (in this case, two-stage least squares with principal components) and parameter estimates are obtained. The system is then solved for each quarter to obtain simulation values. The coefficients are then reestimated using the *complete system solution values* for the unlagged endogenous variables that appear on the right-hand side of each equation in place of their actual values. The parameter estimates thus obtained are used to resimulate the model for six-quarter periods, and it is these statistics which are reported in the lowest quadrant of Tables 3.1 through 3.10.

We consider the sample period results first. While it would be superfluous to comment on each set of entries individually, a few general comments are in order. First, it can be noted that all the errors are uncomfortably large. In particular, the $6.8 billion RMS error in predicting *GNP* only one quarter ahead is only slightly lower than the actual change of $8.1 billion given by Naive Model I for the same period. Similarly unimpressive results are reported for the other variables included in these tables.[17] Furthermore, the constant adjust-

[17] These summary statistics were originally calculated for seventeen variables. However, in the interests of reducing the number of tables here, we have chosen to analyze only five variables: *GNP*, consumption, and investment in current dollars, *GNP* in constant dollars, and unemployment. Summary statistics for the other variables are available on request.

TABLE 3.1

Sample Period Simulations for GNP in Current Dollars, Wharton-EFU Model Standard Version

	Quarters Ahead						One Year	Anticipation Version: Quarters Ahead	
	1	2	3	4	5	6	Ahead	1	2
				A. No Constant Adjustments					
RMS	6.75	8.20	7.70	8.17	8.19	10.02	6.20	5.11	5.70
UM	.50	.81	.18	.20	4.61	8.13		1.67	2.11
US	.23	.60	0.00	.47	2.42	4.02		.55	.91
UC	44.80	65.83	59.11	66.08	73.79	88.25		23.89	29.47
RMS (% Error)	1.47	1.77	1.67	1.78	1.98	2.22		1.11	1.23
RMS/RMS (Naive I)	.83	.54	.35	.29	.29	.25	.34	.63	.37
MSE	45.56	67.24	59.29	66.75	80.82	100.40	38.44	26.11	32.49
ΣMSE (of components)	20.58	25.14	25.61	28.87	33.46	37.25		18.96	16.98
				B. GG Constant Adjustments					
RMS	6.11	8.14	8.28	8.59	9.18	9.83	6.62		
UM	.10	0.00	.14	.01	1.83	3.63			
US	0.00	.40	.35	0.00	.94	1.75			
UC	37.23	65.86	68.07	73.78	81.50	91.25			
RMS (% Error)	1.39	1.74	1.80	1.86	1.99	2.15			
RMS/RMS (Naive I)	.75	.53	.38	.30	.27	.25	.37		
MSE	37.33	66.26	68.56	73.79	84.27	96.63	43.82		
ΣMSE (of components)	15.78	23.43	25.63	29.15	33.51	36.95			

			C. AR Constant Adjustments						
RMS	6.87	9.29	9.92	11.07	12.92	14.02	8.41	5.15	6.17
UM	2.83	5.70	4.23	5.02	8.18	8.45		1.91	3.46
US	1.04	.77	.49	1.47	6.18	8.25		.13	.04
UC	43.44	79.83	93.69	116.05	152.57	179.85		24.48	34.57
RMS (% Error)	1.49	2.03	2.18	2.44	2.86	3.09		1.12	1.34
RMS/RMS (Naive I)	.84	.61	.45	.39	.38	.35	.47	.63	.41
MSE	47.20	86.30	98.41	122.54	166.93	196.56	70.72	26.52	38.07
ΣMSE (of components)	17.21	31.36	45.47	57.51	73.17	65.24		11.66	17.87
			D. AR Constant Adjustments and ROS Coefficients						
RMS	5.26	8.22	10.00	11.79	13.98	15.30	8.30		
UM	1.33	5.27	7.40	10.70	15.81	22.94			
US	.22	.14	.20	.69	4.10	6.32			
UC	26.12	62.16	92.40	127.61	174.53	204.83			
RMS (% Error)	1.14	1.80	2.19	2.58	3.06	3.35			
RMS/RMS (Naive I)	.65	.54	.46	.42	.41	.38	.46		
MSE	27.67	67.57	100.00	139.00	195.44	234.07	68.89		
ΣMSE (of components)	12.75	25.36	36.04	48.98	64.21	75.84			
Naive I RMS	8.15	15.24	21.87	28.17	34.07	39.83	17.78		
Naive II RMS	5.90	12.05	18.95	26.57	33.11	39.40	15.41		

TABLE 3.2

Sample Period Simulations for Consumption, Wharton-EFU Model Standard Version

	Quarters Ahead						One Year Ahead	Anticipation Version: Quarters Ahead	
	1	2	3	4	5	6		1	2
A. No Constant Adjustments									
RMS	3.94	4.33	4.14	4.22	4.61	4.98	3.45	2.88	3.09
UM	.28	.24	.55	1.25	4.59	6.05		.01	.01
US	0.00	.04	0.00	0.00	.13	.17		.11	.33
UC	15.24	18.47	16.59	16.56	16.53	18.58		8.17	9.21
RMS (% Error)	1.32	1.44	1.37	1.39	1.52	1.66		.95	1.02
RMS/RMS (Naive I)	.87	.50	.33	.26	.23	.20	.33	.64	.36
MSE	15.52	18.75	17.14	17.81	21.25	24.80	11.90	8.29	9.55
ΣMSE (of components)	8.23	9.66	9.35	10.05	11.45	13.06		5.15	5.99
B. GG Constant Adjustments									
RMS	3.80	4.45	4.41	4.42	4.67	4.84	3.65		
UM	.47	.30	.30	.63	2.65	3.45			
US	.03	.09	.10	.03	.05	.04			
UC	13.94	19.41	19.05	18.88	19.11	19.95			
RMS (% Error)	1.25	1.46	1.45	1.44	1.53	1.59			
RMS/RMS (Naive I)	.84	.52	.35	.27	.23	.20	.35		
MSE	14.44	19.80	19.45	19.54	21.81	23.43	13.32		
ΣMSE (of components)	7.20	9.73	10.06	10.76	11.90	12.72			

	C. AR Constant Adjustments								
RMS	4.17	4.97	5.38	5.81	6.66	6.95	4.58	2.96	3.34
UM	1.27	1.51	1.39	1.654	3.09	3.14		.80	.93
US	.61	.37	.37	.742	2.61	2.75		.10	0.00
UC	15.51	22.82	27.18	31.360	37.86	42.41		7.86	10.22
RMS (% Error)	1.42	1.68	1.82	1.98	2.29	2.38		1.01	1.12
RMS/RMS (Naive I)	.92	.58	.43	.35	.33	.29	.44	.65	.39
MSE	17.39	24.70	28.94	33.756	43.56	48.30	20.97	8.76	11.15
ΣMSE (of components)	8.22	15.59	27.95	34.02	41.34	25.61		5.15	7.64
	D. AR Constant Adjustments and ROS Coefficients								
RMS	3.50	4.47	5.36	6.21	7.33	7.85	4.57		
UM	1.21	1.86	2.47	3.20	5.75	7.33			
US	.48	.20	.29	.58	2.31	2.53			
UC	10.56	17.92	25.97	34.78	45.67	51.71			
RMS (% Error)	1.19	1.50	1.79	2.07	2.46	2.64			
RMS/RMS (Naive I)	.77	.52	.43	.38	.36	.33	.44		
MSE	12.25	19.98	28.73	38.56	53.73	61.62	20.88		
ΣMSE (of components)	6.96	12.39	18.90	25.47	32.27	36.28			
Naive I RMS	4.54	8.64	12.63	16.54	20.29	24.06	10.30		
Naive II RMS	3.00	5.17	8.04	10.43	13.06	15.61	5.63		

TABLE 3.3

Sample Period Simulations for Investment, Wharton-EFU Model Standard Version

	Quarters Ahead						One Year Ahead	Anticipation Version: Quarters Ahead	
	1	2	3	4	5	6		1	2
A. No Constant Adjustments									
RMS	3.72	4.80	4.48	4.92	5.37	5.90	3.54	3.11	3.56
UM	1.40	1.91	1.35	.41	.03	.31		1.85	2.46
US	.61	1.11	1.06	.73	.23	.07		.62	1.20
UC	11.83	20.02	17.66	23.07	28.58	34.43		7.20	9.01
RMS (% Error)	5.56	7.20	6.97	7.63	8.12	8.79		4.66	5.35
RMS/RMS (Naive I)	.92	.75	.54	.50	.49	.50	.53	.77	.56
MSE	13.84	23.04	20.07	24.21	28.84	34.81	12.53	9.67	12.67
ΣMSE (of components)	11.06	13.96	14.51	16.73	19.60	21.46		12.54	9.50
B. GG Constant Adjustments									
RMS	2.97	4.46	4.75	5.13	5.51	5.92	3.57		
UM	.07	.18	.73	.43	.02	.06			
US	.29	1.14	2.04	1.65	.74	.40			
UC	8.46	18.57	19.79	24.23	29.60	34.59			
RMS (% Error)	4.36	6.60	7.41	7.95	8.32	8.81			
RMS/RMS (Naive I)	.73	.70	.57	.52	.51	.51	.54		
MSE	8.82	19.89	22.56	26.31	30.36	35.05	12.74		
ΣMSE (of components)	7.60	12.37	13.92	16.50	19.38	21.99			

				C. AR Constant Adjustments					
RMS	3.17	4.79	4.93	5.67	6.88	7.76	4.00	2.65	3.39
UM	.43	1.74	1.02	1.29	1.89	2.29		.32	1.02
US	.01	0.00	.29	.32	.05	0.00		.01	.03
UC	9.61	21.20	22.99	30.54	45.39	57.93		6.69	10.44
RMS (% Error)	4.67	7.13	7.43	8.41	9.96	11.19		3.83	5.01
RMS/RMS (Naive I)	.78	.75	.60	.58	.63	.66	.60	.65	.53
MSE	10.05	22.94	24.30	32.15	47.33	60.22	16.00	7.02	11.49
ΣMSE (of components)	7.99	14.32	15.27	20.55	28.10	35.27		6.06	8.82
				D. AR Constant Adjustments and ROS Coefficients					
RMS	2.44	4.07	4.68	5.53	6.66	7.45	3.66		
UM	0.00	.81	1.14	1.86	2.57	3.99			
US	.21	.31	.61	.55	.18	0.00			
UC	5.74	15.44	20.15	28.17	41.60	51.51			
RMS (% Error)	3.59	6.12	7.09	8.19	9.69	10.80			
RMS/RMS (Naive I)	.60	.64	.57	.56	.61	.64	.55		
MSE	5.95	16.56	21.90	30.58	40.35	55.50	13.39		
ΣMSE (of components)	4.78	11.17	14.15	19.40	26.68	33.22			
Naive I RMS	4.05	6.36	8.27	9.88	10.36	11.72	6.57		
Naive II RMS	5.08	9.34	14.00	19.21	23.49	28.27	10.31		

TABLE 3.4

Sample Period Simulations for GNP in Constant Dollars, Wharton-EFU Model Standard Version

	Quarters Ahead						One Year Ahead	Anticipation Version: Quarters Ahead	
	1	2	3	4	5	6		1	2
A. No Constant Adjustments									
RMS	6.53	7.54	7.55	8.96	10.63	12.06	6.17	4.90	5.20
UM	0.00	0.00	.34	2.25	9.27	12.22		.24	.16
US	.25	.62	2.74	5.86	11.75	16.29		.02	.30
UC	42.39	56.23	53.92	72.17	91.98	116.93		23.74	26.58
RMS (% Error)	1.41	1.64	1.66	2.00	2.37	2.69		1.05	1.19
RMS/RMS (Naive I)	.98	.62	.44	.42	.42	.42	.44	.73	.43
MSE	42.64	56.85	57.00	80.28	113.00	145.44	38.06	24.00	27.04
B. GG Constant Adjustments									
RMS	6.13	7.79	7.89	8.84	10.22	11.40	6.54		
UM	.69	.36	.11	.78	4.41	6.31			
US	.56	.18	.44	1.89	6.23	9.09			
UC	36.33	60.14	61.70	75.48	93.81	114.56			
RMS (% Error)	1.32	1.69	1.73	1.95	2.26	2.52			
RMS/RMS (Naive I)	.92	.64	.46	.41	.41	.40	.47		
MSE	37.58	60.68	62.25	78.15	104.45	129.96	42.77		

				C. AR Constant Adjustments					
RMS	7.06	9.18	9.74	11.27	13.41	14.85	8.46	5.51	6.49
UM	4.44	6.74	4.46	4.83	6.65	5.29		3.31	4.55
US	2.64	2.53	2.09	3.56	9.35	11.47		1.00	.76
UC	42.76	75.00	88.32	118.62	163.83	203.76		20.05	36.81
RMS (% Error)	1.54	2.03	2.16	2.51	2.97	3.26		1.21	1.44
RMS/RMS (Naive I)	1.06	.75	.57	.53	.53	.52	.61	.83	.53
MSE	49.84	84.27	94.87	127.01	179.83	220.52	71.57	30.36	42.12
				D. AR Constant Adjustments and ROS Coefficients					
RMS	5.34	8.38	10.01	11.83	13.99	15.38	8.48		
UM	2.39	6.53	8.02	10.50	14.48	16.79			
US	1.00	1.19	1.50	2.80	7.83	10.88			
UC	25.12	62.50	90.68	126.65	173.41	208.87			
RMS (% Error)	1.21	1.85	2.22	2.62	3.08	3.37			
RMS/RMS (Naive I)	.83	.68	.59	.55	.56	.54	.61		
MSE	28.51	70.22	100.20	139.95	195.72	236.54	71.91		
Naive I RMS	6.68	12.25	17.11	21.41	25.12	25.58	13.79		
Naive II RMS	5.45	11.78	19.05	26.97	34.10	40.24	16.50		

TABLE 3.5

Sample Period Simulation for the Unemployment Rate, Wharton-EFU Model Standard Version

	Quarters Ahead						One Year Ahead	Anticipation Version: Quarters Ahead	
	1	2	3	4	5	6		1	2
A. No Constant Adjustments									
RMS	1.39	1.45	1.40	1.57	1.78	1.94	1.21	1.25	1.20
UM	.43	.49	.62	.85	1.28	1.49		.38	.43
US	.32	.23	.07	.05	.06	.10		.28	.12
UC	1.18	1.38	1.27	1.56	1.83	2.17		.90	.89
RMS (% Error)	29.84	29.67	29.09	32.18	35.54	38.49		26.92	24.09
RMS/RMS (Naive I)	2.77	1.60	1.15	1.11	1.18	1.27	1.27	2.48	1.32
MSE	1.93	2.10	1.96	2.46	3.17	3.76	1.46	1.56	1.44
B. GG Constant Adjustments									
RMS	1.09	1.32	1.33	1.45	1.62	1.75	1.09		
UM	.08	.14	.17	.31	.60	.80			
US	.06	.11	.08	.08	.11	.14			
UC	1.04	1.49	1.52	1.71	1.91	2.12			
RMS (% Error)	23.81	26.38	26.44	38.39	31.40	34.16			
RMS/RMS (Naive I)	2.18	1.46	1.10	1.02	1.07	1.15	1.14		
MSE	1.18	1.74	1.77	2.10	2.62	3.06	1.19		

C. AR Constant Adjustments									
RMS	1.16	1.54	1.61	1.71	1.83	1.86	1.34	1.01	1.22
UM	.08	.13	.08	.07	.08	.07		.06	.09
US	.02	.12	.18	.28	.37	.34		0.00	.01
UC	1.24	2.12	2.33	2.57	2.90	3.05		.96	1.39
RMS (% Error)	25.72	31.04	30.49	31.14	33.60	34.72		23.51	26.45
RMS/RMS (Naive I)	2.29	1.69	1.32	1.21	1.21	1.22	1.41	2.01	1.35
MSE	1.34	2.37	2.59	2.92	3.35	3.46	1.79	1.02	1.49
D. AR Constant Adjustments and ROS Coefficients									
RMS	.98	1.43	1.69	1.85	1.99	2.01	1.37		
UM	.05	.13	.14	.16	.21	.24			
US	0.00	.04	.23	.46	.63	.57			
UC	.91	1.87	2.49	2.80	3.12	3.23			
RMS (% Error)	21.87	29.70	32.84	34.63	37.56	38.13			
RMS/RMS (Naive I)	1.94	1.58	1.39	1.31	1.32	1.32	1.44		
MSE	.96	2.04	2.86	3.42	3.96	4.04	1.87		
Naive I RMS	.50	.91	1.22	1.41	1.51	1.52	.95		
Naive II RMS	.45	1.07	1.80	2.54	3.21	3.80	1.62		

TABLE 3.6

Ex Post Forecasts for GNP in Current Dollars, Wharton-EFU Model Standard Version

	Quarters Ahead						One Year Ahead	Anticipation Version: Quarters Ahead	
	1	2	3	4	5	6		1	2
A. No Constant Adjustments									
RMS	22.00	24.63	11.29	14.87	12.09	10.63	14.76	23.82	27.32
UM	404.92	481.46	162.22	63.99	9.76	.45		524.09	685.47
US	34.13	33.71	8.29	.28	.08	.01		22.27	26.30
UC	44.67	91.66	128.34	156.76	136.23	112.54		21.01	34.90
RMS (% Error)	2.77	3.09	2.16	1.88	1.52	1.33		3.05	3.48
RMS/RMS (Naive I)	1.37	.78	.37	.24	.16	.12	.38	1.48	.86
MSE	483.73	606.84	298.86	221.04	146.08	113.00	217.85	567.33	746.67
ΣMSE (of component)	241.12	265.15	188.86	173.94	164.06	151.91		264.84	293.89
B. GG Constant Adjustments									
RMS	11.77	16.17	15.75	14.79	11.73	10.39	10.62		
UM	95.68	178.69	126.06	71.79	15.34	.25			
US	7.84	12.26	7.81	.50	.58	2.14			
UC	35.01	70.52	114.19	146.45	121.67	105.55			
RMS (% Error)	1.47	2.02	1.97	1.86	1.47	1.28			
RMS/RMS (Naive I)	.73	.51	.33	.24	.16	.12	.27		
MSE	138.53	261.47	248.06	218.74	137.59	107.95	112.78		
ΣMSE (of component)	92.43	154.20	161.52	166.23	153.64	147.75			

	C. AR Constant Adjustments								
RMS	8.13	11.92	15.35	17.32	17.40	20.75	10.63	6.85	8.08
UM	22.87	38.08	43.59	42.60	16.35	3.44		22.76	35.84
US	1.19	7.11	17.67	31.80	78.41	141.22		.47	4.70
UC	42.04	96.90	174.36	225.58	208.00	285.90		23.69	24.75
RMS (% Error)	1.04	1.49	1.91	2.15	2.13	2.48		.89	1.00
RMS/RMS (Naive I)	.51	.38	.33	.28	.23	.23	.27	.43	.26
MSE	66.10	142.09	235.62	299.98	302.76	430.56	112.99	46.92	65.29
ΣMSE (of component)	51.55	73.47	108.74	136.53	152.54	188.75		45.83	54.93
	D. AR Constant Adjustments and ROS Coefficients								
RMS	6.80	11.56	14.84	17.48	18.27	20.83	10.72		
UM	26.59	58.00	67.83	64.16	33.04	11.28			
US	.97	5.08	8.37	12.53	31.38	81.14			
UC	18.68	70.55	144.02	228.86	269.37	341.47			
RMS (% Error)	.88	1.46	1.87	2.20	2.26	2.49			
RMS/RMS (Naive I)	.42	.37	.32	.28	.24	.24	.27		
MSE	46.24	133.63	220.22	305.55	333.79	433.89	114.91		
ΣMSE (of component)	45.78	74.02	106.52	136.40	132.53	187.19			
Naive I RMS	16.06	31.65	47.11	61.84	75.68	88.53	38.32		
Naive II RMS	5.51	11.16	16.18	24.14	32.78	39.89	15.21		

TABLE 3.7

Ex Post Forecasts for Consumption, Wharton-EFU Model Standard Version

	Quarters Ahead						One Year Ahead	Anticipation Version: Quarters Ahead	
	1	2	3	4	5	6		1	2
A. No Constant Adjustments									
RMS	14.55	14.60	12.45	11.38	10.47	8.83	10.31	16.62	17.40
UM	160.91	157.18	97.73	75.48	61.55	39.66		52.41	68.55
US	28.80	24.74	16.39	6.55	11.65	12.19		21.22	21.79
UC	21.93	31.27	40.91	47.45	36.41	26.13		11.29	14.50
RMS (% Error)	2.89	2.89	2.45	2.25	2.03	1.69		3.37	3.51
RMS/RMS (Naive I)	1.52	.79	.46	.32	.24	.18	.46	1.74	.94
MSE	211.64	213.19	155.03	129.49	109.62	77.98	106.29	276.23	302.75
ΣMSE (of component)	95.39	93.39	76.69	70.32	65.14	54.44		108.25	114.97
B. GG Constant Adjustments									
RMS	8.08	10.51	11.07	10.90	8.49	8.84	7.55		
UM	37.14	70.25	72.05	66.95	38.75	39.24			
US	8.15	13.41	14.01	8.33	4.72	16.25			
UC	20.00	26.80	36.48	43.53	23.61	22.66			
RMS (% Error)	1.59	2.07	2.18	2.14	1.83	1.68			
RMS/RMS (Naive I)	.84	.57	.41	.30	.22	.18	.33		
MSE	65.29	110.46	122.54	118.81	72.08	78.15	57.00		
ΣMSE (of component)	25.23	58.44	65.29	65.85	58.63	54.46			

				C. AR Constant Adjustments					
RMS	5.61	7.48	9.81	11.35	11.47	14.00	6.90	4.85	6.09
UM	8.15	20.42	30.70	41.61	30.92	29.99		8.80	20.62
US	2.08	9.29	17.90	29.11	56.96	91.53		1.58	7.79
UC	21.24	26.24	47.64	58.10	43.68	74.48		13.14	8.68
RMS (% Error)	1.14	1.47	1.93	2.22	2.20	2.65		.99	1.19
RMS/RMS (Naive I)	.59	.41	.36	.32	.27	.28	.30	.51	.33
MSE	31.47	55.95	96.24	128.82	131.56	196.00	47.61	23.52	37.09
ΣMSE (of component)	17.83	27.77	46.81	62.99	74.87	97.48		14.65	20.45
				D. AR Constant Adjustments and ROS Coefficients					
RMS	5.59	7.69	9.54	11.00	11.32	13.74	6.84		
UM	7.66	15.75	20.38	24.91	28.98	31.45			
US	1.31	4.32	6.17	8.41	23.73	55.46			
UC	12.48	14.40	22.44	29.43	46.19	82.17			
RMS (% Error)	1.14	1.53	1.89	2.17	2.19	2.61			
RMS/RMS (Naive I)	.59	.42	.35	.31	.26	.27	.30		
MSE	21.45	34.31	57.22	79.05	98.87	169.08	46.78		
ΣMSE (of component)	18.78	31.89	49.00	62.75	70.73	96.11			
Naive I RMS	9.57	18.68	27.01	35.81	48.19	50.31	22.30		
Naive II RMS	5.64	8.50	13.03	16.04	19.98	21.83	8.28		

TABLE 3.8

Ex Post Forecasts for Investment, Wharton-EFU Model Standard Version

	Quarters Ahead						One Year	Anticipation Version: Quarters Ahead	
	1	2	3	4	5	6	Ahead	1	2
A. No Constant Adjustments									
RMS	13.96	17.10	11.85	10.34	8.72	7.96	10.59	13.76	17.18
UM	172.69	246.56	91.39	47.16	13.66	3.78		172.28	267.79
US	10.99	12.26	3.99	.16	.16	.72		8.55	14.61
UC	11.33	33.49	44.96	59.69	62.26	58.84		8.42	12.75
RMS (% Error)	11.82	14.38	9.92	8.66	7.32	6.65		17.63	14.46
RMS/RMS (Naive I)	2.28	2.16	1.20	.92	.67	.59	1.38	2.24	2.17
MSE	195.01	292.31	140.34	107.01	76.09	63.35	112.14	189.26	295.15
ΣMSE (of component)	122.01	144.74	83.39	69.26	57.89	52.42		132.19	150.43
B. GG Constant Adjustments									
RMS	8.31	11.53	11.06	10.55	9.14	8.11	8.17		
UM	55.51	102.56	77.89	53.97	23.58	7.66			
US	2.15	4.58	3.46	1.12	1.35	2.17			
UC	11.40	25.80	40.97	56.21	58.60	55.94			
RMS (% Error)	7.08	9.77	9.30	8.82	7.64	6.75			
RMS/RMS (Naive I)	1.36	1.46	1.12	.93	.71	.60	1.07		
MSE	69.06	132.94	122.32	111.30	83.54	65.77	66.74		
ΣMSE (of component)	55.78	77.89	72.44	69.89	58.65	51.74			

				C. AR Constant Adjustments					
RMS	4.80	6.83	8.31	9.59	10.10	11.26	5.38	4.60	4.92
UM	8.53	9.19	8.56	6.62	1.63	.26		7.85	7.97
US	.11	.33	.07	0.00	.61	0.00		0.00	.53
UC	14.40	37.13	60.43	85.35	99.77	126.53		13.31	15.71
RMS (% Error)	4.19	5.86	7.03	8.05	8.54	9.40		3.97	4.18
RMS/RMS (Naive I)	.78	.86	.84	.85	.78	.83	.70	.75	.62
MSE	23.04	46.65	69.06	91.97	102.01	126.79	28.94	21.16	24.21
ΣMSE (of component)	29.04	40.80	54.66	62.88	66.02	78.33		26.50	29.58
				D. AR Constant Adjustments and ROS Coefficients					
RMS	3.97	6.47	8.12	9.80	10.68	11.36	5.47		
UM	6.86	12.10	12.40	9.13	3.31	0.00			
US	0.00	0.00	.06	.19	.23	.52			
UC	8.90	29.76	53.47	86.72	110.52	128.53			
RMS (% Error)	3.52	5.60	6.91	8.29	9.12	9.56			
RMS/RMS (Naive I)	.65	.82	.82	.87	.83	.84	.71		
MSE	15.16	41.86	65.93	96.04	114.06	129.05	29.92		
ΣMSE (of component)	22.61	36.86	49.78	62.81	50.00	77.91			
Naive I RMS	6.13	7.91	9.90	11.28	12.95	13.53	7.63		
Naive II RMS	8.73	14.25	20.21	25.09	32.24	37.98	10.34		

TABLE 3.9

Ex Post Forecasts for GNP *in Constant Dollars, Wharton-EFU Model Standard Version*

	Quarters Ahead						One Year	Anticipation Version: Quarters Ahead	
	1	2	3	4	5	6	Ahead	1	2
A. No Constant Adjustments									
RMS	17.18	15.58	11.10	14.06	16.52	19.48	8.85	19.04	17.49
UM	245.34	162.41	4.43	13.67	97.54	221.01		337.44	272.05
US	8.55	.22	12.29	54.87	60.92	62.79		5.43	.34
UC	41.33	80.20	106.38	129.19	114.55	95.73		19.64	33.53
RMS (% Error)	2.56	2.33	1.67	2.11	2.45	2.87		2.86	2.63
RMS/RMS (Naive I)	1.90	.89	.43	.42	.41	.43	.41	2.10	1.00
MSE	295.23	242.82	123.10	197.72	273.01	379.53	78.32	362.52	305.93
B. GG Constant Adjustments									
RMS	9.13	11.10	11.07	13.03	14.69	17.47	7.48		
UM	51.78	56.33	9.09	2.61	60.17	161.60			
US	3.67	6.66	9.68	38.03	46.72	46.85			
UC	31.21	66.30	103.77	129.13	108.91	96.72			
RMS (% Error)	1.36	1.67	1.67	1.96	2.19	2.58			
RMS/RMS (Naive I)	1.01	.64	.43	.39	.37	.38	.35		
MSE	83.36	123.31	122.54	169.78	215.80	305.20	55.95		

C. AR Constant Adjustments									
RMS	6.83	9.83	12.65	14.18	13.98	17.08	8.75	5.57	6.22
UM	11.66	13.43	7.04	1.00	7.04	36.76		11.79	12.42
US	.37	.58	1.60	3.02	0.00	0.00		.43	.23
UC	34.62	82.62	151.38	197.05	188.40	254.97		18.80	26.04
RMS (% Error)	1.03	1.47	1.89	2.12	2.09	2.51		.85	.93
RMS/RMS (Naive I)	.75	.56	.49	.43	.35	.38	.41	.61	.36
MSE	46.65	96.63	160.02	201.07	195.44	291.73	76.56	31.02	38.69
D. AR Constant Adjustments and ROS Coefficients									
RMS	5.55	9.40	12.18	14.63	15.34	17.60	8.91		
UM	13.89	24.12	16.32	5.14	1.41	23.85			
US	.22	.79	4.45	11.34	9.41	4.34			
UC	16.69	63.45	127.58	197.56	224.49	281.57			
RMS (% Error)	.84	.41	1.83	2.20	2.30	2.60			
RMS/RMS (Naive I)	.61	.54	.47	.44	.38	.39	.41		
MSE	30.80	88.36	148.35	214.04	235.31	309.76	79.38		
Naive I RMS	9.06	12.44	25.72	33.36	39.91	45.61	21.27		
Naive II RMS	4.94	9.62	13.64	20.21	27.32	33.46	12.64		

TABLE 3.10

Ex Post Forecasts for the Unemployment Rate, Wharton-EFU Model Standard Version

	Quarters Ahead						One Year Ahead	Anticipation Version: Quarters Ahead	
	1	2	3	4	5	6		1	2
A. No Constant Adjustments									
RMS	1.17	1.28	.90	1.08	1.29	1.41	.75	1.15	1.31
UM	.40	.68	.02	.60	1.50	1.89		.54	1.14
US	.43	.53	.50	.40	.06	.04		.30	.26
UC	.53	.43	.28	.17	.10	.06		.47	.32
RMS (% Error)	30.38	33.32	23.70	29.05	34.47	37.67		29.87	34.02
RMS/RMS (Naive I)	6.36	4.13	2.18	2.05	2.13	2.24	2.14	6.26	4.23
MSE	1.36	1.64	.81	1.17	1.66	1.99	.56	1.32	1.72
B. GG Constant Adjustments									
RMS	.89	.88	.98	1.18	1.42	1.54	.88		
UM	.12	.02	.25	.75	1.74	2.14			
US	.50	.62	.61	.55	.20	.17			
UC	.17	.13	.10	.09	.07	.06			
RMS (% Error)	22.89	22.10	25.67	31.84	38.45	41.51			
RMS/RMS (Naive I)	4.85	2.83	2.37	2.24	2.35	2.45	2.15		
MSE	.79	.77	.96	1.39	2.02	2.37	.77		

C. AR Constant Adjustments									
RMS	1.04	1.13	1.15	1.01	.85	.85	1.02	.94	.88
UM	.24	.10	.07	.07	.29	.38		.25	.11
US	.63	.96	1.00	.70	.22	.12		.48	.54
UC	.21	.22	.25	.25	.21	.22		.15	.12
RMS (% Error)	26.94	29.07	29.80	26.67	22.34	22.39		24.16	22.25
RMS/RMS (Naive I)	5.69	3.64	2.78	1.92	1.40	1.34	2.91	5.14	2.83
MSE	1.08	1.28	1.32	1.02	.72	.72	1.04	.88	.77
D. AR Constant Adjustments and ROS Coefficients									
RMS	.94	.99	1.06	.99	.87	.81	.95		
UM	.20	.03	.01	.02	.16	.24			
US	.52	.77	.91	.70	.34	.18			
UC	.16	.18	.20	.26	.26	.24			
RMS (% Error)	24.39	25.15	27.15	25.70	23.04	21.41			
RMS/RMS (Naive I)	5.14	3.18	2.57	1.87	1.44	1.28	2.71		
MSE	.88	.98	1.12	.98	.76	.66	.90		
Naive I RMS	.18	.31	.41	.53	.61	.63	.35		
Naive II RMS	.19	.38	.51	.63	.84	1.01	.354		

ments do not seem to affect the results very much. The simulations with AR adjustments are almost uniformly worse than the no-constant-adjustment results, the only exception being investment one quarter ahead. The results using the GG adjustments are slightly better, but the difference, in most cases, is quite small. It can also be noted that while the performance of the AR continues to deteriorate relative to the no-constant-adjustments simulations as the forecast span increases, the GG adjustments tend to perform about the same relative to no-constant-adjustments for all quarters. One would expect that by six quarters, these latter types of adjustments would disappear for the most part, and the results should be similar to no-adjustments in any case.

The anticipations version does indicate a substantial improvement for the two quarters for which the figures are available. The ROS coefficients are significantly better for the first quarter but rapidly lose this advantage, becoming the worst of the four methods by the time six quarters have passed. The comparison with the naive models shows that all of the simulations perform much better than either of the naive models. It is interesting to note that for four of the five variables chosen for these tables, Naive Model I (no change) has a smaller RMS error than Naive Model II (same change); this finding is reversed only for the relatively stable consumption series.

The decomposition of error shows the same pattern in virtually all cases. Almost the entire error is due to imperfect covariation; there is very little systematic error due to bias in the mean values or cyclical behavior. Theil states that "if the forecaster's ability does not allow him to attain perfection, the desirable distribution of inequality over the three sources is $U^M = U^S = 0$, $U^C = 1$."[18] The Wharton pattern very nearly fits this description. However, the errors themselves are large enough so that little comfort can be drawn from these results.

The forecast period (1965.1–1968.4) results are quite different. The forecasts with no constant adjustments are clearly the worst. For all variables, the error increases from the first to the second quarter and then declines for the rest of the six-quarter period. The RMS errors for *GNP* for the first two quarters are \$22.0 and \$24.6 billion, which compares unfavorably with the RMS of actual changes of \$16.1 and \$31.6 billion, and even more unfavorably with RMS errors of

[18] Theil, *op. cit.*, p. 37. In Theil's notation, U^M, U^S and U^C correspond to UM/MSE, US/MSE and UC/MSE respectively, where $MSE = UM + US + UC$.

Naive Model II, \$5.5 and \$11.2 billion, respectively. It is clear that the Wharton-EFU Model cannot be used to make short-term forecasts outside the sample period without some kind of adjustments. It should be noted, however, that after six periods, the RMS error is only \$10.6 billion, and there are similar declines for the other numbers reported in these tables. By this time, Naive Models I and II have RMS errors of \$88.6 and \$39.9 billion respectively, so that the no-constant-adjustment forecasts appear in a much more favorable light.

The constant adjustments do make quite a difference in the forecast period. The AR adjustments lead to forecasts which are relatively much better for the first two quarters. Their relative advantage begins to decline thereafter, so that by the sixth quarter these forecasts are much worse than no-constant-adjustments for *GNP* in current prices, consumption, and investment. For *GNP* in constant prices and unemployment, the AR adjustments continue to have smaller errors for the full six-quarter period.

Since the AR adjustments give relatively good performance in the first two quarters, and the no-constant-adjustment forecasts do better for the remaining periods, it should be expected that the GG adjustments would perform best for all six quarters. With a few exceptions, this is exactly what does happen. For *GNP* in current dollars, the GG adjustments are substantially better than no-constant-adjustments but slightly worse than AR adjustments for the first three quarters; for the remaining three quarters, they are the best. The consumption pattern is identical to *GNP*. A similar pattern is observed for investment, with the changeover coming at the fourth quarter; the no-constant-adjustment forecasts are slightly better than the GG adjustments thereafter. For constant dollar *GNP*, the changeover comes in the third period. The pattern is reversed for unemployment, where the GG adjustments are best for three quarters, and the AR adjustments are better thereafter.

A few other brief items might be mentioned. When none of the constant terms are adjusted, the anticipations version performs even more poorly than the standard version. With the AR adjustments, the anticipations are slightly better for all variables listed. The ROS coefficients have the best one-quarter forecasting record for all variables except unemployment (for which GG adjustments are slightly better) but deteriorate rapidly, and perform no better than the AR coefficients by the end of six quarters. This time the decomposition of error shows a more interesting pattern. The large errors in the first two quarters are due primarily to large components in UM, but by six quarters almost the entire error is due to imperfect covariation. Thus, the early quarter forecasts are bad not only because of their large magnitude, but because they are badly biased in addition.

In spite of the fact that the errors tend to diminish over time for the no-constant-adjustment version, and in spite of the fact that the size of the error is considerably diminished by introducing various constant adjustments, the level of error is still too high to be satisfactory when these mechanical methods are used. In particular, it is hard to accept a RMS error in predicting unemployment one quarter ahead of 0.89% (using the method of constant adjustment which gives the smallest error) when compared to RMS errors of 0.18% and 0.19% for Naive Models I and II, respectively.

In addition to these tables, we present several diagrams for key variables. These diagrams might be called complete forecasting accuracy diagrams, because they show all the simulation results from one to six quarters superimposed on the actual path of the variable. More than any summary statistic, these diagrams reveal how well the model is performing. All graphs include the period from 1953.1 to 1968.4 and are based on both sample-period simulations, and ex post forecasts using the Wharton-EFU Model.

We have not calculated sample-period statistics for the Evans Model, relying instead on the figures gathered for the Wharton-EFU Model. We have, however, evaluated mechanical ex post forecasts for the published version of the Evans Model.[19] These simulated forecasts were made for the period 1963.1 through 1965.2. The later forecasts cannot be made for the full six quarters because of the data revision that occurred in the third quarter of 1965. In Table 3.11, we present the predicted values minus the actual ones for *GNP* in constant dollars for each of the simulated forecasts that were made.

These results can be compared with Table 3.12, where the errors for sample-period forecasts of the Wharton-EFU Model are given. The average absolute errors are not directly comparable, because the Evans

[19] Michael K. Evans, "Multiplier Analysis of a Postwar Quarterly U.S. Model and a Comparison with Several Other Models," *Review of Economic Studies*, Vol. 33, No. 4, pp. 337–60.

TABLE 3.11

Published Evans Model: Accuracy of Mechanical Ex Post GNP Forecasts, 1963.1–1965.2
Residuals (Predicted – Actual)

Starting Point	Quarter 1	2	3	4	5	6
1963.1	0.9	3.4	3.2	3.4	2.0	7.2
1963.2	4.7	3.8	3.0	1.7	6.7	11.2
1963.3	0.7	0.2	0.8	5.7	10.0	11.2
1963.4	2.6	3.1	9.4	12.1	12.2	0.4
1964.1	−0.5	5.8	9.8	9.8	−2.5	1.6
1964.2	10.8	13.5	14.0	−0.5	3.8	
1964.3	6.4	9.0	−1.4	3.4		
1964.4	9.9	1.0	8.0			
1965.1	−2.9	8.1				
1965.2	9.0					
Root mean-square error	6.2	6.7	7.6	6.6	7.3	7.8

TABLE 3.12

Wharton-EFU Model Predicted Minus Actual in Mechanical Ex Post GNP Forecasts with No Constant Adjustment

Starting Point	Quarters Ahead 1	2	3	4	5	6
1963.1	4.8	2.8	1.3	−0.1	−3.3	3.7
1963.2	6.0	2.9	0.4	2.9	3.0	−1.6
1963.3	3.0	0.6	−2.8	2.1	−2.0	2.7
1963.4	0.4	−3.2	2.8	−0.8	3.3	−9.2
1964.1	−6.3	−1.1	−3.1	0.3	−11.5	−9.8
1964.2	0.4	−4.4	1.2	−10.0	−8.5	
1964.3	−4.7	−1.3	−12.7	−11.6		
1964.4	1.8	−13.6	−11.5			
1965.1	−13.9	−10.3				
1965.2	−13.1					
Root mean-square error	7.1	6.2	6.3	6.0	6.3	6.4

Model errors are based on ex post forecasts, while the Wharton-EFU figures are based on sample-period simulations. More interesting is the lack of a direct correspondence between these errors, even when we recognize that different models and different data bases have been used. This difference would seem to indicate that mechanical forecast errors are very sensitive to the slight modification of models, and that the actual modifications and adjustments which are made are, in fact, quite significant.

C. THE OBE MODEL

The sample-period simulations and ex post forecasting record for the OBE Model are treated much the same way as is the Wharton-EFU Model, with three exceptions: (*a*) the comparison of sample period against ex post forecast for the *same* model was not ready for the Conference and, therefore, only the sample-period results are presented; (*b*) for the same reason, the complete forecasting accuracy diagrams for OBE are missing from the text; and (*c*) there are no experiments with ROS coefficients for the OBE Model. The sample-period simulations are 1953.2 to 1966.4; and in each case, six-quarter simulations were generated by the methods described earlier. The complete forecasting accuracy diagrams for the OBE Model from 1953.3 to 1969.3 are presented immediately following the sample-period tables. The heavy line indicates actual data.

In general, the sample-period simulations results are slightly better for the OBE Model than for the Wharton-EFU Model.[20] If we consider the simulation results for current-dollar *GNP* with no constant adjustments, the first-quarter OBE RMS error of $4.6 billion is substantially better than the Wharton-EFU error of $6.8 billion. However, the difference narrows by six quarters, when the figures are $8.9 and $10.0 billion, respectively. The comparison is much the same for consumption and investment, with almost no difference by the sixth quar-

[20] It should be emphasized that the sample simulation periods of the Wharton-EFU Model and the OBE Model are not identical. In particular, the Wharton-EFU sample period does not include the years 1965 and 1966. These years were noted for being trend dominated, as is clearly exhibited by the difference between the RMS of the Naive Models in Wharton and OBE simulation periods.

ter. The gap is considerably larger, in favor of OBE, for constant-dollar *GNP*; and for unemployment, the gap between the two model simulations steadily widens in favor of OBE.

The finding that the GG adjustments are better than the AR adjustments is borne out by the OBE Model also, and is, in fact, somewhat stronger for that model. For all the variables compiled here, the GG adjustments are better than AR adjustments in the first quarter and continue to improve their relative performance throughout the six-quarter simulations. It can also be noted that the GG adjustments are superior to no-constant-adjustments for all variables in all quarters, except for unemployment in the fourth quarter and constant-dollar *GNP* in the last three quarters. This is a somewhat stronger showing for the GG adjustments than is the case with the Wharton-EFU Model. However, it should be stressed that in almost all cases the differences are rather small and, as would be expected, are almost nonexistent for the last three quarters.

As in the Wharton-EFU Model, there is an exceptionally persistent pattern to the decomposition of error; both UM and US are small relative to UC. This is especially true for the shorter time periods. Thus, most of the inaccuracy in the forecasts is accounted for by the fact that the realized and simulated values do not move together, rather than by the fact that the average values and the variances of the two differ. This is related to Suits's argument that a quarterly model should be judged according to its ability to account for quarter-to-quarter variations.[21] A model does not necessarily deserve to be called quarterly only because it is estimated with quarterly data and can generate quarterly forecasts. The decomposition of error does show that the major weakness of the models lies precisely in tracking these fluctuations. The fact that, in most cases, the one-year-ahead simulations had smaller errors than the average of the one-to-four-quarter simulations is another indication of the same phenomenon.

It is somewhat surprising that the AR adjustments, which did not perform well relative to the other methods, were the most successful

[21] D. B. Suits and G. R. Sparks, "Consumption Regressions with Quarterly Data," in J. S. Duesenberry et al., eds., *The Brookings Quarterly Econometric Model of the United States*. Chicago, Rand McNally and Co., 1965.

TABLE 3.13

Sample Period Simulations for GNP in Current Dollars, OBE Model

	Quarters Ahead 1	2	3	4	5	6	One Year Ahead
			No Constant Adjustments				
RMS	4.62	6.48	7.69	8.24	8.52	8.96	5.86
UM	.25	1.23	2.50	5.21	9.64	14.98	1.23
US	.01	.14	.39	.38	.16	.02	1.06
UC	21.05	40.67	56.24	62.27	62.78	65.28	32.10
RMS (% Error)	.84	1.53	2.17	2.47	2.60	2.79	
RMS/RMS (Naive I)	.49	.36	.29	.24	.20	.18	.26
MSE	21.31	42.04	59.12	67.86	72.58	80.27	34.39
ΣMSE (of components)	14.47	20.02	25.14	28.85	32.42	36.65	
			GG Constant Adjustments				
RMS	3.63	5.43	6.94	7.77	8.35	8.91	5.17
UM	.15	.94	2.00	4.14	7.55	11.64	1.14
US	.17	.22	.32	.50	.90	1.97	.06
UC	12.88	28.32	45.81	55.78	61.34	65.79	25.49
RMS (% Error)	.58	1.18	1.87	2.23	2.42	2.59	
RMS/RMS (Naive I)	.38	.30	.26	.22	.20	.18	.23
MSE	13.19	29.48	48.13	60.43	69.79	79.40	26.69
ΣMSE (of components)	8.96	14.85	20.38	24.81	29.47	34.78	

			AR Constant Adjustments				
RMS	3.72	5.84	7.86	9.86	11.60	13.08	6.20
UM	.05	.68	1.59	2.83	4.08	5.31	1.00
US	.02	.23	1.00	1.65	1.81	2.35	.55
UC	13.75	33.16	59.14	92.80	128.66	163.41	36.93
RMS (% Error)	.61	2.88	4.90	7.43	10.16	12.63	
RMS/RMS (Naive I)	.39	.32	.30	.28	.27	.26	.28
MSE	13.82	34.06	61.73	97.28	134.55	171.08	38.48
ΣMSE (of components)	11.12	20.47	29.02	39.36	50.92	63.27	
			Naive I				
RMS	9.48	18.18	26.57	34.75	42.54	49.99	21.75
UM	55.91	227.49	517.61	931.23	1455.66	2074.23	350.81
US	10.83	39.31	82.64	138.90	200.58	265.17	55.85
UC	23.17	63.72	105.61	137.53	153.47	159.44	66.20
RMS (% Error)	3.18	11.29	23.38	38.88	57.05	77.72	
RMS/RMS (Naive I)	1.00	1.00	1.00	1.00	1.00	1.00	1.00
MSE	89.91	330.52	705.86	1207.66	1809.71	2498.85	472.86
ΣMSE (of components)	27.44	73.21	143.13	232.43	332.76	449.30	
			Naive II				
RMS	5.29	10.86	16.94	23.50	29.50	34.93	13.67
UM	.08	.78	2.78	10.52	27.51	49.79	2.84
US	.08	1.15	5.60	8.19	9.04	15.12	1.73
UC	27.77	116.11	278.51	533.64	833.92	1155.51	182.32
RMS (% Error)	1.22	5.29	12.91	24.72	38.49	52.51	
RMS/RMS (Naive I)	.56	.60	.64	.68	.69	.70	.62
MSE	27.94	118.04	286.89	552.36	870.47	1220.43	186.89
ΣMSE (of components)	34.48	92.91	191.25	352.30	515.06	733.89	

TABLE 3.14

Sample Period Simulations for Consumption, OBE Model

	Quarters Ahead						One Year
	1	2	3	4	5	6	Ahead
No Constant Adjustments							
RMS	2.93	3.74	4.39	4.77	5.12	5.35	3.48
UM	.26	.84	1.46	2.37	3.76	5.50	.92
US	.23	.10	.02	.01	0.00	.02	.01
UC	8.12	13.03	17.83	20.38	22.43	23.12	11.20
RMS (% Error)	.84	1.23	1.74	2.08	2.36	2.53	
RMS/RMS (Naive I)	.55	.36	.29	.23	.20	.18	.27
MSE	8.61	13.98	19.31	22.75	26.20	28.64	12.13
ΣMSE (of components)	4.47	6.37	8.14	9.51	11.29	12.84	
GG Constant Adjustments							
RMS	2.54	3.30	4.08	4.57	5.03	5.29	3.15
UM	.11	.61	1.22	2.06	3.24	4.61	.79
US	.14	.20	.21	.19	.14	.16	.18
UC	6.18	10.05	15.18	18.63	21.93	23.26	8.94
RMS (% Error)	.65	.97	1.51	1.89	2.26	2.44	
RMS/RMS (Naive I)	.47	.32	.27	.22	.20	.18	.24
MSE	6.43	10.87	16.61	20.88	25.32	28.02	9.91
ΣMSE (of components)	3.53	5.31	7.25	8.76	10.79	12.55	

			AR Constant Adjustments				
RMS	2.68	3.74	4.98	6.20	7.55	8.80	3.97
UM	0.00	.21	.59	1.07	1.45	1.95	.44
US	0.00	0.00	.08	.15	.06	.05	.14
UC	7.19	13.75	24.15	37.25	55.45	75.39	15.15
RMS (% Error)	.68	2.46	4.51	7.03	10.47	13.95	
RMS/RMS (Naive I)	.50	.36	.32	.30	.30	.29	.31
MSE	7.20	13.96	24.82	38.47	56.96	77.40	15.73
ΣMSE (of components)	4.22	7.64	12.33	17.57	24.17	32.33	
			Naive I				
RMS	5.38	10.37	15.37	20.38	25.30	29.99	12.73
UM	20.98	86.07	194.84	350.11	547.96	781.73	134.29
US	2.49	10.08	21.82	39.53	60.47	81.79	16.28
UC	5.52	11.30	19.46	25.78	31.72	36.13	11.58
RMS (% Error)	2.40	8.79	19.04	32.95	50.10	69.77	
RMS/RMS (Naive I)	1.00	1.00	1.00	1.00	1.00	1.00	1.00
MSE	28.99	107.45	236.12	415.42	640.15	899.65	162.15
ΣMSE (of components)	12.91	42.98	92.04	157.58	238.45	332.26	
			Naive II				
RMS	3.17	5.18	7.80	10.24	12.65	15.00	6.28
UM	0.00	.14	.29	1.47	5.40	9.78	.43
US	.06	.18	1.56	1.72	.38	.60	.35
UC	9.96	26.46	58.91	101.75	154.31	214.72	38.67
RMS (% Error)	.78	2.29	5.26	9.37	14.66	20.41	
RMS/RMS (Naive I)	.59	.50	.51	.50	.50	.50	.49
MSE	10.03	26.78	60.76	104.94	160.08	225.10	39.45
ΣMSE (of components)	9.21	23.73	50.53	84.91	127.40	175.56	

TABLE 3.15

Sample Period Simulations for Investment, OBE Model

	Quarters Ahead						One Year Ahead
	1	2	3	4	5	6	
			No Constant Adjustments				
RMS	3.34	4.51	5.12	5.33	5.38	5.59	3.79
UM	.04	0.00	.06	.38	1.14	2.21	0.00
US	.01	.13	.22	.17	.03	.10	1.05
UC	11.10	20.24	25.97	27.84	27.80	28.96	13.32
RMS (% Error)	17.62	31.41	39.75	42.12	42.01	43.83	
RMS/RMS (Naive I)	.81	.70	.60	.51	.46	.43	.55
MSE	11.15	20.36	26.24	28.39	28.96	31.27	14.37
ΣMSE (of components)	9.21	12.45	15.49	17.68	19.43	22.11	
			GG Constant Adjustments				
RMS	2.48	3.59	4.37	4.79	5.15	5.63	3.04
UM	.02	.09	.20	.54	1.21	2.08	.06
US	.30	.53	.82	1.22	1.86	3.11	.13
UC	5.82	12.27	18.07	21.20	23.46	26.51	9.02
RMS (% Error)	11.23	23.79	33.14	35.85	36.64	39.58	
RMS/RMS (Naive I)	.60	.56	.51	.46	.44	.43	.44
MSE	6.14	12.89	19.09	22.96	26.53	31.71	9.21
ΣMSE (of components)	5.12	8.93	12.22	14.90	17.38	20.78	

			AR Constant Adjustments				
RMS	2.65	3.97	4.83	5.59	6.30	6.91	3.66
UM	.07	.29	.51	.79	1.12	1.36	.25
US	.27	.77	1.88	3.13	4.37	5.71	.55
UC	6.65	14.70	20.99	27.31	34.20	40.73	12.59
RMS (% Error)	13.51	64.46	86.49	106.22	127.75	144.69	
RMS/RMS (Naive I)	.64	.62	.57	.54	.54	.53	.53
MSE	7.00	15.76	23.37	31.23	39.69	47.80	13.39
ΣMSE (of components)	6.62	12.25	15.68	20.37	24.99	28.68	
			Naive I				
RMS	4.10	6.43	8.51	10.35	11.73	13.05	6.85
UM	1.69	7.04	16.59	29.88	46.39	64.47	11.20
US	.49	1.08	2.51	4.33	6.65	9.60	1.15
UC	14.66	33.24	53.37	72.96	84.52	96.34	34.55
RMS (% Error)	33.47	84.38	140.81	194.96	233.56	272.07	
RMS/RMS (Naive I)	1.00	1.00	1.00	1.00	1.00	1.00	1.00
MSE	16.84	41.36	72.47	107.16	137.56	170.41	46.90
ΣMSE (of components)	13.67	28.14	47.08	68.43	85.31	105.26	
			Naive II				
RMS	8.86	16.49	24.40	32.73	40.29	48.20	20.59
UM	.63	2.87	5.69	9.50	13.53	19.52	3.99
US	.29	19.32	94.12	262.42	541.01	949.17	58.42
UC	77.52	249.80	495.56	799.44	1068.42	1354.80	361.59
RMS (% Error)	235.12	1020.43	2134.83	3654.38	5140.97	6296.73	
RMS/RMS (Naive I)	2.16	2.56	2.87	3.16	3.43	3.69	3.00
MSE	78.44	271.99	595.37	1071.36	1622.97	2323.48	424.00
ΣMSE (of components)	23.89	66.09	134.08	255.56	369.50	530.82	

TABLE 3.16

Sample Period Simulations for GNP in Constant Dollars, OBE Model

	Quarters Ahead						One Year Ahead
	1	2	3	4	5	6	
			No Constant Adjustments				
RMS	3.67	5.00	5.89	6.36	6.74	7.22	4.52
UM	0.00	.11	.42	1.35	2.95	4.66	.22
US	.04	.37	.63	.41	.03	.36	.71
UC	13.42	24.54	33.63	38.75	42.45	47.05	19.51
RMS (% Error)	.56	1.01	1.39	1.60	1.75	1.95	
RMS/RMS (Naive I)	.50	.37	.30	.26	.23	.21	.28
MSE	13.46	25.03	34.68	40.50	45.43	52.06	20.44
ΣMSE (of components)	12.63	16.05	19.58	21.98	23.86	26.52	
			GG Constant Adjustments				
RMS	3.07	4.43	5.48	6.11	6.69	7.34	4.08
UM	0.00	.06	.24	.85	1.94	3.14	.19
US	.02	.02	.06	.35	1.34	3.71	.06
UC	9.38	19.53	29.68	36.17	41.41	47.09	16.41
RMS (% Error)	.42	.86	1.28	1.51	1.69	1.91	
RMS/RMS (Naive I)	.42	.33	.28	.25	.22	.21	.25
MSE	9.40	19.60	29.98	37.37	44.70	53.94	16.66
ΣMSE (of components)	7.90	12.34	16.23	19.19	21.95	25.62	

			AR Constant Adjustments				
RMS	3.33	5.05	6.44	7.89	9.19	10.10	5.05
UM	.01	.14	.41	1.06	1.97	2.59	.43
US	0.00	0.00	.02	.31	1.30	2.93	.13
UC	11.10	25.35	41.01	60.88	81.09	96.58	24.89
RMS (% Error)	.50	2.28	3.60	5.34	7.08	8.17	
RMS/RMS (Naive I)	.46	.37	.33	.32	.31	.29	.31
MSE	11.11	25.49	41.44	62.25	84.37	102.10	25.45
ΣMSE (of components)	9.90	17.53	23.49	29.65	36.21	42.00	
			Naive I				
RMS	7.30	13.59	19.39	24.86	29.94	34.72	15.88
UM	21.79	90.03	210.42	386.59	610.09	869.39	145.34
US	5.23	19.86	42.14	74.02	113.04	156.96	31.37
UC	26.22	74.89	123.29	157.56	173.42	178.85	75.47
RMS (% Error)	2.14	7.19	14.07	22.26	31.25	41.06	
RMS/RMS (Naive I)	1.00	1.00	1.00	1.00	1.00	1.00	1.00
MSE	53.24	184.78	375.85	618.17	896.55	1205.20	252.18
ΣMSE (of components)	21.56	50.87	94.08	145.18	198.58	259.57	
			Naive II				
RMS	7.50	15.33	24.18	34.03	43.70	53.42	19.99
UM	.85	4.28	11.48	29.40	62.96	106.56	9.96
US	2.83	20.54	76.25	164.70	284.63	477.58	43.72
UC	52.55	210.09	497.05	964.25	1562.52	2269.62	346.08
RMS (% Error)	2.87	12.22	30.84	61.22	100.08	146.29	
RMS/RMS (Naive I)	1.03	1.13	1.25	1.37	1.46	1.54	1.25
MSE	56.24	234.92	584.77	1158.35	1910.11	2853.76	399.76
ΣMSE (of components)	269.24	1043.66	2388.21	4307.41	6784.77	9942.39	

TABLE 3.17

Sample Period Simulations for the Unemployment Rate, OBE Model

	Quarters Ahead						One Year Ahead
	1	2	3	4	5	6	
No Constant Adjustments							
RMS	.42	.57	.64	.67	.66	.67	.51
UM	0.00	0.00	0.00	.01	.02	.04	0.00
US	.01	.01	.02	.02	.02	.02	0.00
UC	.17	.31	.40	.42	.40	.38	.25
RMS (% Error)	66.48	120.59	146.17	163.64	170.07	176.12	
RMS/RMS (Naive I)	.87	.65	.58	.53	.51	.51	.57
MSE	.18	.32	.41	.44	.44	.44	.25
ΣMSE (of components)	0.00	0.00	0.00	0.00	0.00	0.00	
GG Constant Adjustments							
RMS	.35	.54	.64	.67	.66	.65	.49
UM	0.00	0.00	0.00	.01	.01	.02	0.00
US	0.00	.01	.02	.03	.03	.04	0.00
UC	.12	.28	.39	.42	.40	.36	.24
RMS (% Error)	49.06	106.48	136.07	156.53	160.55	158.39	
RMS/RMS (Naive I)	.72	.62	.57	.54	.51	.49	.55
MSE	.12	.29	.41	.45	.44	.42	.24
ΣMSE (of components)	0.00	0.00	0.00	0.00	0.00	0.00	

			AR Constant Adjustments				
RMS	.40	.67	.90	1.08	1.20	1.26	.71
UM	0.00	0.00	.01	.02	.04	.06	.01
US	0.00	0.00	0.00	0.00	0.00	0.00	.02
UC	.15	.45	.80	1.15	1.38	1.52	.49
RMS (% Error)	56.67	286.59	513.70	827.83	1112.59	1289.83	
RMS/RMS (Naive I)	.82	.77	.81	.87	.93	.96	.79
MSE	.16	.45	.81	1.17	1.43	1.58	.52
ΣMSE (of components)	0.00	0.00	0.00	0.00	0.00	0.00	
			Naive I				
RMS	.48	.87	1.12	1.25	1.29	1.31	.89
UM	0.00	0.00	0.00	0.00	.01	.01	0.00
US	0.00	0.00	0.00	0.00	0.00	0.00	.02
UC	.23	.75	1.24	1.56	1.66	1.71	.77
RMS (% Error)	114.28	293.74	400.81	498.27	549.11	587.24	
RMS/RMS (Naive I)	1.00	1.00	1.00	1.00	1.00	1.00	1.00
MSE	.24	.75	1.24	1.56	1.67	1.72	.79
ΣMSE (of components)	0.00	0.00	0.00	0.00	0.00	0.00	
			Naive II				
RMS	.42	1.00	1.65	2.30	2.88	3.43	1.31
UM	0.00	0.00	.01	.03	.07	.13	.01
US	.04	.30	.89	1.86	3.32	5.27	.71
UC	.13	.70	1.82	3.42	4.92	6.35	1.00
RMS (% Error)	74.03	336.24	824.31	1720.49	3032.79	4675.53	
RMS/RMS (Naive I)	.87	1.15	1.48	1.84	2.23	2.61	1.47
MSE	.18	.99	2.72	5.31	8.32	11.76	1.72
ΣMSE (of components)	0.00	0.00	0.00	0.00	0.00	0.00	

CHART 3.1

Gross National Product – Forecasts with No Constant Adjustments

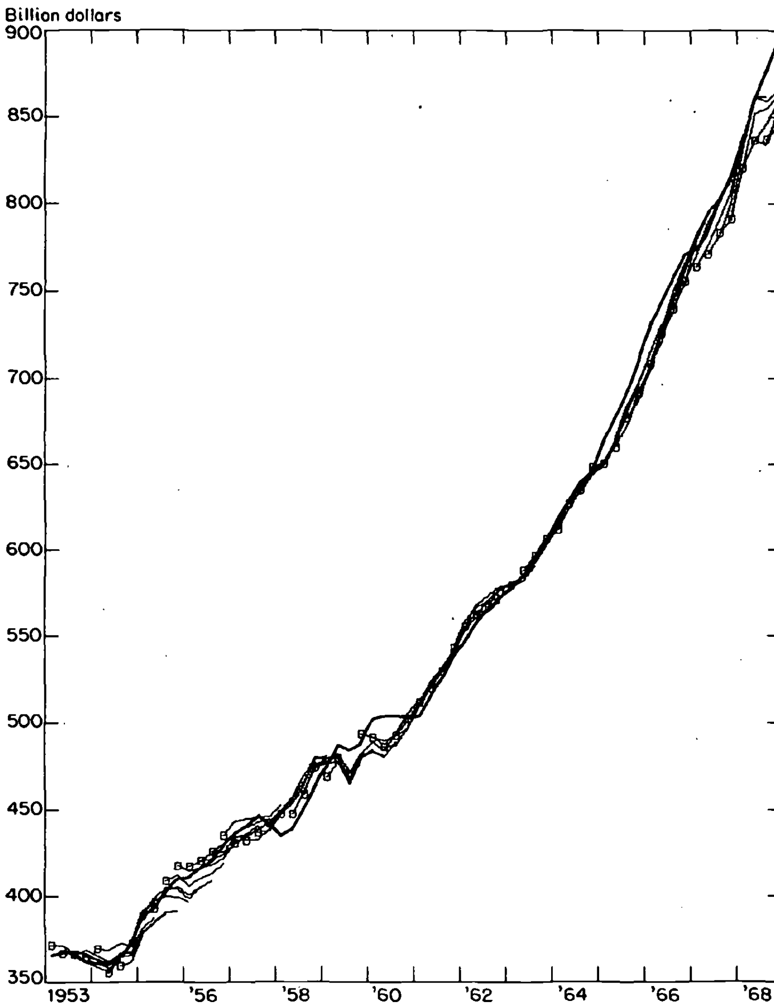


CHART 3.2

Gross National Product—Forecasts with AR Constant Adjustments

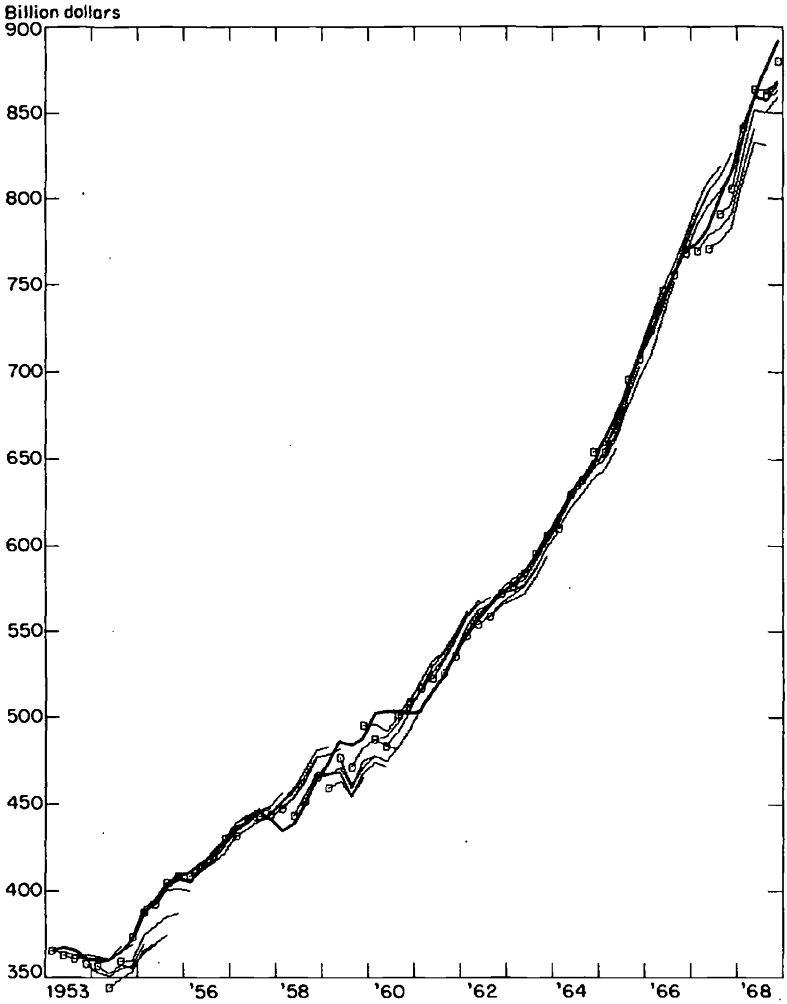


CHART 3.3

Gross National Product—Forecasts with No Constant Adjustments

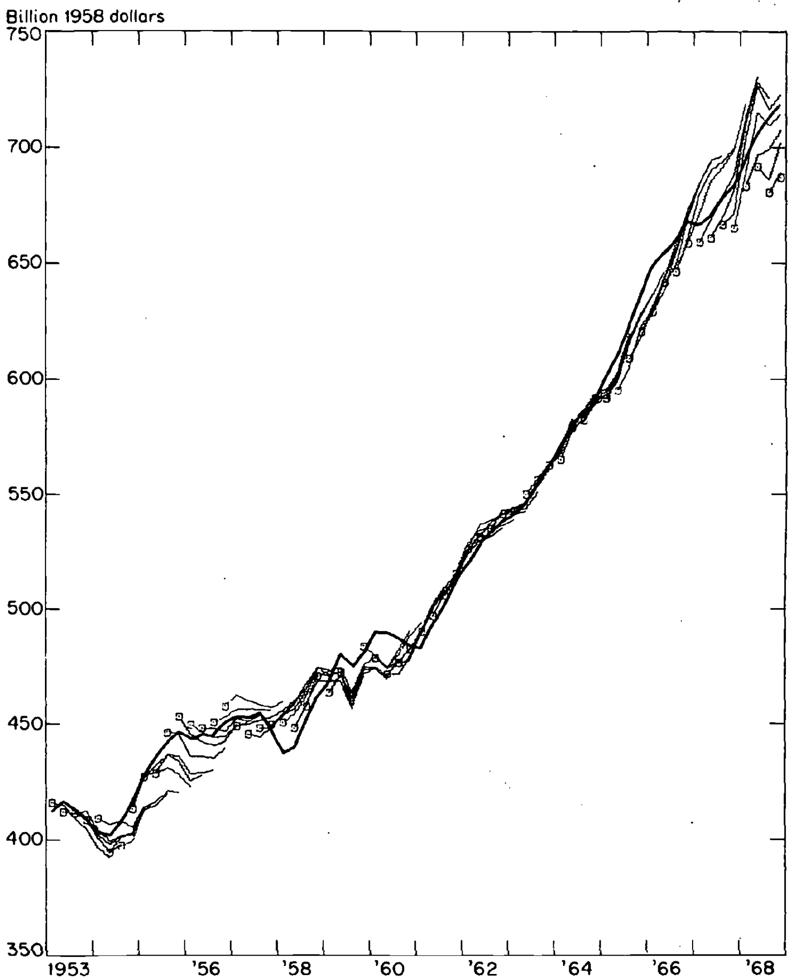


CHART 3.4

Gross National Product – Forecasts with AR Constant Adjustments

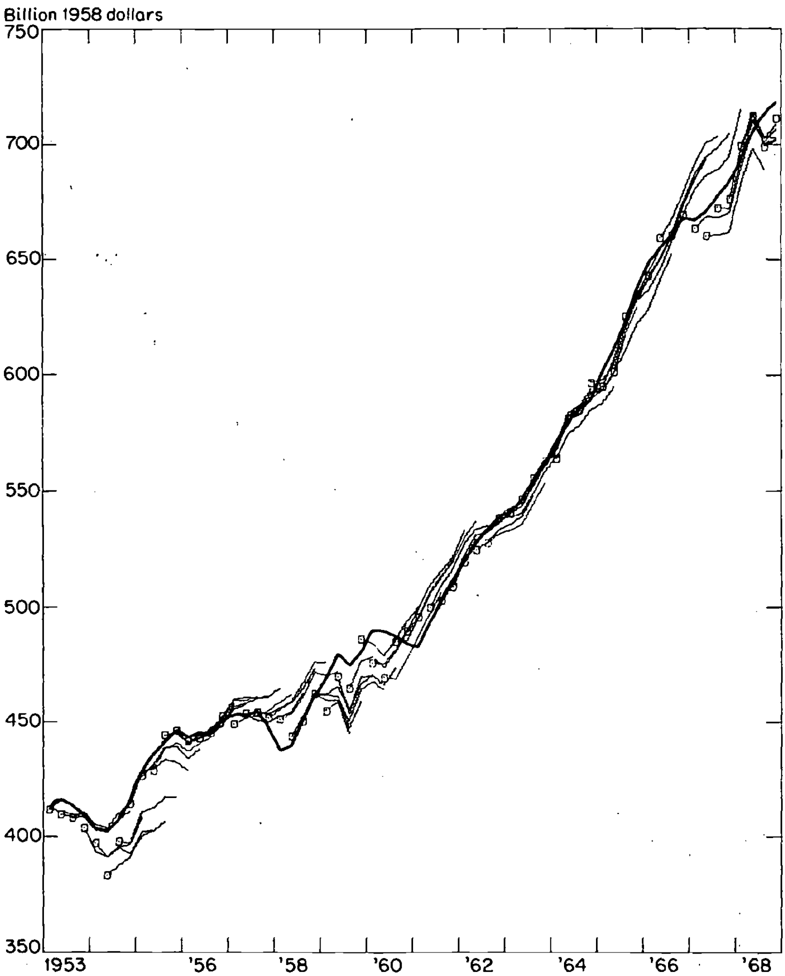


CHART 3.5

GNP Implicit Price Deflator—Forecasts with AR Constant Adjustments

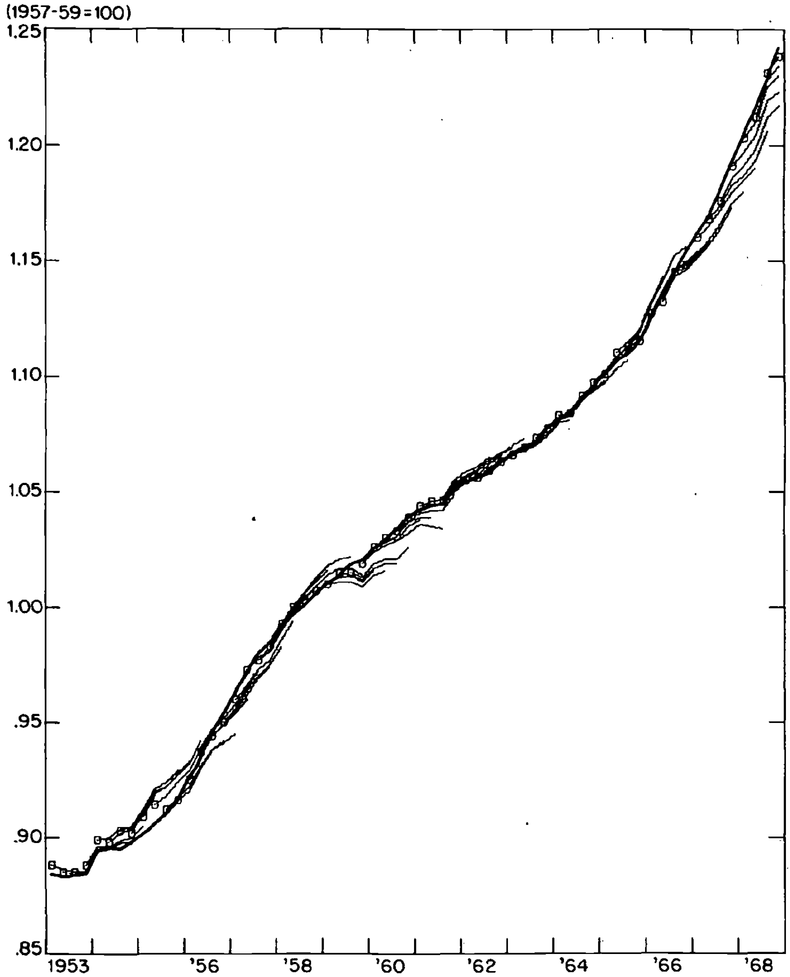


CHART 3.6

Consumption — Forecasts with AR Constant Adjustments

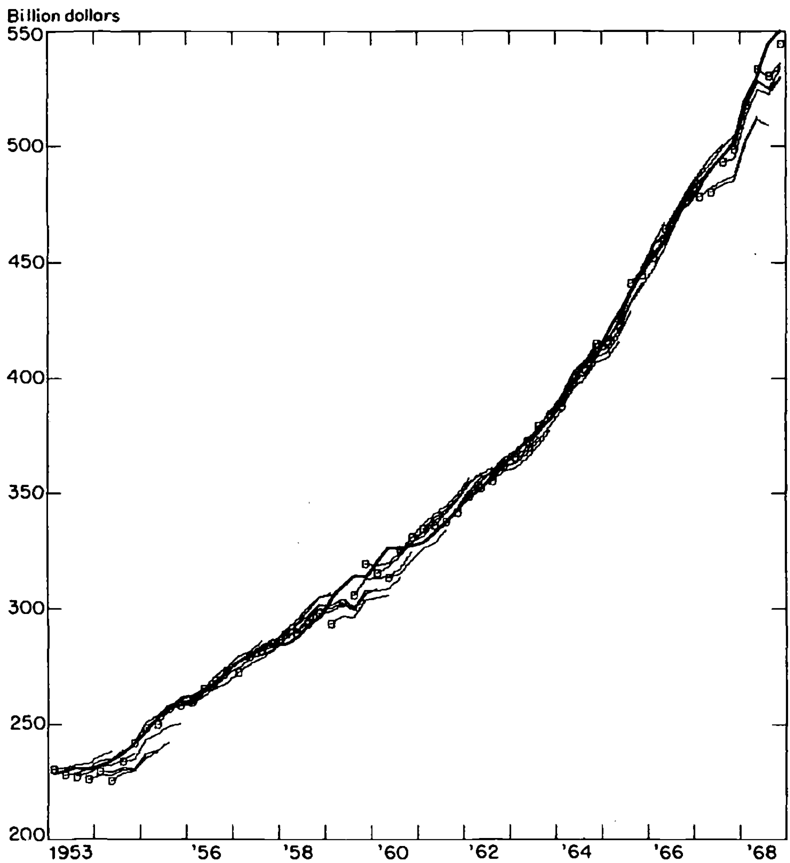


CHART 3.7

Gross Private Domestic Investment–Forecasts with AR Constant Adjustments

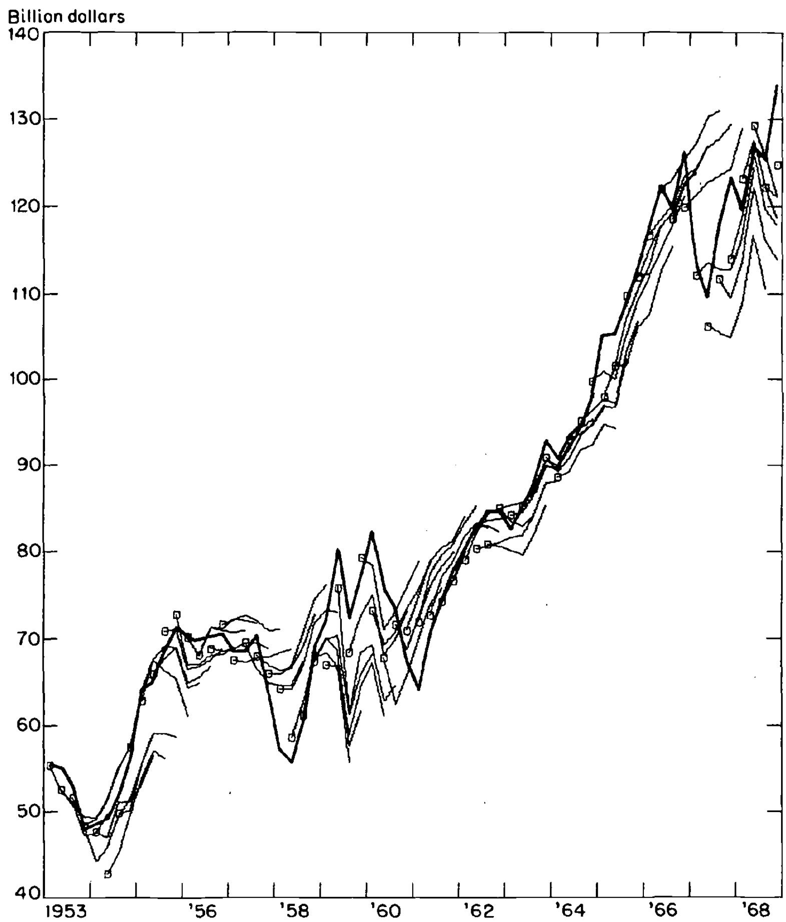


CHART 3.8

Unemployment Rate—Forecasts with AR Constant Adjustments

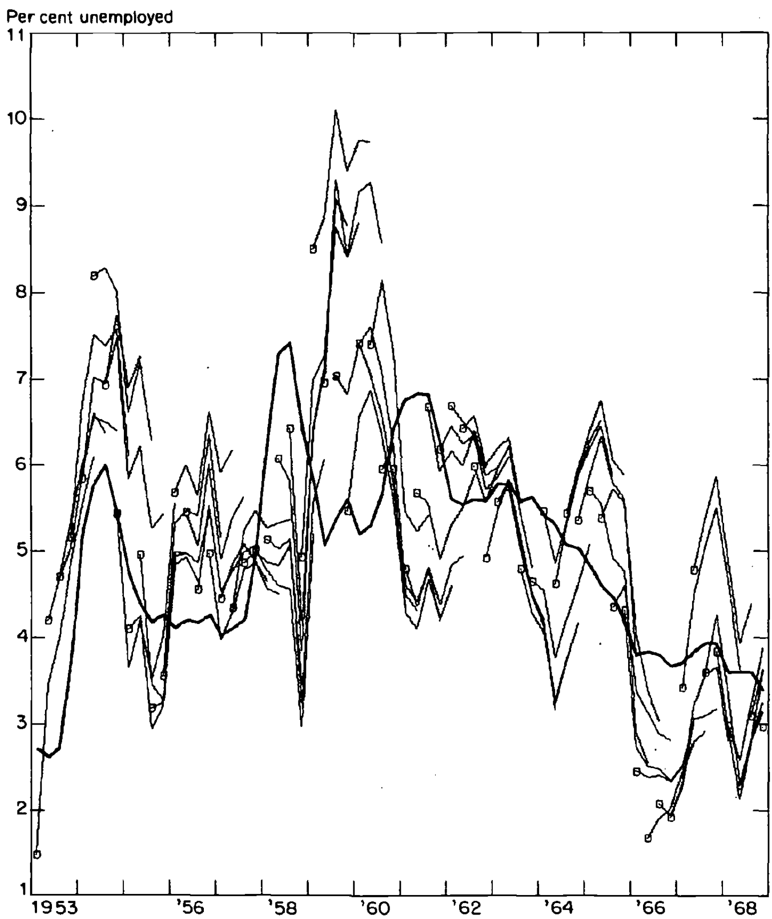


CHART 3.9

Gross National Product—Forecasts with No Constant Adjustments

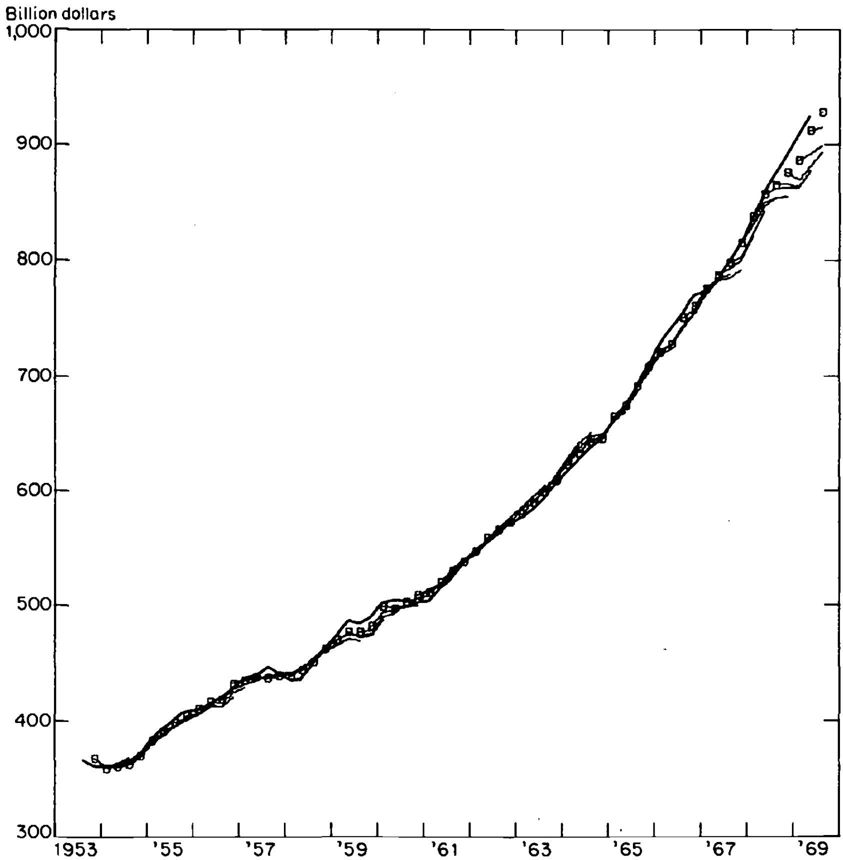


CHART 3.10

Gross National Product—Forecasts with AR Constant Adjustments

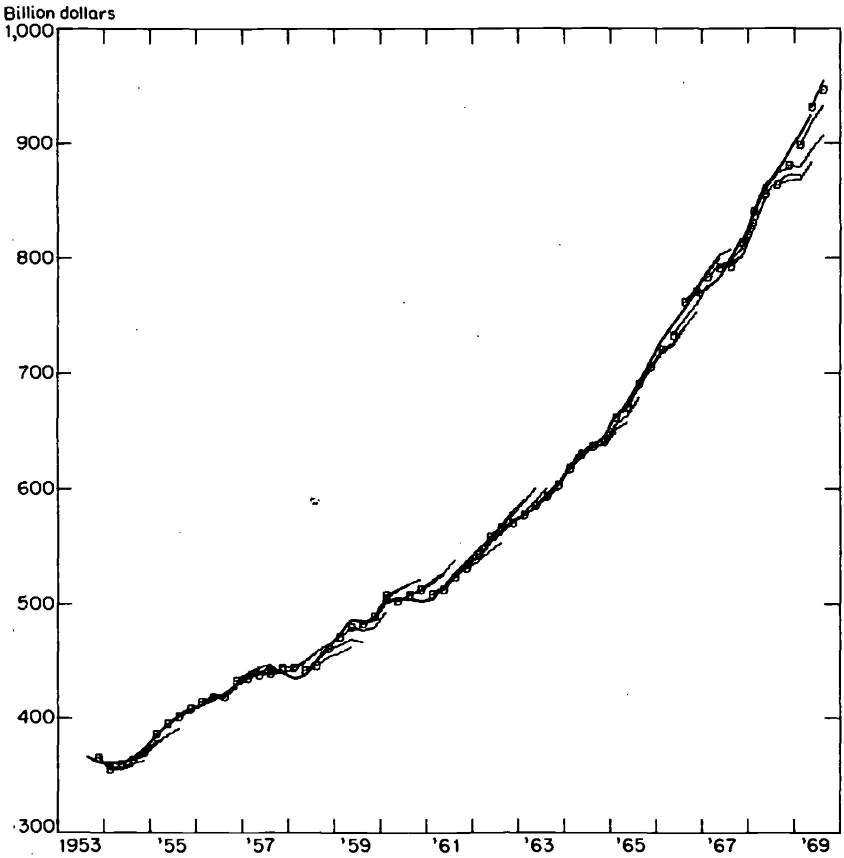


CHART 3.11

Gross National Product—Forecasts with GG Constant Adjustments

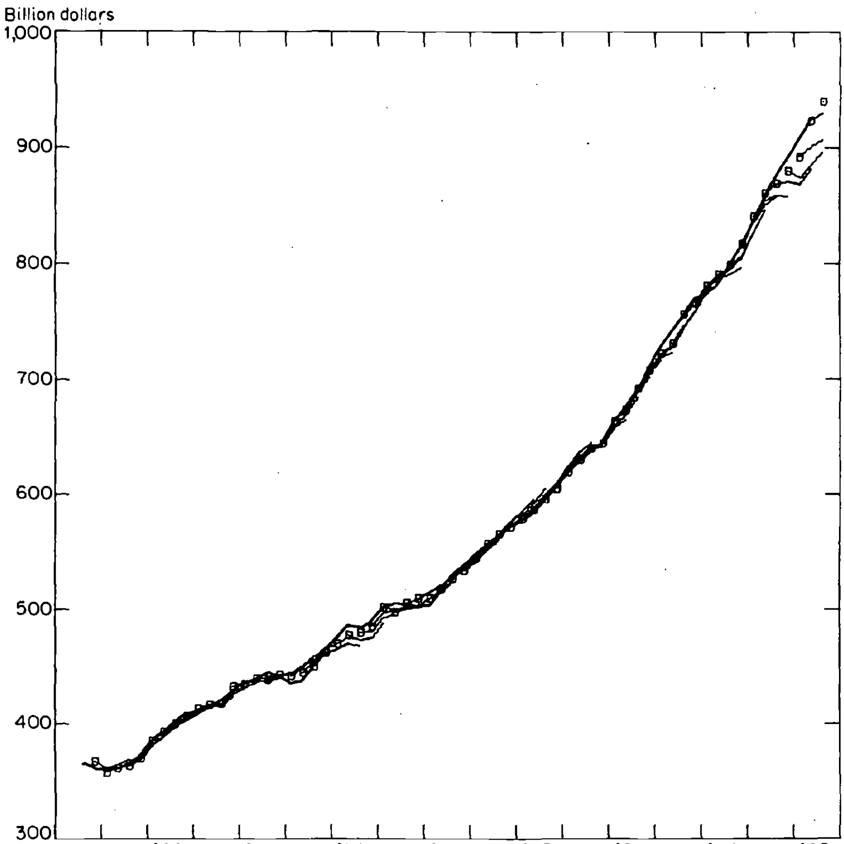


CHART 3.12

Gross National Product — Forecasts with No Constant Adjustments

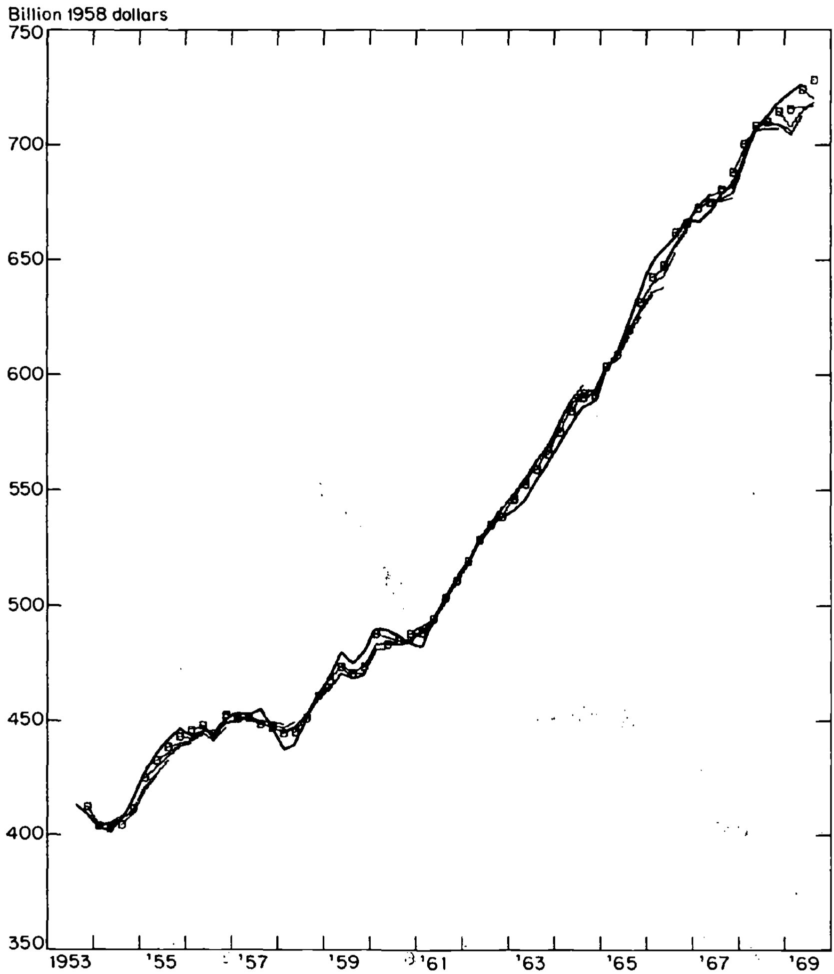


CHART 3.13

Gross National Product – Forecasts with AR Constant Adjustments

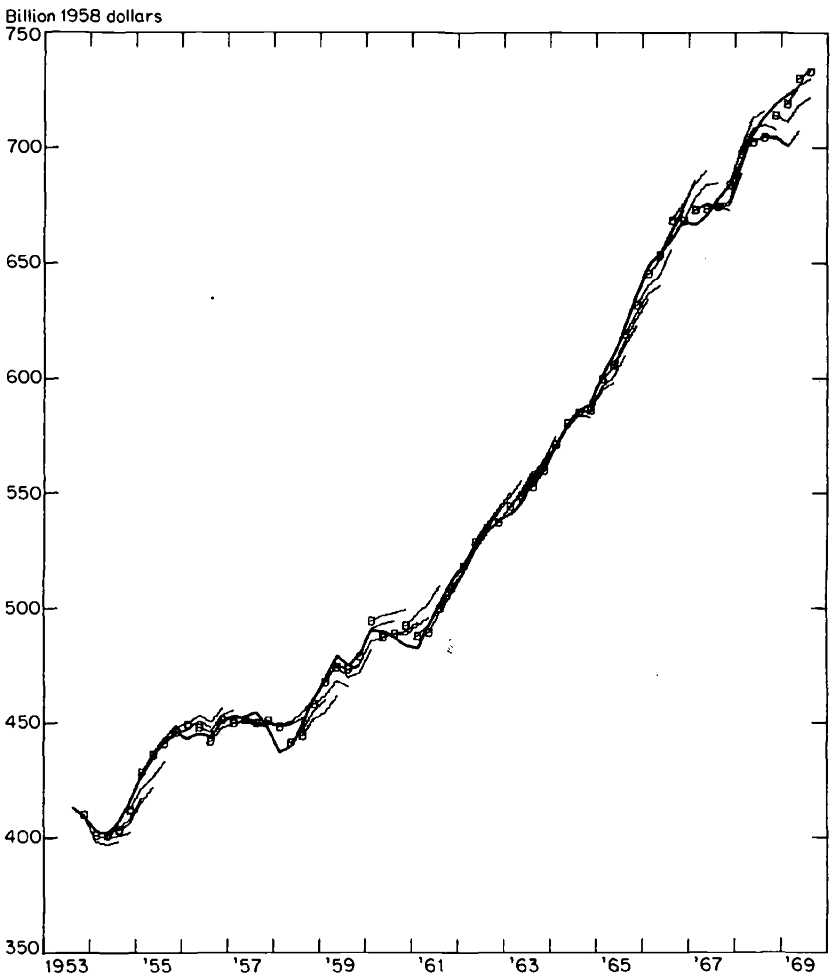


CHART 3.14

Gross National Product—Forecasts with GG Constant Adjustments

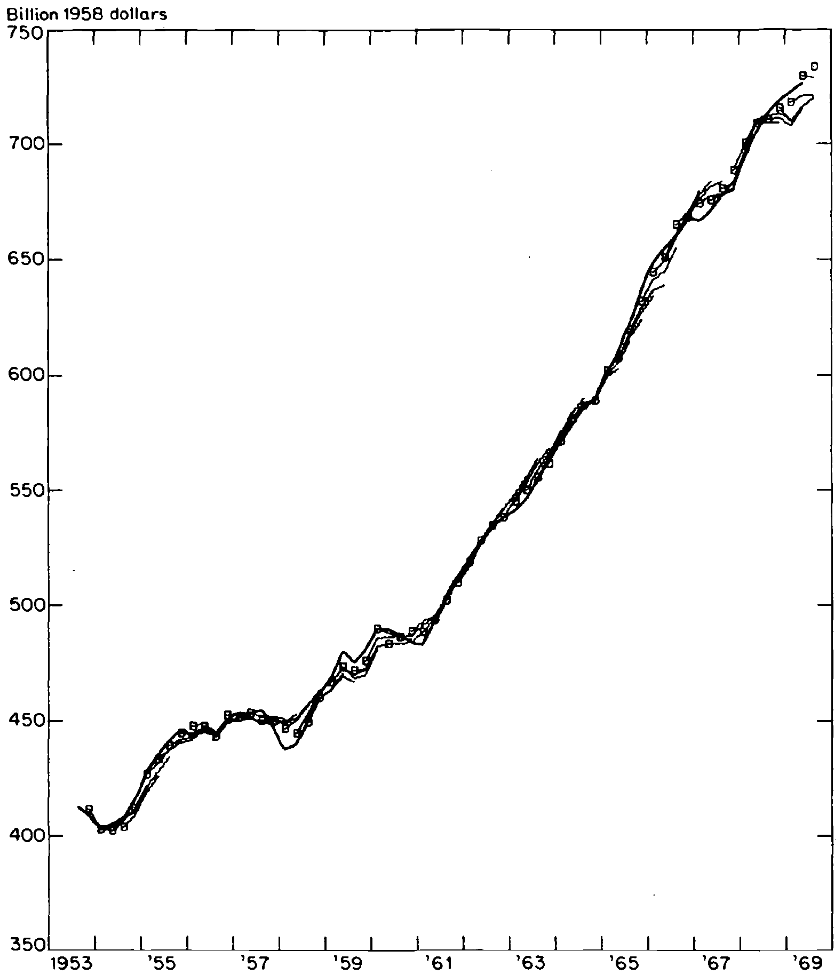


CHART 3.15

Consumption—Forecasts with No Constant Adjustments

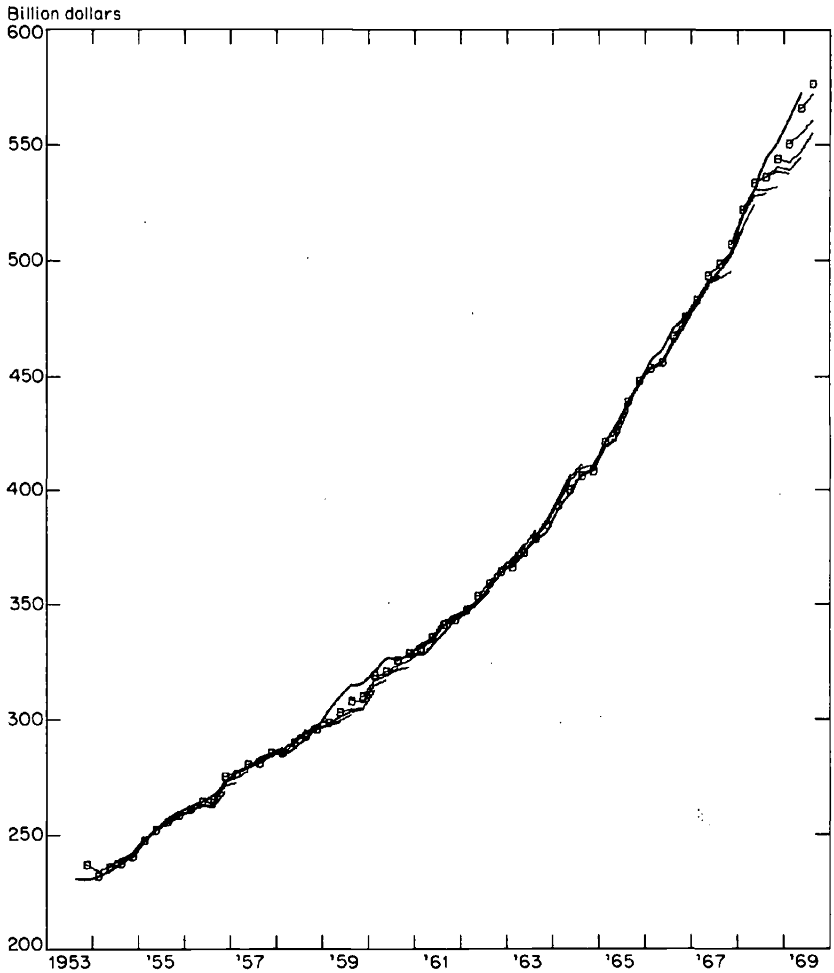


CHART 3.16

Consumption – Forecasts with AR Constant Adjustments

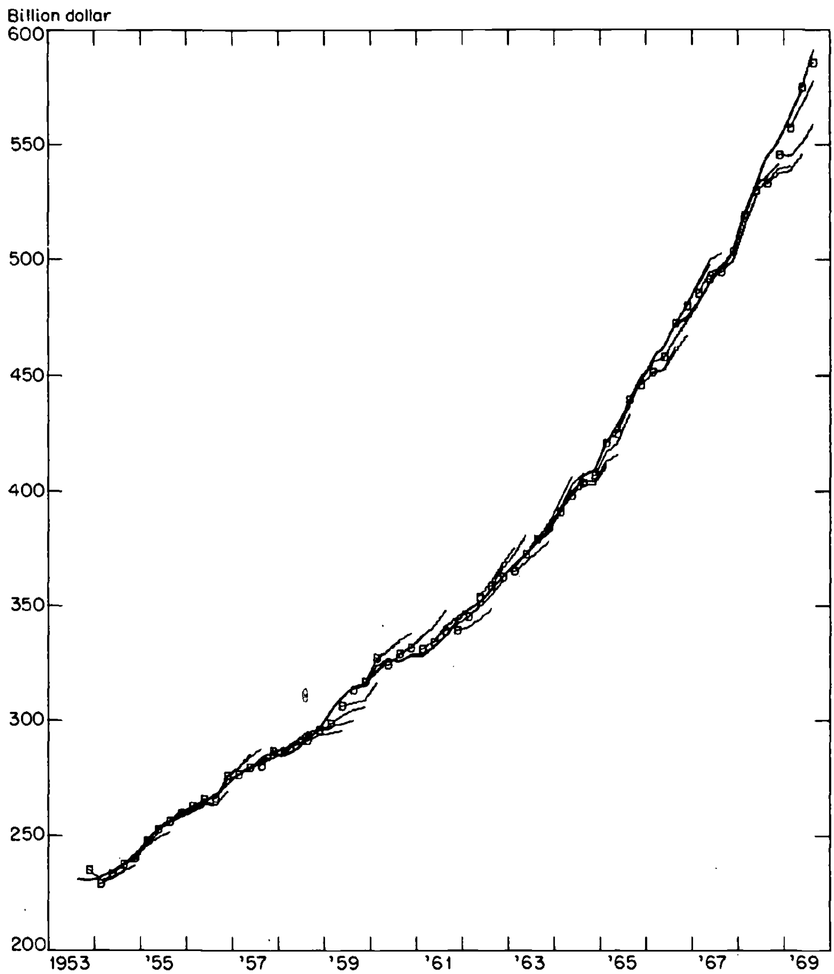


CHART 3.17

Consumption—Forecasts with GG Constant Adjustments

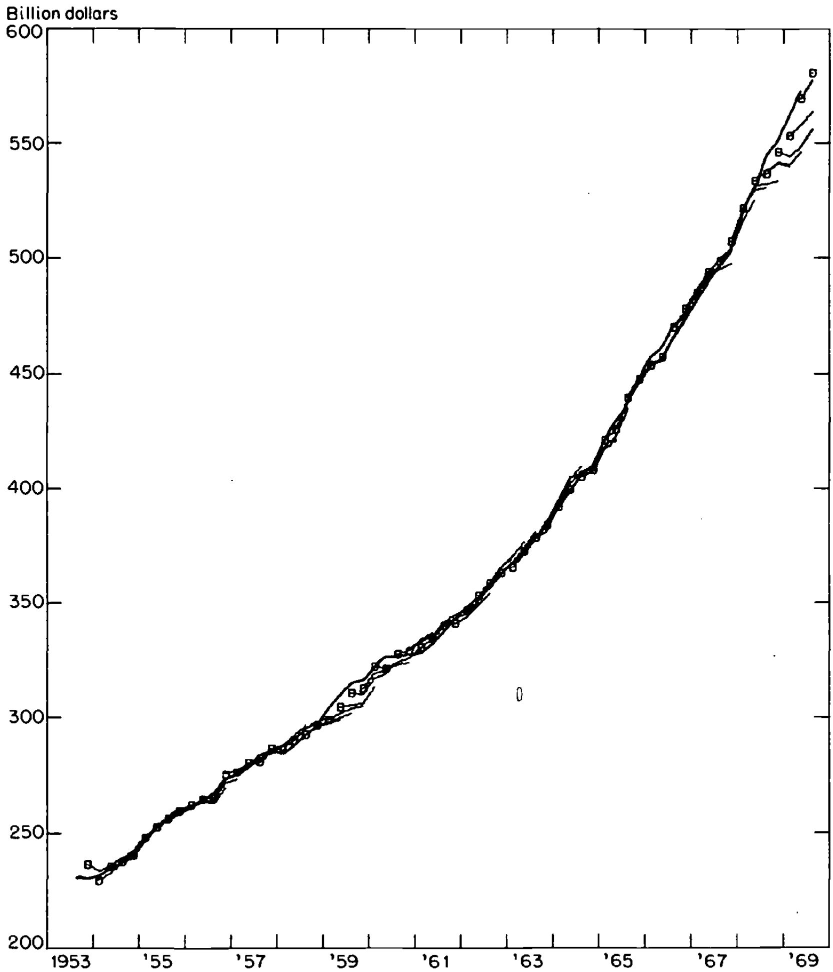


CHART 3.18

Gross Private Domestic Investment—Forecasts with No Constant Adjustments

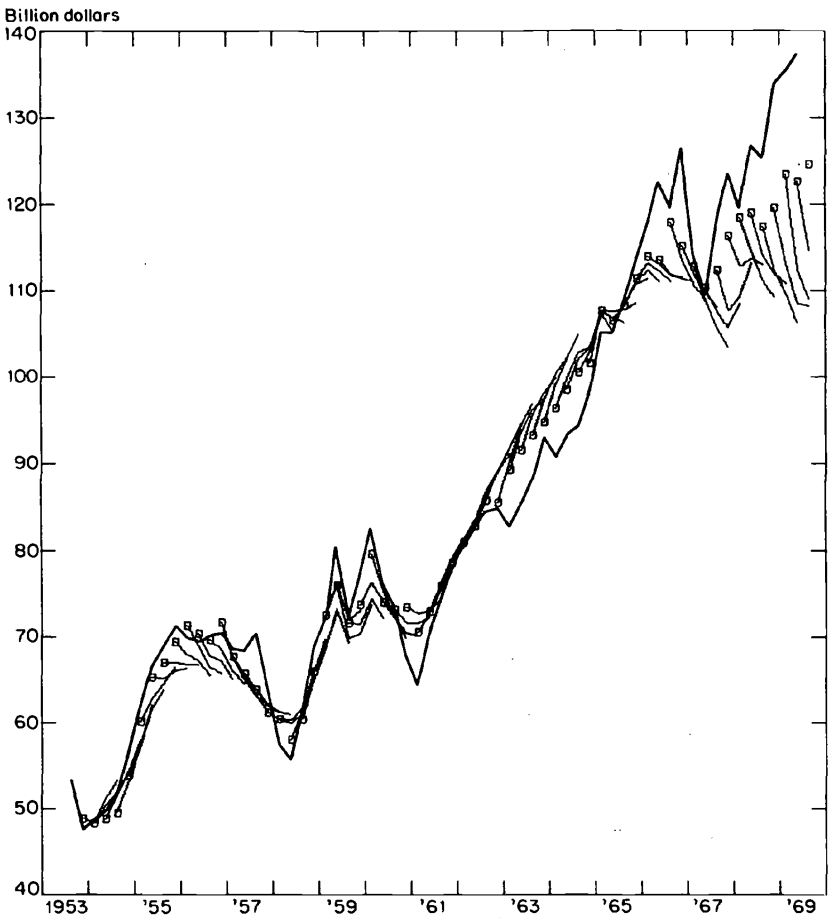


CHART 3.19

Gross Private Domestic Investment—Forecasts with AR Constant Adjustments

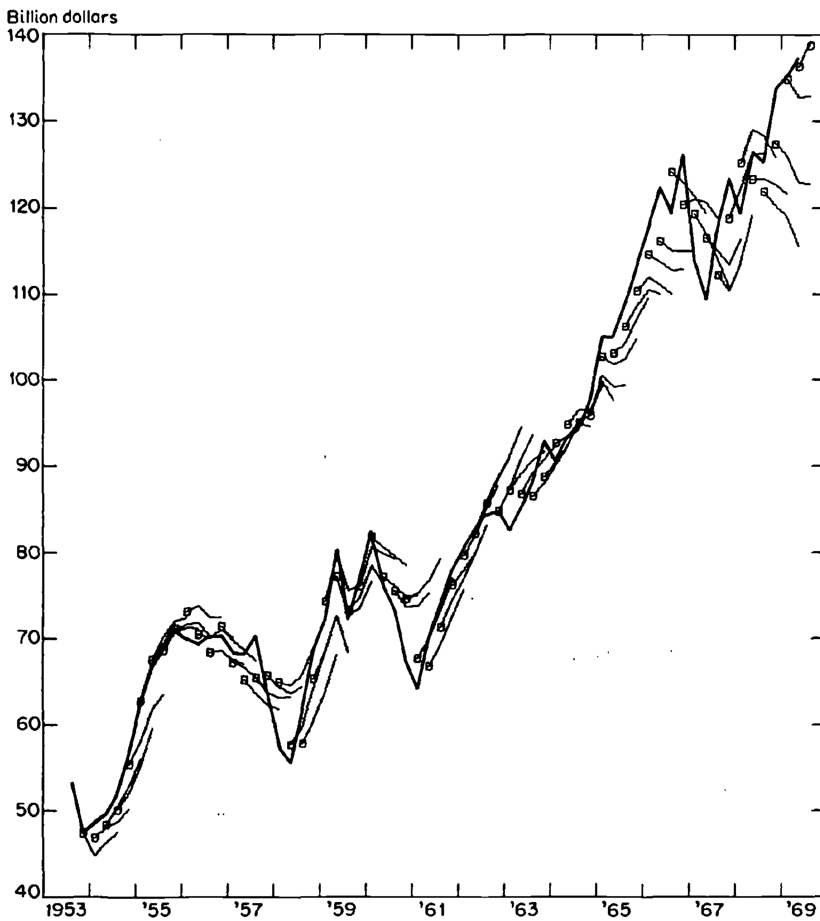


CHART 3.20

Gross Private Domestic Investment—Forecasts with GG Constant Adjustments

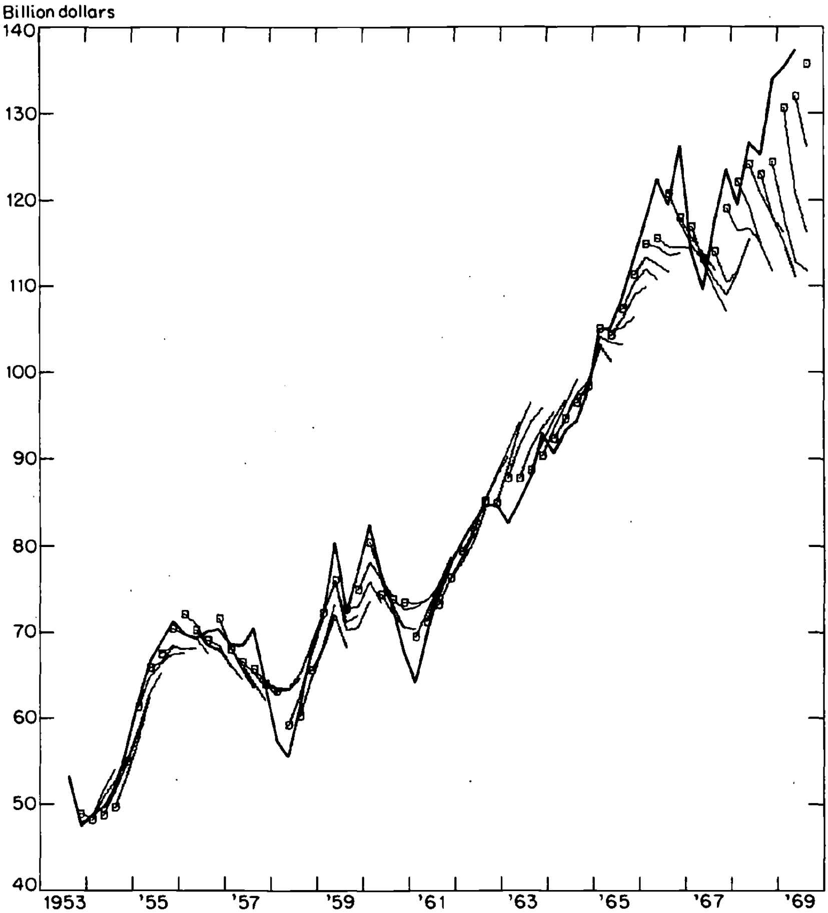


CHART 3.21

Unemployment Rate – Forecasts with No Constant Adjustments

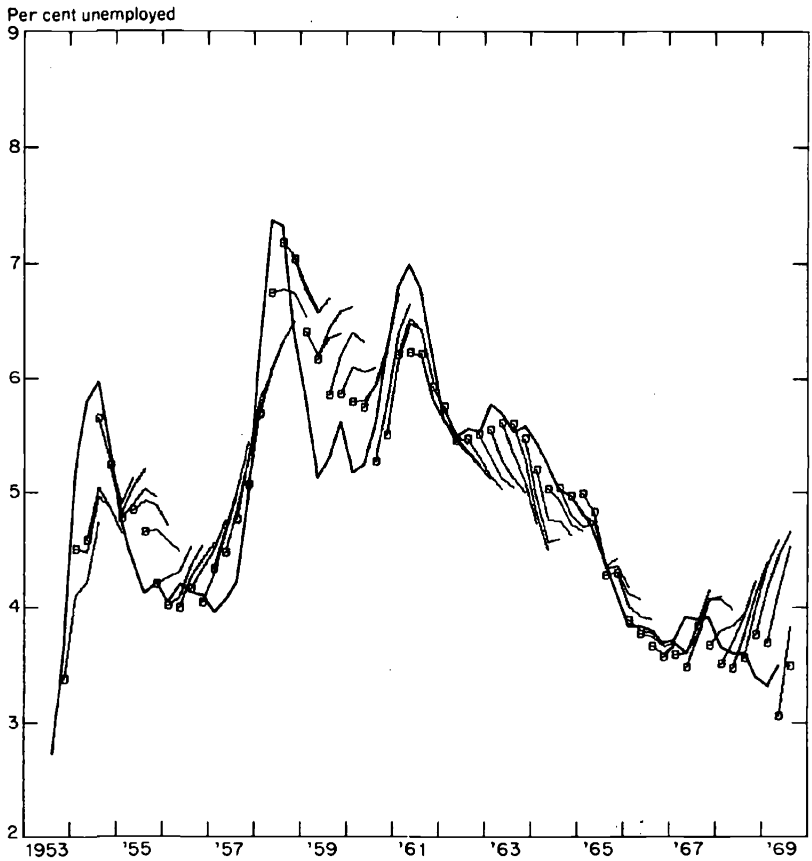


CHART 3.22

Unemployment Rate – Forecasts with AR Constant Adjustments

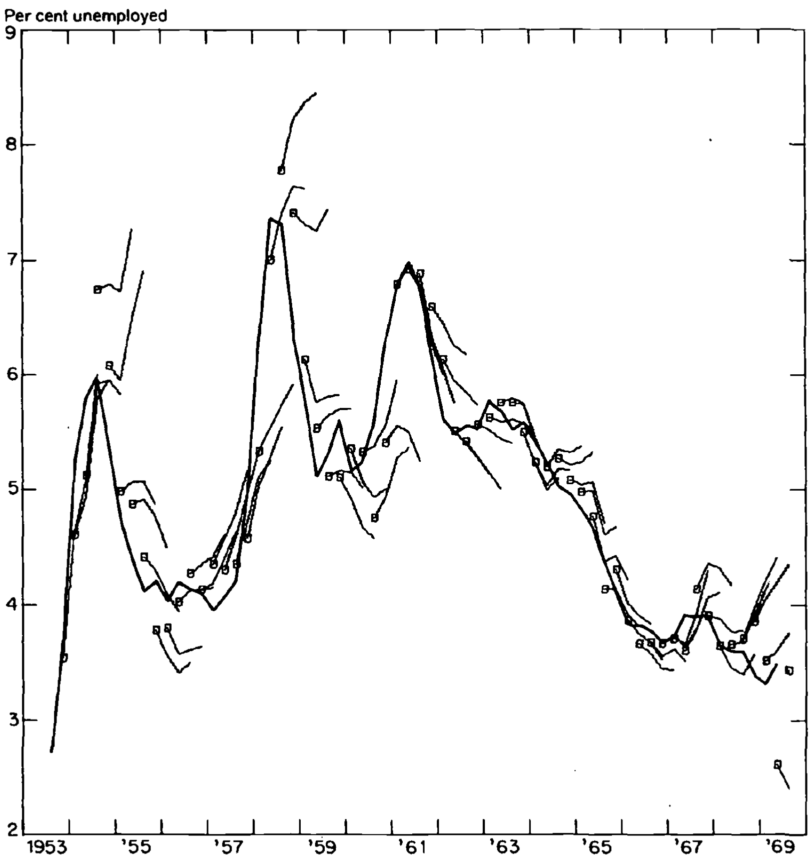
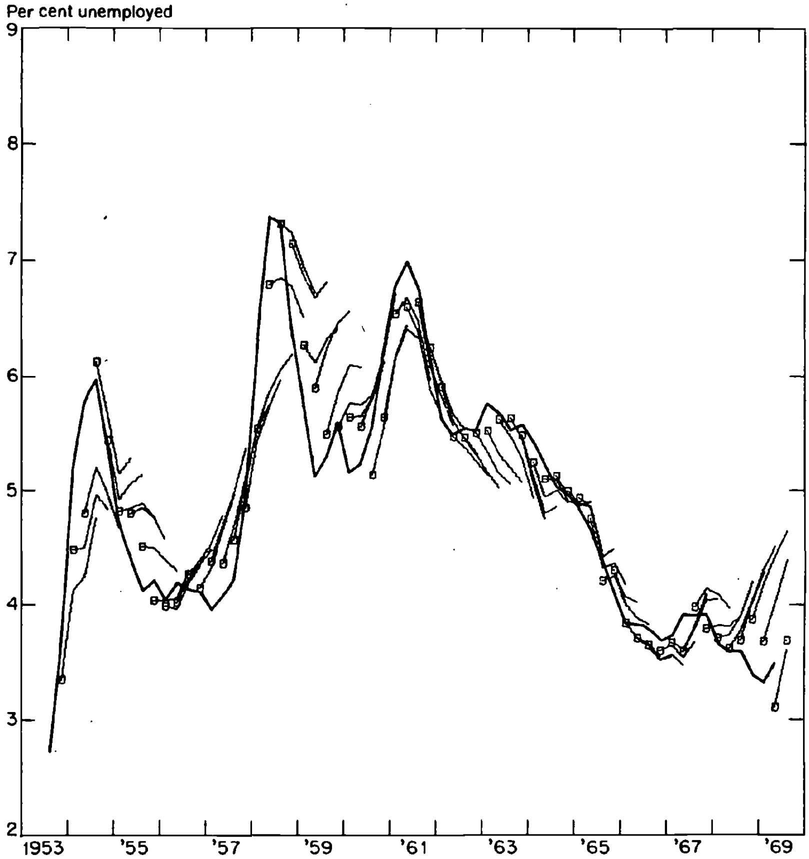


CHART 3.23

Unemployment Rate – Forecasts with GG Constant Adjustments



in getting the forecasts on the right track. The component of bias (UM) is consistently smaller for the AR adjustments than for any other method. This was true for all of the simulations from one to six quarters. The US component remains small in almost all cases and only occasionally exceeds 10 per cent of the total mean square error.

For the largest component of error, UC, the GG adjustments usually produce the lowest values; but with very few exceptions the no-constant-adjustments simulations improve their relative position, and in some cases, even become superior to the GG adjustments as the time span lengthens. The AR adjustments remain inferior to the other two methods for the UC component as well.

In addition, it might be noted that for almost all variables in both models, the simulation performance improves substantially, compared to the naive models, as the time span increases. This is, perhaps, the one encouraging note about these econometric models to be drawn from this section: even if there are cases where the model is unable to track the short-run fluctuations, it is capable of returning to the actual path over a longer period.

In summary, the sample-period statistics for both models show little difference between no-constant-adjustments, AR adjustments, GG adjustments, and (for the Wharton-EFU Model) ROS coefficients with AR adjustments. There is a slight tendency for the GG adjustments to give superior simulation results in the sample period. In the forecast period, it was found that the constant adjustments do reduce forecast errors substantially. In all cases, however, the errors are large relative to the actual change in *GNP* and its components. One is left with the conclusion that mechanical adjustment of econometric models does not lead to satisfactory predictive performance. It is this point which will be analyzed in detail in the next section.

4 HOW WELL DO ECONOMETRICIANS FORECAST

AS WE have already stated, the sample-period simulations and ex post forecasts presented in the previous section are not very impressive. If these are compared to the average of all noneconometric forecasts made at year-end,[22] the results are still less so. The RMS error of these forecasts for prediction of *GNP* one year ahead is $8.1 billion during the period 1959–1968. Recall that this figure may be compared with RMS errors one year ahead ranging from $10.6 to $14.8 billion—depending on the method of constant adjustment—for the Wharton-EFU Model during its ex post forecasting period.

[22] These are tabulated near the end of each calendar year by the Federal Reserve Bank of Philadelphia.

Similar results have led many economists to conclude that econometric models do not forecast very well. On the basis of the results brought forth in the previous section, we are not in a position to contradict them.

However, it was stressed at the beginning of this study that comparisons with forecasts generated by econometric models which have not been adjusted (or have been adjusted using only mechanical rules of thumb) are not to be confused with forecasts which have actually been issued. Fine-tuning of the model (i.e., adjustment on the basis of judgment) is a very important step in forecasting for the Wharton Model. For comparison, the publicly circulated[23] ex ante forecasts of the Wharton Model for the period 1963–1968 have had a root mean square error of $3.5 billion for *GNP* one quarter ahead, and $9.1 billion for an average of four quarters ahead. The Wharton year-end forecasts for one year ahead, which are directly comparable with the Philadelphia FRB figure of $8.1 billion, were considerably better than the Wharton average one year ahead forecast, and have had a RMS error of only $4.3 billion. The RMS error for the true ex ante forecast is substantially smaller than the RMS error of both the sample-period simulations and the ex post forecasts.

We now consider in more detail the various types of forecasts which were calculated. Our first step was to obtain exact replications of the existing ex ante forecasts, which were then used as a comparison with other types of predictions. As has been mentioned in Section II, we have a complete record of the various Wharton and OBE Model forecasts, and of all of the exogenous inputs. However, we could not always find a complete record of all of the constant adjustments or of all of the values of the lagged variables. It was not always easy to obtain the exact lagged values used at the time of prediction, because preliminary (or even guessed) data were often used, particularly for the one-quarter lags. After some experimentation, we were usually able to duplicate the forecast solution exactly. However, in a few cases this did not prove to be possible. Many of the early calculations were done by hand on a desk calculator, and some shortcuts

[23] These forecasts are now published in *Business Week* and *The Wharton Quarterly*. However, in the first two years, these forecasts were restricted to subscribers of the Wharton-EFU forecasting service.

and rounding errors were found when these forecasts were reduplicated. In these cases, we made further small adjustments in the constant terms of the equations which seemed to contain errors until exact replication of the entire forecast was obtained within a tolerance of .1 per cent.

It should be mentioned at this point that Wharton Model predictions for each quarter usually contain a set of different forecasts which depend on various guesses about monetary and fiscal policy over the forecast period. However, one particular solution is always designated as the *control* solution, meaning that this solution contained their best guesses about future exogenous variables, and is the one which was publicly issued as their best forecast.

In almost all cases, we used the control solution in the tables which follow in this section (Tables 4.1A through 4.15P). However, there are two major exceptions to this rule which should be stated. First, the Wharton Model forecasters were consistently wrong about the date of implementation of the 1968 surcharge. At first, it was thought that this would be enacted in late 1967; later, it was believed that the surcharge would be in effect by April, 1968. Thus, the control solution forecasts made in 1967.4 and 1968.1 are far too low in the first few quarters, because they assumed that the surtax would be imposed at an earlier date than it actually was. In these cases, we have analyzed the results with the alternative solution—no surcharge—but have included in the summary tables the surcharge forecasts as well. The second exception is related to the great automobile strike of early 1968, which never occurred. The Wharton forecasters had what they considered good reason to believe that there would be a severe strike at GM, which would take place during the first quarter of 1968. Accordingly, they built this assumption into their official year-end forecasts (made in 1967.4), which were released to *Business Week*, and were tabulated by the Federal Reserve Bank of Philadelphia. By mid-December, it became much clearer that there would be no such automobile strike, so the forecasts were again revised; the revised version was circulated on December 18, 1967. We have used this revised version for the 1967.4 forecast, although it is not the one which was officially released earlier in the quarter.

It was necessary to use a somewhat different procedure for the OBE forecasts. The Office of Business Economics does not release its forecasts to the public; they are intended only for restricted circulation within certain sectors of the federal government. In addition, no one set of forecasts were identified as *preferred* solutions before 1968.2. Instead, the model is used to test the effect of various alternative monetary and fiscal policies on the economy. In some cases, in considering the OBE it is possible to identify a "most widely circulated" forecast,[24] but in these predictions, the forecasters were restricted by having to use official government budget figures, which were known to be out of date. It is not surprising that these exogenous assumptions gave very poor forecasts. There seemed to be no worthwhile purpose in using such forecasts in this study, since they are not a true indication of the forecasting efficacy of the OBE Model. Instead, for the 1967.2, 1967.3, and 1968.1 forecasts, they chose the forecasts containing the set of exogenous variables which, according to their memory, seemed to include the most probable set of exogenous variables at that time. There was only one version for 1967.4 that was a "serious forecast." The 1968.2–1968.4 forecasts were designated as preferred forecasts internally at OBE, but were not verified as such outside that office. The OBE forecasts that were selected at an ex post date, rather than being true control solutions, should be regarded as *selected ex ante forecasts*. For this reason, the reader is cautioned against comparing the Wharton and OBE records. Another reason why the summary results should not be compared is that they encompass different forecast periods.

After we had succeeded in duplicating the ex ante forecasts, we inserted the actual values of all the exogenous variables,[25] but did not change any of the constant adjustments or lagged values. These

[24] There is a substantial difference between a *control* solution and a most widely circulated forecast. In the former case, the forecaster enters his best guesses about future exogenous values; in the latter case, the forecaster may be restricted to using unrealistic values for exogenous variables, although this need not occur.

[25] Unfortunately, the term actual needs to be severely qualified. In order to keep the *ex ante* and *ex post* forecasts on a comparable basis, we used preliminary estimates of all lagged variables. If we were to use revised figures for the values of the exogenous variables during the forecast period, there might be an inconsistency in the data. The change between G_{t-1} (on a preliminary basis) and G_t (on a revised basis) would be much greater than the actual difference. In order to minimize such problems, we have calculated realized G_t as *preliminary* G_{t-1} plus *actual revised* ΔG_t.

are called ex post forecasts with actual adjustments. The comparison of these two tests should enable us to examine how much of the forecast error is due to erroneous guesses about future values of the exogenous variables. Both of these forecasts are properly compared with preliminary data, which is defined as the most recent lagged value of *GNP* (or any other variable) available at the time of the forecast, plus the actual change in *GNP* during the forecast period. In this case, the actual values are taken from the July, 1969, issue of the *Survey of Current Business* for the Wharton tables, and from the May, 1969, issue for the OBE tables.

We also calculated both ex ante and ex post forecasts, using the two methods of constant adjustments—average residual of the past two quarters (AR) and that residual multiplied by powers of the autocorrelation coefficient (GG)—which were used for the sample-period simulations and for the ex post forecasts in Section 3. In addition, we calculated both ex ante and ex post forecast with no-constant-adjustments. For the Wharton-EFU Model we added ex post forecasts with AR adjustments where the coefficients were estimated by the ROS (regression simulated values) method. The results are presented in Tables 4.1–4.5 for the Wharton-EFU Model, 1966.1–1968.4; in Tables 4.6–4.10 for the Evans Model, 1964.1–1965.2;[26] and in Tables 4.11–4.15 for the OBE Model, 1967.2–1968.4.[27] In addition, the results for constant-dollar *GNP* for these models are portrayed on the familiar forecast-realization diagrams in Charts 4.1–4.8.

The principal results to be drawn from these tables can be summarized as follows:

1. With very few exceptions, the Wharton true ex ante forecasts are *superior* to the ex post forecasts with the original constant adjust-

[26] Although the Evans Model was used for true ex ante forecasting during 1963, these early forecasts could not be replicated, due in part to a data base which was largely drawn from sources other than the *Survey of Current Business*. In addition, since there are no formal records of constant adjustments for the Evans Model, only the actual ex ante forecasts and the ex post forecasts calculated by substituting in the correct values of the exogenous variables are given. While this results in a much briefer treatment, a good deal of the analysis based on the results of the other two models cannot be extended to include the Evans Model.

[27] In initial calculation, it has been determined that there is an error in the ex post AR forecasts of 67.3 and 67.4. Since the data set is such that it is not feasible to regenerate the calculation, these two forecasts are deleted from all tables.

TABLE 4.1A

Comparison of Ex Ante Forecasts, Wharton Model, GNP in Current Dollars

Quarter in Which Forecast Was Made	Reproduced Ex Ante Forecast Value	Reproduced Ex Ante Forecast Error	Ex Ante with AR Adjustments Value	Ex Ante with AR Adjustments Error	Ex Ante with GG Adjustments Value	Ex Ante with GG Adjustments Error	Ex Ante with No Adjustments Value	Ex Ante with No Adjustments Error	Ex Post with Actual Adjustments Value	Ex Post with Actual Adjustments Error	Realized Prelimi-nary Value
					First Quarter of Forecast						
1966.1	707.9	−9.1	716.3	−0.7	718.2	1.2	705.6	−11.4	710.0	−7.0	717.0
1966.2	727.6	1.2	739.1	12.7	739.5	13.1	725.1	−1.3	725.6	−0.8	727.9
1966.3	748.6	4.2	744.4	0.0	736.4	−8.0	726.8	−17.6	751.9	7.5	744.4
1966.4	757.9	−1.5	751.1	−8.3	743.7	−15.7	732.6	−26.8	760.5	1.1	759.4
1967.1	769.7	6.7	764.7	1.7	758.1	−4.9	750.8	−12.2	776.1	13.1	763.0
1967.2	776.1	2.5	771.1	−2.5	769.1	−4.5	763.2	−10.4	780.6	7.0	773.6
1967.3	795.0	2.5	787.3	−5.2	787.6	−4.9	780.1	−12.4	791.6	−0.9	792.5
1967.4	*805.9	0.1									
	806.7	0.9	810.5	4.7	808.5	2.7	795.5	−10.3	802.2	−3.6	805.8
1968.1	*828.8	2.0									
	829.1	2.3	828.7	1.9	815.1	−11.7	794.2	−32.6	840.7	13.9	826.8
1968.2	846.6	−4.1	840.1	−10.6	849.4	−1.3	813.3	−37.4	847.9	−2.8	850.7
1968.3	861.3	−8.0	855.7	−13.6	863.0	−6.3	832.0	−37.3	866.3	−3.0	869.3
1968.4	884.1	−2.8	866.7	−20.2	871.3	−15.6	837.7	−49.2	883.4	−3.5	886.9
AFE*		*3.7									
AFE		3.8		6.8		7.5		21.6		5.4	

Second Quarter of Forecast

1966.1	720.6	−10.2	733.1	2.3	731.0	0.2	717.1	−13.7	725.5	−5.3	730.8
1966.2	741.6	2.6	758.9	19.9	753.9	14.9	737.8	−1.2	743.7	4.7	739.0
1966.3	762.1	2.9	757.8	−1.4	744.7	−14.5	735.4	−23.8	768.9	9.7	759.2
1966.4	767.0	4.1	760.2	−2.7	746.2	−16.7	737.5	−25.4	772.4	9.5	762.9
1967.1	780.2	7.9	778.9	6.6	766.4	−5.9	759.6	−12.7	787.6	15.3	772.3
1967.2	796.1	5.6	781.6	−8.9	778.4	−12.1	774.1	−16.4	800.2	9.7	790.5
1967.3	816.1	7.9	800.0	−8.2	802.0	−6.2	795.2	−13.0	803.0	−5.2	808.2
1967.4	*815.1	−9.9									
	832.9	7.9	828.8	3.8	825.0	0.0	812.9	−12.1	838.2	13.2	825.0

(continued)

NOTES (Tables 4.1 through 4.10):
* These forecasts were originally issued as control solutions but are not included in the analysis. See text for explanation.

AFE is absolute average forecast error.

AR adjustments are the average residual of the previous two periods. See text, Section 3A, for fuller discussion.

GG adjustments are the average residuals of the previous two periods multiplied by the powers of the autocorrelation coefficient. See text, Section 3A, for fuller discussion.

ROS means the version of the model estimated with ROS (regression on simulated values) coefficients. See text, Section 5, for fuller explanation.

"Ex post with actual adjustments" forecasts are made by replacing the ex ante values of the exogenous variables and the ex ante tax-equation slope and intercepts with the appropriate realized values. In the case of the exogenous variables, the revised change is added to the lagged value. The tax functions are adjusted to reflect new tax laws and growth of state and local tax collections.

TABLE 4.1A (*continued*)

Quarter in Which Forecast Was Made	Reproduced Ex Ante Forecast Value	Reproduced Ex Ante Forecast Error	Ex Ante with AR Adjustments Value	Ex Ante with AR Adjustments Error	Ex Ante with GG Adjustments Value	Ex Ante with GG Adjustments Error	Ex Ante with No Adjustments Value	Ex Ante with No Adjustments Error	Ex Post with Actual Adjustments Value	Ex Post with Actual Adjustments Error	Realized Prelimi-nary Value
					Second Quarter of Forecast (continued)						
1968.1	*839.3	−10.9									
	846.4	−3.8	845.3	−4.9	823.3	−26.9	804.5	−45.7	861.0	10.8	850.2
1968.2	856.4	−12.0	841.3	−27.1	843.8	−24.6	812.3	−56.1	856.4	−12.0	868.4
1968.3	873.8	−11.6	859.3	−26.1	861.4	−24.0	835.3	−50.1	879.2	−6.2	885.4
AFE*		*7.7									
AFE		7.0		10.2		13.3		24.6		9.2	
					Third Quarter of Forecast						
1966.1	733.7	−9.7	743.9	0.5	737.3	−6.1	730.3	−13.1	743.5	0.1	743.4
1966.2	755.6	1.8	771.1	17.3	761.1	7.3	751.5	−2.3	763.2	9.4	753.8
1966.3	770.5	7.8	768.4	5.7	756.3	−6.4	752.9	−9.8	784.9	22.2	762.7
1966.4	778.4	6.2	774.7	2.5	761.7	−10.5	761.1	−11.1	782.7	10.5	772.2
1967.1	785.2	−4.0	789.0	−0.2	778.5	−10.7	778.5	−10.7	789.7	0.5	789.2
1967.2	809.2	3.0	792.6	−13.6	792.6	−13.6	793.8	−12.4	810.0	3.8	806.2
1967.3	824.0	−3.4	808.5	−18.9	813.9	−13.5	813.6	−13.8	826.8	−0.6	827.4
1967.4	*845.2	−3.2									
	852.5	4.1	839.1	−9.3	837.3	−11.1	833.3	−15.1	866.1	17.7	848.4
1968.1	*848.5	−19.4									
	858.4	−9.5	855.0	−12.9	835.6	−32.3	829.5	−38.4	859.8	−8.1	867.9

1968.2	862.4	−22.1	842.6	−41.9	839.0	−45.5	830.2	−54.3	864.9	−19.6	884.5
AFE*		*8.0									
AFE		7.2		12.3		15.7		18.1		9.3	
Fourth Quarter of Forecast											
1966.1	745.8	−12.4	756.0	−2.2	747.5	−10.7	742.5	−15.7	760.0	2.4	758.2
1966.2	768.5	11.2	786.2	28.9	773.5	16.2	766.5	9.2	787.6	30.3	757.3
1966.3	780.4	8.4	777.2	5.2	766.1	−5.9	764.7	−7.3	801.3	29.3	772.0
1966.4	788.9	−0.2	788.3	−0.8	776.7	−12.4	777.8	−11.3	790.9	1.8	789.1
1967.1	793.9	−11.0	797.1	−7.8	790.3	−14.6	792.8	−12.1	796.8	−8.1	804.9
1967.2	828.3	2.9	807.9	−17.5	812.7	−12.7	815.2	−10.2	841.8	16.4	825.4
1967.3	838.1	−12.7	820.7	−30.1	830.1	−20.7	830.8	−20.0	850.6	−0.2	850.8
1967.4	*852.2	−13.9									
	856.5	−9.6	841.6	−24.5	842.3	−23.8	840.9	−25.2	862.8	−3.3	866.1
1968.1	*856.6	−27.4									
	865.5	−18.5	861.9	−22.1	844.9	−39.1	842.2	−41.8	863.2	−20.8	884.0
AFE*		*11.1									
AFE		9.7		15.5		17.3		17.0		12.5	
Fifth Quarter of Forecast											
1966.1	753.2	−8.5	761.5	−0.2	751.3	−10.4	751.7	−10.0	780.6	18.9	761.7
1966.2	775.7	9.1	788.2	21.6	773.7	4.1	774.0	7.4	802.2	46.6	766.6
1966.3	791.0	2.1	785.9	−3.0	778.1	−10.8	777.0	−11.9	813.5	24.6	788.9
1966.4	802.5	−2.3	802.1	−2.7	793.6	−11.2	795.7	−9.1	803.1	−1.7	804.8
1967.1	816.4	−7.7	812.6	−11.5	811.0	−13.1	814.3	−9.8	828.1	4.0	824.1

(continued)

TABLE 4.1A (*concluded*)

Quarter in Which Forecast Was Made	Reproduced Ex Ante Forecast		Ex Ante with AR Adjustments		Ex Ante with GG Adjustments		Ex Ante with No Adjustments		Ex Post with Actual Adjustments		Realized Prelimi-nary Value
	Value	Error	Value	Error	Value	Error	Value	Error	Value	Error	
					Fifth Quarter of Forecast (continued)						
1967.2	839.1	−9.7	818.6	−30.2	827.7	−21.1	829.6	−19.2	864.8	16.0	848.8
1967.3	852.7	−15.8	831.7	−36.8	844.1	−24.4	844.8	−23.7	852.6	−15.9	868.5
1967.4	*855.5	−26.5									
	867.3	−14.9	854.5	−27.7	857.8	−24.4	857.7	−24.5	870.0	−12.2	882.2
AFE		8.8		16.7		14.9		14.5		17.5	
					Sixth Quarter of Forecast						
1966.1	762.3	−8.7	771.2	0.2	761.8	−9.2	761.7	−9.3	796.4	28.3	768.1
1966.2	782.1	−1.4	792.2	8.7	778.9	−4.6	779.6	−3.9	813.2	29.7	783.5
1966.3	799.0	−5.6	793.2	−11.4	787.3	−17.3	787.3	−17.3	824.8	20.2	804.6
1966.4	819.4	−4.6	818.0	−6.0	812.1	−11.9	814.4	−9.6	830.6	6.6	824.0

1967.1	834.8	−12.7	828.6	−18.9	830.8	−16.7	834.7	−12.8	854.3	6.8	847.5
1967.2	842.0	−24.5	823.5	−43.0	835.5	−31.0	837.1	−29.4	861.0	−5.5	866.5
1967.3	867.4	−17.2	846.5	−38.1	861.2	−23.4	862.1	−22.5	860.5	−24.1	884.6
AFE		10.7		18.0		16.3		15.0		17.3	
					Forecast One Year Ahead						
1966.1	727.0	−10.3	737.3	−1.8	733.5	−5.6	723.8	−15.3	734.7	−4.4	737.3
1966.2	748.3	3.8	763.8	19.3	757.0	12.5	745.2	0.7	755.0	10.5	744.5
1966.3	765.4	5.9	744.4	−15.1	736.4	−23.1	744.9	−14.6	776.7	17.2	759.5
1966.4	773.0	2.1	768.5	−2.4	757.0	−13.9	752.2	−18.7	776.6	5.7	770.9
1967.1	782.2	−0.1	782.4	0.1	773.3	−9.0	770.4	−11.9	787.5	5.2	782.3
1967.2	802.4	3.5	788.3	−10.6	788.2	−10.7	786.6	−12.3	808.1	9.2	798.9
1967.3	818.3	−1.4	804.1	−15.6	808.4	−11.3	804.9	−14.8	818.0	−1.7	819.7
1967.4	*829.6	−6.7									
	837.1	0.8	830.0	−6.3	828.2	−8.1	820.6	−15.7	842.3	6.0	836.3
1968.1	*843.3	−13.9									
	849.8	−7.4	847.7	−9.5	829.7	−27.5	817.6	−39.6	856.2	−1.0	857.2
AFE		*5.3									
		3.9		8.9		13.5		15.9		6.7	

TABLE 4.1P

Comparison of Ex Post Forecasts, Wharton Model, GNP in Current Dollars

Quarter in Which Forecast Was Made	Ex Post with AR Adjustments		Ex Post with GG Adjustments		Ex Post with No Adjustments		Ex Post ROS with AR Adjustments		Realized Revised Value
	Value	Error	Value	Error	Value	Error	Value	Error	
First Quarter of Forecast									
1966.1	724.2	−5.3	719.3	−10.2	708.0	−21.5	720.8	−8.7	729.5
1966.2	746.5	3.2	737.5	−5.8	725.4	−17.9	742.8	−0.5	743.3
1966.3	755.6	−0.3	748.8	−7.1	739.2	−16.7	753.6	−2.3	755.9
1966.4	768.3	−2.4	764.6	−6.1	755.3	−15.4	766.4	−4.3	770.7
1967.1	769.3	−4.9	769.1	−5.1	763.4	−10.8	771.8	−2.4	774.2
1967.2	771.0	−12.5	775.3	−8.2	770.5	−13.0	772.5	−11.0	783.5
1967.3	790.9	−9.5	790.0	−10.4	782.7	−17.7	790.9	−9.5	800.4
1967.4	805.1	−10.9	800.8	−15.3	790.7	−25.4	809.8	−6.3	816.1
1968.1	840.6	5.3	834.6	−0.7	819.4	−15.9	836.4	1.1	835.3
1968.2	836.1	4.4	853.7	−5.0	835.5	−23.2	858.3	−0.4	858.7
1968.3	860.4	−16.0	851.7	−20.4	836.0	−40.4	863.1	−13.3	876.4
1968.4	880.3	−12.2	867.4	−25.1	850.0	−42.5	882.8	−9.7	892.5
AFE		7.2		10.0		21.7		5.8	
Second Quarter of Forecast									
1966.1	733.9	−4.4	729.7	−13.6	720.0	−23.3	732.4	−10.9	743.3
1966.2	762.2	6.3	747.5	−8.4	737.3	−18.6	757.1	1.2	755.9

1966.3	773.5	2.8	762.4	−8.3	754.0	−16.7	768.9	−1.8	770.7
1966.4	785.0	10.8	777.7	3.5	769.9	−4.3	783.3	9.1	774.2
1967.1	778.8	−4.7	779.6	−3.9	775.1	−8.4	780.5	−3.0	783.5
1967.2	775.6	−24.8	784.6	−15.8	781.2	−19.2	776.3	−24.1	800.4
1967.3	796.5	−19.6	796.6	−19.5	790.4	−25.7	800.5	−15.6	816.1
1967.4	835.4	0.1	827.6	−7.7	817.9	−17.4	833.1	−2.2	835.3
1968.1	859.8	1.1	849.2	−9.5	834.8	−23.9	855.8	−2.9	858.7
1968.2	863.1	−13.3	849.0	−27.4	832.9	−43.5	863.8	−12.6	876.4
1968.3	868.6	−23.9	857.0	−22.5	843.9	−48.6	869.1	−23.4	892.5
AFE		10.2		12.7		22.7		9.7	
Third Quarter of Forecast									
1966.1	756.2	0.3	747.1	−8.8	744.1	−11.8	748.0	−7.9	755.9
1966.2	778.1	7.4	764.4	−6.3	761.3	−9.4	772.7	2.0	770.7
1966.3	790.9	16.7	781.4	7.2	779.2	5.0	788.4	14.2	774.2
1966.4	795.8	12.3	790.1	6.6	789.6	6.1	797.9	14.4	783.5
1967.1	782.9	−17.5	788.9	−11.5	790.8	−9.6	785.3	−15.1	800.4
1967.2	782.5	−33.6	797.6	−18.5	800.1	−16.0	784.7	−31.4	816.1
1967.3	826.3	−9.0	830.1	−5.2	830.7	−4.6	822.6	−12.7	835.3
1967.4	859.0	0.3	854.3	−4.4	852.2	−6.5	855.5	−3.2	858.7
1968.1	857.5	−18.9	850.8	−25.6	846.7	−29.7	861.1	−15.3	876.4
1968.2	866.9	−25.6	858.4	−34.1	854.2	−38.3	868.5	−24.0	892.5
AFE		14.2		12.8		13.7		14.0	

(continued)

TABLE 4.1P (*concluded*)

Quarter in Which Forecast Was Made	Ex Post with AR Adjustments Value	Ex Post with AR Adjustments Error	Ex Post with GG Adjustments Value	Ex Post with GG Adjustments Error	Ex Post with No Adjustments Value	Ex Post with No Adjustments Error	Ex Post ROS with AR Adjustments Value	Ex Post ROS with AR Adjustments Error	Realized Revised Value
				Fourth Quarter of Forecast					
1966.1	773.5	2.8	764.6	−6.1	763.3	−7.4	764.6	−6.1	770.7
1966.2	795.9	21.7	783.0	8.8	782.2	8.0	792.2	18.0	774.2
1966.3	803.8	20.3	795.6	12.1	795.4	11.9	805.4	21.9	783.5
1966.4	803.8	3.4	800.7	0.3	802.6	2.2	808.6	8.2	800.4
1967.1	790.6	−25.5	803.1	−13.0	807.1	−9.0	795.8	−20.3	816.1
1967.2	810.7	−24.6	833.5	−1.8	837.4	2.1	805.3	−30.0	835.3
1967.3	851.4	−7.3	860.3	1.6	862.7	4.0	845.9	−12.8	858.7
1967.4	856.3	−20.1	855.8	−20.6	856.8	−19.6	861.9	−14.5	876.4
1968.1	863.1	−29.4	861.0	−31.5	861.0	−31.5	866.2	−26.3	892.5
AFE		17.2		10.6		10.6		16.5	
				Fifth Quarter of Forecast					
1966.1	789.0	14.8	782.5	8.3	783.2	9.0	782.7	8.5	774.2
1966.2	810.5	27.0	799.0	15.5	799.2	15.7	809.5	26.0	783.5
1966.3	813.5	13.1	806.4	6.0	806.8	6.4	817.4	17.0	800.4
1966.4	816.0	−0.1	815.6	−0.5	818.0	1.9	823.0	6.9	816.1
1967.1	817.5	−17.8	836.1	0.8	840.0	4.7	815.3	−20.0	835.3
1967.2	832.4	−26.3	861.5	2.8	864.2	5.5	825.8	−32.9	858.7

1967.3	850.3	−26.1	862.1	−14.3	863.3	−13.1	853.3	−23.1	876.4
1967.4	867.1	−25.4	868.1	−24.4	868.3	−24.2	871.0	−21.5	892.5
AFE		18.8		9.1		10.1		19.5	
Sixth Quarter of Forecast									
1966.1	803.4	19.9	798.1	14.6	799.1	15.6	799.5	16.0	783.5
1966.2	818.7	18.3	807.9	7.5	808.7	8.3	820.0	19.6	800.4
1966.3	826.2	10.1	819.7	3.6	820.3	4.2	832.4	16.3	816.1
1966.4	843.8	8.5	845.0	9.7	847.6	12.3	844.2	8.9	835.3
1967.1	840.4	−18.3	863.7	5.0	867.3	8.6	836.5	−22.2	858.7
1967.2	830.8	−45.6	864.2	−12.2	867.0	−9.4	831.9	−44.5	876.4
1967.3	859.5	−33.0	873.2	−19.3	875.6	−16.9	861.6	−30.9	892.5
AFE		22.0		10.3		10.8		22.6	
Forecast One Year Ahead									
1966.1	746.9	−2.9	740.1	−9.7	733.8	−16.0	741.4	−8.4	749.8
1966.2	770.6	9.6	758.1	−2.9	751.5	−9.5	766.2	5.2	761.0
1966.3	780.9	9.9	772.0	1.0	766.9	−4.1	779.0	8.0	771.0
1966.4	788.2	6.0	783.2	1.0	779.3	−2.9	789.0	6.8	782.2
1967.1	780.4	−5.6	785.1	−0.9	784.1	−1.9	783.3	−2.7	786.0
1967.2	784.9	−23.9	797.7	−11.1	797.3	−11.5	784.7	−24.1	808.8
1967.3	816.2	−11.4	819.2	−8.4	816.6	−11.0	814.9	−12.7	827.6
1967.4	838.9	−7.7	834.6	−12.0	829.4	−17.2	840.0	−6.6	846.6
1968.1	855.2	−10.5	848.9	−16.8	840.4	−25.3	854.8	−10.9	865.7
AFE		9.7		7.0		11.0		9.4	

TABLE 4.2A

Comparison of Ex Ante Forecasts, Wharton-EFU Model, Consumption

Quarter in Which Forecast Was Made	Reproduced Ex Ante Forecast		Ex Ante with AR Adjustments		Ex Ante with GG Adjustments		Ex Ante with No Adjustments		Ex Post with Actual Adjustments		Realized Preliminary Value
	Value	Error	Value	Error	Value	Error	Value	Error	Value	Error	
					First Quarter of Forecast						
1966.1	445.5	−5.2	447.2	−3.5	447.9	−2.8	443.7	−7.0	446.0	−4.7	450.7
1966.2	459.2	3.5	462.9	7.2	462.2	6.5	457.3	1.6	457.9	2.2	455.7
1966.3	470.8	2.6	467.8	−0.4	461.9	−6.3	456.2	−12.0	470.3	2.1	468.2
1966.4	475.2	2.0	471.7	−1.5	465.7	−7.5	458.7	−14.5	477.5	4.3	473.2
1967.1	483.9	3.0	481.3	0.4	475.9	−5.0	469.3	−11.6	486.0	5.1	480.9
1967.2	488.1	−3.0	485.2	−5.9	483.0	−8.1	477.3	−13.8	491.6	0.5	491.1
1967.3	497.9	1.3	490.1	−6.5	490.5	−6.1	483.5	−13.1	497.7	1.1	496.6
1967.4	*502.4	−0.3									
	502.8	0.1	504.2	1.5	503.2	0.5	494.1	−8.6	498.9	−3.8	502.7
1968.1	*514.6	−4.8									
	514.9	−4.5	513.8	−5.6	506.4	−13.0	493.3	−26.1	519.6	0.2	519.4
1968.2	526.9	−0.6	521.7	−5.8	527.1	−0.4	504.3	−23.2	527.4	−0.1	527.5
1968.3	535.4	−6.8	527.2	−15.0	530.9	−11.3	511.3	−30.9	537.5	−4.7	542.2
1968.4	548.6	1.7	535.7	−11.2	537.7	−9.2	514.5	−32.4	548.7	1.8	546.9
AFE*		*2.9									
AFE		2.9		5.4		6.4		16.2		2.6	

					Second Quarter of Forecast						
1966.1	453.4	−1.4	455.9	1.1	454.9	0.1	451.2	−3.6	454.4	−0.4	454.8
1966.2	468.2	3.2	473.2	8.2	470.3	5.3	465.8	0.8	467.3	2.3	465.0
1966.3	477.8	6.3	474.9	3.4	466.9	−4.6	463.0	−8.5	478.6	7.1	471.5
1966.4	480.4	0.8	477.0	−2.6	468.2	−11.4	464.3	−15.3	482.3	2.7	479.6
1967.1	489.3	−0.5	488.3	−1.5	480.5	−9.3	476.3	−13.5	490.8	1.0	489.8
1967.2	496.5	−0.5	490.1	−6.9	487.1	−9.9	483.7	−13.3	500.6	3.6	497.0
1967.3	505.5	2.0	496.6	−6.9	497.0	−6.5	492.1	−11.4	499.3	−4.2	503.5
1967.4	*506.9	−13.8									
	518.7	−2.0	513.3	−7.4	511.4	−9.3	504.6	−16.1	521.4	0.7	520.7
1968.1	*519.7	−9.4									
	525.3	−3.8	522.9	−6.2	512.4	−16.7	503.2	−25.9	530.6	1.5	529.1
1968.2	530.6	−11.5	520.1	−22.0	520.0	−22.1	505.0	−37.1	530.6	−11.5	542.1
1968.3	540.0	−7.8	529.5	−18.3	528.6	−19.2	516.3	−31.5	542.6	−5.2	547.8
AFE*		5.2									
AFE		3.6		7.7		10.4		16.1		3.7	
					Third Quarter of Forecast						
1966.1	461.8	−2.3	463.6	−0.5	461.3	−2.8	459.4	−4.6	463.3	−0.8	464.1
1966.2	477.2	8.9	481.7	13.4	477.3	9.0	474.5	6.2	478.1	9.8	468.3
1966.3	483.5	5.6	481.1	3.2	473.1	−4.8	471.4	−6.5	485.4	7.5	477.9
1966.4	486.9	−1.6	483.8	−4.7	474.9	−13.6	474.2	−14.3	488.2	−0.3	488.5
1967.1	491.7	−4.0	491.7	−4.0	484.5	−11.2	483.3	−12.4	494.2	−1.5	495.7
1967.2	502.6	−1.3	495.2	−8.7	493.0	−10.9	492.1	−11.8	504.2	0.3	503.9
1967.3	509.2	−12.3	500.1	−21.4	501.2	−20.3	499.2	−22.3	514.2	−7.2	521.5

(continued)

TABLE 4.2A (*continued*)

Quarter in Which Forecast Was Made	Reproduced Ex Ante Forecast		Ex Ante with AR Adjustments		Ex Ante with GG Adjustments		Ex Ante with No Adjustments		Ex Post with Actual Adjustments		Realized Prelimi-nary Value
	Value	Error	Value	Error	Value	Error	Value	Error	Value	Error	
	Third Quarter of Forecast (continued)										
1967.4	*526.3	−3.1									
	530.8	0.4	520.9	−9.5	519.5	−10.9	516.1	−14.3	535.2	4.8	530.4
1968.1	*525.8	−17.9									
	532.3	−11.4	528.3	−15.4	518.2	−25.5	514.1	−29.6	528.0	−15.7	543.7
	537.6	−10.1	523.3	−24.4	520.6	−27.1	514.7	−33.0	538.3	−9.4	547.7
AFE		5.8		10.5		13.6		15.5		5.7	
	Fourth Quarter of Forecast										
1966.1	470.0	2.6	471.6	4.2	469.1	1.7	467.7	0.3	473.4	6.0	467.4
1966.2	485.3	10.6	491.6	16.9	486.4	11.7	484.2	9.5	489.0	14.3	474.7
1966.3	490.1	3.3	487.1	0.3	479.2	−7.6	478.4	−8.4	493.1	6.3	486.8
1966.4	490.8	−3.6	488.6	−5.8	480.1	−14.3	480.2	−14.2	493.7	−0.7	494.4
1967.1	496.8	−5.8	496.3	−6.3	490.5	−12.1	490.7	−11.9	496.3	−6.3	502.6
1967.2	514.7	−7.2	504.8	−17.1	504.3	−17.6	504.2	−17.7	523.5	1.6	521.9
1967.3	517.7	−13.5	507.3	−23.9	509.9	−21.3	508.6	−22.6	526.1	−5.1	531.2
1967.4	*529.3	−15.7									
	534.9	−10.1	522.7	−22.3	522.3	−22.7	520.4	−24.6	532.5	−12.5	545.0

1968.1	*532.2	−17.1									
	538.7	−10.6	532.9	−16.4	523.9	−25.4	521.2	−28.1	533.5	−15.8	549.3
AFE*		8.8									
AFE		7.5		12.6		14.9		15.3		7.6	
					Fifth Quarter of Forecast						
1966.1	474.3	0.5	475.9	2.1	473.3	−0.5	473.1	−0.7	482.3	8.5	473.8
1966.2	490.6	7.0	494.4	10.8	489.0	5.4	488.6	5.0	496.6	13.0	483.6
1966.3	496.6	3.9	493.3	0.6	485.4	−7.3	484.5	−8.2	500.9	8.2	492.7
1966.4	499.1	−2.2	496.0	−5.3	488.3	−13.0	488.6	−12.7	499.7	−1.6	501.3
1967.1	509.7	−10.9	504.8	−15.8	501.1	−19.5	501.5	−19.1	515.3	−5.3	520.6
1967.2	520.0	−11.6	510.1	−21.5	510.8	−20.8	510.2	−21.4	534.2	2.6	531.6
1967.3	525.6	−20.2	511.7	−34.1	515.3	−30.5	514.0	−31.8	526.5	−19.3	545.8
1967.4	*534.0	−16.6									
	542.6	−8.0	530.6	−20.0	531.4	−19.2	529.9	−20.7	539.7	−10.9	550.6
AFE		8.0		13.8		14.5		15.0		8.7	
					Sixth Quarter of Forecast						
1966.1	481.3	−1.4	482.9	0.2	480.5	−2.2	480.2	−2.5	490.9	8.2	482.7
1966.2	495.3	5.8	498.1	8.6	493.2	3.7	493.0	3.5	530.6	14.1	489.5
1966.3	502.1	2.5	498.5	−1.1	491.6	−8.0	491.7	−7.9	505.1	5.5	499.6
1966.4	508.7	−10.6	505.5	−13.8	499.0	−20.3	500.0	−19.3	514.6	−4.7	519.3
1967.1	518.3	−12.0	513.0	−17.3	511.1	−19.2	512.5	−17.8	526.8	−3.5	530.3
1967.2	522.1	−24.1	512.7	−33.5	514.6	−31.6	514.7	−31.5	531.1	−15.1	546.2
1967.3	533.3	−18.1	519.6	−31.8	524.2	−27.2	523.6	−27.8	532.4	−19.0	551.4
AFE		10.6		15.2		16.0		15.8		10.0	

(continued)

TABLE 4.2A (*concluded*)

Quarter in Which Forecast Was Made	Reproduced Ex Ante Forecast		Ex Ante with AR Adjustments		Ex Ante with GG Adjustments		Ex Ante with No Adjustments		Ex Post with Actual Adjustments		Realized Prelimi-nary Value
	Value	Error	Value	Error	Value	Error	Value	Error	Value	Error	
					Forecast One Year Ahead						
1966.1	457.6	−1.6	459.5	0.3	458.3	−0.9	455.5	−3.7	464.2	5.0	459.2
1966.2	472.4	6.5	477.3	11.4	474.0	8.1	470.4	4.5	473.0	7.1	465.9
1966.3	480.5	4.4	467.8	−8.3	461.9	−14.2	467.2	−8.9	481.1	5.0	476.1
1966.4	483.3	−0.6	480.2	−3.7	472.2	−11.7	469.3	−14.6	485.4	1.5	483.9
1967.1	490.4	−1.8	489.4	−2.8	482.8	−9.4	479.9	−12.3	491.8	−0.4	492.2
1967.2	500.4	−3.0	493.8	−9.6	491.8	−11.6	489.3	−14.1	504.9	1.5	503.4
1967.3	507.5	−5.7	498.5	−14.7	499.6	−13.6	495.8	−17.4	509.3	−3.9	513.2
1967.4	*516.2	−8.5									
	521.8	−2.9	515.2	−9.5	514.1	−10.6	508.8	−15.9	522.0	−2.7	524.7
1968.1	*523.0	−12.3									
	527.8	−7.5	524.5	−10.9	515.2	−20.2	507.9	−27.4	527.9	−7.5	535.3
		*4.9									
AFE		3.7		7.9		11.1		13.2		3.8	

TABLE 4.2P

Comparison of Ex Post Forecasts, Wharton Model, Consumption

Quarter in Which Forecast Was Made	Ex Post with AR Adjustments		Ex Post with GG Adjustments		Ex Post with No Adjustments		Ex Post ROS with AR Adjustments		Realized Revised Value
	Value	Error	Value	Error	Value	Error	Value	Error	
				First Quarter of Forecast					
1966.1	452.2	−5.6	450.1	−7.7	444.6	−13.2	448.7	−9.1	457.8
1966.2	464.7	2.8	459.4	−2.5	453.3	−8.6	461.4	−0.5	461.9
1966.3	470.6	−0.6	466.5	−4.7	461.3	−9.9	468.4	−2.8	471.2
1966.4	478.2	3.7	475.9	1.4	470.0	−4.5	477.1	2.6	474.5
1967.1	478.0	−2.9	478.4	−2.5	473.9	−7.0	479.1	−1.8	480.9
1967.2	480.2	−9.6	483.6	−6.2	478.7	−11.1	480.7	−9.1	489.8
1967.3	492.9	−2.8	492.2	−3.5	485.4	−10.3	492.7	−3.0	495.7
1967.4	498.4	−4.2	495.4	−7.2	487.5	−15.1	501.5	−1.1	502.6
1968.1	518.2	−2.4	514.5	−6.1	504.5	−16.1	516.6	−4.0	520.6
1968.2	533.3	3.0	526.9	−3.4	515.4	−14.9	531.4	1.0	530.3
1968.3	530.5	−14.4	524.1	−20.8	514.3	−30.6	530.6	−14.3	544.9
1968.4	544.3	−6.4	534.2	−16.5	522.3	−28.4	544.7	−6.0	550.7
AFE		4.9		6.9		14.1		4.6	

(*continued*)

TABLE 4.2P (*continued*)

Quarter in Which Forecast Was Made	Ex Post with AR Adjustments		Ex Post with GG Adjustments		Ex Post with No Adjustments		Ex Post ROS with AR Adjustments		Realized Revised Value
	Value	Error	Value	Error	Value	Error	Value	Error	
				Second Quarter of Forecast					
1966.1	459.3	−2.6	455.6	−6.3	451.7	−10.2	454.7	−7.2	461.9
1966.2	472.2	1.0	464.7	−6.5	460.7	−10.5	460.4	−2.8	471.2
1966.3	480.0	5.5	474.4	−0.1	470.9	−3.6	477.8	3.3	474.5
1966.4	485.1	4.2	481.3	0.4	477.5	−3.4	485.2	4.3	480.9
1967.1	482.0	−7.8	483.3	−6.5	480.6	−9.2	483.4	−6.4	489.8
1967.2	483.7	−12.0	489.1	−6.6	486.2	−9.5	483.8	−11.9	495.7
1967.3	494.5	−8.1	493.8	−8.8	489.5	−13.1	497.0	−5.6	502.6
1967.4	516.4	−4.2	511.8	−8.8	506.4	−14.2	516.1	−4.5	520.6
1968.1	528.4	−1.9	522.9	−7.4	515.9	−14.4	527.8	−2.5	530.3
1968.2	529.9	−15.0	521.7	−23.2	514.1	−30.8	529.7	−15.2	544.9
1968.3	536.0	−14.7	528.5	−22.2	522.5	−28.4	535.4	−15.3	550.7
AFE		7.0		8.8		13.4		7.2	
				Third Quarter of Forecast					
1966.1	467.7	−3.5	464.0	−7.2	462.5	−8.7	462.2	−9.0	471.2
1966.2	481.2	6.7	473.9	−0.6	472.5	−2.0	477.9	3.4	474.5
1966.3	487.0	6.1	482.0	1.1	480.8	−0.1	486.5	5.6	480.9
1966.4	490.0	10.2	486.8	−3.0	485.8	−4.0	492.1	2.3	489.8

1967.1	485.1	−10.6	488.7	−7.0	488.6	−7.1	486.7	−9.0	495.7
1967.2	485.2	−17.4	493.2	−9.4	492.8	−9.8	487.0	−15.6	502.6
1967.3	512.4	−8.2	512.5	−8.1	511.2	−9.4	511.1	−9.5	520.6
1967.4	528.2	−2.1	524.4	−5.9	522.2	−8.1	528.6	−1.7	530.3
1968.1	524.6	−20.3	520.4	−24.5	517.7	−27.2	526.2	−18.7	544.9
1968.2	534.4	−16.4	527.9	−22.8	525.3	−25.4	534.4	−16.3	550.7
AFE		9.2		9.0		10.2		9.1	
				Fourth Quarter of Forecast					
1966.1	477.0	2.5	473.4	−1.0	472.5	−2.0	471.7	−2.8	474.5
1966.2	488.5	7.6	481.5	0.6	481.0	0.1	486.4	5.5	480.9
1966.3	492.7	2.9	488.4	−1.4	488.0	−1.8	494.2	4.4	489.8
1966.4	495.5	−0.2	493.3	−2.4	493.4	−2.3	498.4	2.7	495.7
1967.1	487.0	−15.6	493.8	−8.8	494.8	−7.8	490.7	−11.9	502.6
1967.2	501.8	−18.8	513.3	−7.3	513.7	−6.9	499.9	−20.7	520.6
1967.3	524.7	−5.6	526.7	−3.6	526.4	−3.9	523.7	−6.6	530.3
1967.4	524.8	−20.1	522.7	−22.2	522.0	−22.9	527.8	−17.1	544.9
1968.1	529.7	−21.0	527.7	−23.0	526.9	−23.8	531.2	−19.5	550.7
AFE		10.5		7.8		7.9		10.1	
				Fifth Quarter of Forecast					
1966.1	482.6	1.7	480.0	−0.9	479.6	−1.3	478.6	−2.3	480.9
1966.2	495.4	5.6	488.6	−1.2	488.0	−1.8	494.4	−4.6	489.8
1966.3	499.3	3.6	494.8	−0.9	494.0	−1.7	501.2	5.5	495.7
1966.4	500.9	−1.7	499.3	−3.3	499.2	−3.4	505.8	3.2	502.6

(continued)

TABLE 4.2P (*concluded*)

Quarter in Which Forecast Was Made	Ex Post with AR Adjustments		Ex Post with GG Adjustments		Ex Post with No Adjustments		Ex Post ROS with AR Adjustments		Realized Revised Value
	Value	Error	Value	Error	Value	Error	Value	Error	
				Fifth Quarter of Forecast (continued)					
1967.1	502.7	−17.9	512.2	−8.4	512.6	−8.0	502.8	−17.8	520.6
1967.2	511.3	−19.0	525.5	−4.8	524.7	−5.6	509.7	−20.0	530.3
1967.3	522.4	−22.5	524.8	−20.1	523.2	−21.7	524.0	−20.9	544.9
1967.4	533.4	−17.3	530.9	−19.8	528.9	−21.8	536.0	−14.7	550.7
AFE		11.2		7.4		8.2		11.2	
				Sixth Quarter of Forecast					
1966.1	489.8	0.0	487.7	−2.1	487.9	−1.9	486.8	−3.0	489.8
1966.2	500.7	5.0	494.1	−1.6	494.4	−1.3	500.0	4.3	495.7
1966.3	504.7	2.1	500.4	−2.2	500.5	−2.1	508.5	5.9	502.6
1966.4	516.6	−4.0	515.5	−5.1	516.3	−4.3	518.0	−2.6	520.6

1967.1	513.1	−17.2	525.1	−5.2	526.0	−4.3	513.3	−17.0	530.3
1967.2	508.8	−36.1	525.1	−19.8	525.4	−19.5	509.3	−35.6	544.9
1967.3	529.9	−20.8	532.9	−17.8	533.0	−17.7	531.2	−19.5	550.7
AFE		12.2		7.7		7.3		12.6	
Forecast One Year Ahead									
1966.1	464.0	−2.3	460.7	−5.6	457.8	−8.5	459.3	−7.0	466.3
1966.2	476.6	4.5	469.8	−2.3	466.8	−5.3	471.5	−0.6	472.1
1966.3	482.5	3.4	477.8	−1.3	475.2	−3.9	481.7	2.6	479.1
1966.4	487.2	2.0	484.3	−0.9	481.6	−3.6	488.2	3.0	485.2
1967.1	483.0	−9.2	486.0	−6.2	484.4	−7.8	484.9	−7.3	492.2
1967.2	487.7	−14.4	494.8	−7.3	492.8	−9.3	487.8	−14.3	502.1
1967.3	506.1	−6.2	506.3	−6.0	503.1	−9.2	506.1	−6.2	512.3
1967.4	516.9	−7.7	513.5	−11.1	509.5	−15.1	518.5	−6.1	524.6
1968.1	525.2	−11.4	521.3	−15.3	516.2	−20.4	525.4	−11.2	536.6
AFE		6.7		6.2		9.2		6.4	

TABLE 4.3A

Comparison of Ex Ante Forecasts, Wharton-EFU Model, Investment

Quarter in Which Forecast Was Made	Reproduced Ex Ante Forecast Value	Reproduced Ex Ante Forecast Error	Ex Ante with AR Adjustments Value	Ex Ante with AR Adjustments Error	Ex Ante with GG Adjustments Value	Ex Ante with GG Adjustments Error	Ex Ante with No Adjustments Value	Ex Ante with No Adjustments Error	Ex Post with Actual Adjustments Value	Ex Post with Actual Adjustments Error	Realized Preliminary Value
					First Quarter of Forecast						
1966.1	109.5	−2.2	116.3	4.6	117.8	6.1	108.9	−2.8	109.9	−1.8	111.7
1966.2	114.9	0.0	122.8	−7.9	124.0	9.1	114.4	−0.5	114.5	−0.4	114.9
1966.3	117.9	3.2	116.5	1.8	113.0	−1.7	107.8	−6.9	117.3	2.6	114.7
1966.4	118.0	−3.6	114.4	−7.2	110.2	−11.4	104.2	−17.5	119.1	−2.5	121.6
1967.1	113.9	8.5	110.7	5.3	107.2	1.8	104.9	−0.5	114.7	9.1	105.4
1967.2	109.7	4.9	107.1	2.3	105.1	0.3	103.2	−1.6	111.7	6.9	104.8
1967.3	112.1	−0.7	110.9	−1.9	109.1	−3.7	107.1	−5.7	112.0	−0.8	112.8
1967.4	*113.6	−2.6									
	114.7	−1.5	116.8	0.6	113.7	−2.5	108.0	−8.2	114.3	−1.9	116.2
1968.1	*125.7	8.9									
	125.8	9.0	121.8	5.0	115.6	−1.2	106.9	−9.9	128.0	11.2	116.8
1968.2	126.3	−0.3	125.4	−1.2	128.3	1.7	107.9	−18.7	127.0	0.4	126.6
1968.3	122.7	−2.5	123.3	−1.9	125.4	0.2	107.1	−18.1	125.2	0	125.2
1968.4	128.2	−5.7	121.9	−12.0	123.6	−10.3	106.0	−27.9	127.8	−6.1	133.9
AFE*		3.2									
AFE		3.5		4.3		4.5		9.9		3.6	

					Second Quarter of Forecast						
1966.1	111.0	−5.6	120.7	4.1	119.4	2.8	109.6	−7.0	112.4	−4.2	116.6
1966.2	115.9	3.8	128.0	15.9	126.1	14.0	114.5	2.4	116.0	3.9	112.1
1966.3	120.6	−0.7	119.0	−2.3	111.7	−9.6	105.5	−15.8	121.5	0.2	121.3
1966.4	115.9	6.9	112.3	3.3	103.2	−5.8	97.0	−12.0	117.2	8.2	109.0
1967.1	113.9	12.7	113.1	11.9	105.1	3.9	101.4	0.2	116.9	15.7	101.2
1967.2	117.1	4.0	108.0	−5.1	104.8	−8.3	102.7	−10.4	120.8	7.7	113.1
1967.3	118.4	0.0	109.2	−9.2	108.8	−9.6	105.8	−12.6	116.2	−2.2	118.4
1967.4	*116.1	3.8									
	122.5	10.2	122.7	10.4	118.1	5.8	111.5	−0.8	120.8	8.5	112.3
1968.1	*126.6	2.6									
	128.5	4.5	124.6	0.6	113.0	−11.0	102.7	−21.3	132.9	8.9	124.0
1968.2	126.3	1.1	123.1	−2.1	121.6	−3.6	100.6	−24.6	125.2	0.0	125.2
1968.3	126.5	−7.4	120.9	−13.0	119.2	−14.7	101.2	−32.7	129.1	−4.8	133.9
AFE*		4.4									
AFE		5.2		7.1		8.1		12.7		5.8	
					Third Quarter of Forecast						
1966.1	112.3	−1.5	120.2	6.4	115.7	1.9	111.1	−2.7	114.9	1.1	113.8
1966.2	117.9	−0.8	128.5	9.8	123.1	4.4	116.5	−2.2	120.6	1.9	118.7
1966.3	120.3	11.6	120.6	11.9	113.9	5.2	111.6	2.9	123.1	14.4	108.7
1966.4	115.1	10.3	114.2	9.4	105.5	0.7	104.9	0.1	117.4	12.6	104.8
1967.1	118.8	9.1	108.7	−1.0	107.2	−2.5	108.8	−0.9	121.1	11.4	109.7
1967.2	117.8	−0.8	109.3	−9.3	111.2	−7.4	112.3	−6.3	117.4	−1.2	118.6
1967.3	117.8	3.3	109.3	−5.2	111.2	−3.3	112.3	−2.2	117.4	2.9	114.5

(continued)

TABLE 4.3A (*continued*)

Quarter in Which Forecast Was Made	Reproduced Ex Ante Forecast		Ex Ante with AR Adjustments		Ex Ante with GG Adjustments		Ex Ante with No Adjustments		Ex Post with Actual Adjustments		Realized Preliminary Value
	Value	Error	Value	Error	Value	Error	Value	Error	Value	Error	
					Third Quarter of Forecast (continued)						
1967.4	*123.9	4.4									
	127.4	7.9	121.7	2.2	118.1	−1.4	116.7	−2.8	131.5	12.0	119.5
1968.1	*123.0	−0.4									
	126.9	4.3	122.9	0.3	113.5	−9.1	111.2	−11.4	126.4	3.8	122.6
1968.2	122.2	−11.7	118.1	−15.8	111.2	−22.7	105.5	−28.4	122.2	11.7	133.9
AFE*		5.4									
AFE		6.1		7.1		5.9		6.0		7.3	
					Fourth Quarter of Forecast						
1966.1	112.9	−7.5	120.8	0.4	114.9	−5.5	111.7	−8.7	117.4	−3.0	120.4
1966.2	120.2	14.1	131.1	25.0	123.8	17.7	119.4	13.3	124.5	18.4	106.1
1966.3	120.8	16.3	120.5	16.0	114.2	9.7	113.0	8.5	126.5	22.0	104.5
1966.4	116.2	3.1	117.3	4.2	109.2	−3.9	109.5	−3.6	118.1	5.0	113.1
1967.1	110.1	−5.0	113.2	−1.9	107.8	−7.3	109.7	−5.4	112.7	−2.4	115.1
1967.2	112.7	−2.1	110.8	−4.0	112.1	−2.7	114.1	−0.7	126.7	11.9	114.8
1967.3	118.5	−3.2	108.9	−12.8	113.2	−8.5	114.7	−7.0	125.3	3.6	121.7
1967.4	*123.2	5.1									
	122.5	4.4	118.2	0.1	115.7	−2.4	115.8	−2.3	122.9	4.8	118.1

1968.1	*121.0	−10.3									
	124.0	−7.3	121.0	−10.3	113.0	18.3	112.7	−18.6	120.7	−10.6	131.3
AFE*		7.4									
AFE		7.0		8.3		8.4		7.6		9.1	
Fifth Quarter of Forecast											
1966.1	112.9	5.1	118.8	11.0	111.5	3.7	112.8	5.0	119.8	12.0	107.8
1966.2	119.5	17.6	127.3	25.4	118.6	16.7	119.9	18.0	127.4	25.5	101.9
1966.3	122.3	9.5	122.1	9.3	116.6	3.8	116.1	3.3	129.0	16.2	112.8
1966.4	116.7	−2.0	118.8	0.1	112.3	−6.4	113.5	−5.2	118.8	0.1	118.7
1967.1	115.7	4.5	115.6	4.4	113.0	1.8	115.5	4.3	118.0	6.8	111.2
1967.2	124.7	2.7	112.6	−9.4	116.4	−5.6	118.3	−3.7	134.9	12.9	122.0
1967.3	120.8	0.5	110.6	−9.7	116.5	−3.8	118.2	−2.1	120.3	0.0	120.3
1967.4	*117.2	−9.6									
	121.0	−5.8	118.1	−8.7	116.8	−10.0	117.9	−8.9	119.3	−7.5	126.8
		*6.4									
AFE		6.0		9.8		6.5		6.3		10.1	
Sixth Quarter of Forecast											
1966.1	112.3	8.7	118.5	14.9	111.9	8.3	112.8	9.2	127.7	24.1	103.6
1966.2	118.4	8.2	124.7	14.5	117.1	6.9	118.4	8.2	128.1	17.9	110.2
1966.3	122.1	3.7	121.4	3.0	116.5	−1.9	116.1	−2.3	130.3	11.9	118.4
1966.4	120.4	5.6	121.5	6.7	116.0	1.2	116.8	2.0	123.9	9.1	114.8
1967.1	120.6	2.2	118.4	0.0	117.5	−0.9	119.6	1.2	128.5	10.1	118.4
1967.2	121.5	0.9	110.6	−10.0	115.9	−4.7	117.1	−3.5	127.5	6.9	120.6
1967.3	121.8	−7.2	111.4	−17.6	118.5	−10.5	119.6	−9.4	118.4	−10.6	129.0
AFE		5.2		9.5		4.9		5.1		12.9	

(continued)

TABLE 4.3A (*concluded*)

Quarter in Which Forecast Was Made	Reproduced Ex Ante Forecast Value	Reproduced Ex Ante Forecast Error	Ex Ante with AR Adjustments Value	Ex Ante with AR Adjustments Error	Ex Ante with GG Adjustments Value	Ex Ante with GG Adjustments Error	Ex Ante with No Adjustments Value	Ex Ante with No Adjustments Error	Ex Post with Actual Adjustments Value	Ex Post with Actual Adjustments Error	Realized Preliminary Value
					Forecast One Year Ahead						
1966.1	111.4	−4.2	119.5	3.9	116.9	1.3	110.3	−5.3	113.6	−2.0	115.6
1966.2	117.2	4.3	127.6	14.7	124.2	11.3	116.2	3.3	118.9	6.0	112.9
1966.3	119.9	7.6	119.2	6.9	113.2	0.9	109.4	−2.9	122.1	9.8	112.3
1966.4	116.3	4.2	114.5	2.4	107.0	−5.1	103.9	−8.2	117.9	5.8	112.1
1967.1	114.1	6.1	111.4	3.4	106.8	−1.2	106.2	−1.8	116.3	8.3	108.0
1967.2	114.3	1.5	108.8	−4.0	108.3	−4.5	108.0	−4.8	119.1	6.3	112.8
1967.3	116.7	−0.2	109.5	−7.4	110.5	−6.4	111.0	−5.9	117.7	0.8	116.9
1967.4	*119.2	2.7									
	121.7	5.2	119.8	3.3	116.4	−0.1	111.6	−4.9	122.3	5.8	116.5
1968.1	*124.0	0.4									
	126.3	2.7	122.6	−1.1	113.8	−9.9	106.9	−16.7	127.0	3.3	123.6
		3.5									
AFE		4.0		5.2		4.5		6.0		5.0	

TABLE 4.3P

Comparison of Ex Post Forecasts, Wharton Model, Investment

Quarter in Which Forecast Was Made	Ex Post with AR Adjustments		Ex Post with GG Adjustments		Ex Post with No Adjustments		Ex Post ROS with AR Adjustments		Realized Revised Value
	Value	Error	Value	Error	Value	Error	Value	Error	
				First Quarter of Forecast					
1966.1	116.6	−0.9	112.1	−5.4	105.1	−12.4	116.8	−0.7	117.5
1966.2	121.9	−0.5	115.9	−6.5	108.4	−14.0	121.4	−1.0	122.4
1966.3	118.4	−1.2	113.2	−6.4	106.9	−12.7	118.5	−1.1	119.6
1966.4	119.8	−6.4	115.4	−10.8	109.9	−16.3	119.3	−6.9	126.2
1967.1	112.1	−1.5	108.2	−5.4	105.2	−8.4	114.0	0.4	113.6
1967.2	106.2	−3.2	104.3	−5.1	102.7	−6.7	107.7	−1.7	109.4
1967.3	111.6	−6.1	108.8	−8.9	106.5	−11.2	111.7	−6.0	117.7
1967.4	113.9	−9.4	110.2	−13.1	106.1	−17.2	115.8	−7.5	123.3
1968.1	123.1	3.7	117.8	−1.6	110.2	−9.2	120.9	1.5	119.4
1968.2	129.2	2.6	121.5	−5.1	111.2	−15.4	126.3	−0.3	126.6
1968.3	122.2	−3.0	114.7	−10.5	105.5	−19.7	125.2	0.0	125.2
1968.4	124.7	−9.2	117.1	−16.8	108.0	−25.9	127.0	−6.9	133.9
AFE		4.0		8.0		14.1		2.8	

(*continued*)

TABLE 4.3P (*continued*)

Quarter in Which Forecast Was Made	Ex Post with AR Adjustments Value	Ex Post with AR Adjustments Error	Ex Post with GG Adjustments Value	Ex Post with GG Adjustments Error	Ex Post with No Adjustments Value	Ex Post with No Adjustments Error	Ex Post ROS with AR Adjustments Value	Ex Post ROS with AR Adjustments Error	Realized Revised Value
				Second Quarter of Forecast					
1966.1	118.4	–4.0	110.3	–12.1	103.7	–18.7	116.5	–5.9	122.4
1966.2	123.1	3.5	112.5	–7.1	105.2	–14.4	121.5	1.9	119.6
1966.3	122.4	–3.8	113.1	–13.1	107.0	–19.2	120.2	–6.0	126.2
1966.4	121.2	7.6	113.2	–0.4	107.9	–5.7	119.7	6.1	113.6
1967.1	113.4	4.0	108.3	–1.1	105.4	–4.0	114.2	4.8	109.4
1967.2	105.4	–12.3	105.3	–12.4	103.8	–13.9	106.4	–11.3	117.7
1967.3	109.4	–13.9	106.7	–16.6	103.7	–19.6	111.3	–12.0	123.3
1967.4	118.6	–0.8	111.9	–7.5	106.5	–12.9	117.1	–2.3	119.4
1968.1	127.6	1.0	118.1	–8.5	109.1	–17.5	124.5	–2.1	126.6
1968.2	125.7	0.5	113.3	–11.9	102.6	–22.6	127.3	2.1	125.2
1968.3	121.1	–12.8	111.1	–23.8	100.9	–33.0	122.4	–11.5	133.9
AFE		5.8		10.4		16.5		6.0	
				Third Quarter of Forecast					
1966.1	120.1	0.5	111.7	–7.9	109.9	–9.7	117.5	–2.1	119.6
1966.2	125.3	–0.9	114.9	–11.3	112.5	–13.7	123.2	–3.0	126.2
1966.3	124.2	10.6	115.1	1.5	113.3	–0.3	122.3	8.7	113.6
1966.4	122.7	13.3	115.0	5.6	114.5	5.1	123.1	13.7	113.6

1967.1	112.6	−5.1	109.6	−8.1	110.8	−6.9	113.8	−3.9	117.7
1967.2	104.7	−18.6	107.5	−15.8	109.8	−13.5	105.9	−17.4	123.3
1967.3	113.6	−5.8	113.1	−6.3	114.5	−4.9	111.7	−7.7	119.4
1967.4	126.0	−0.6	120.9	−5.8	120.3	−6.3	122.5	−4.1	126.6
1968.1	122.1	−3.1	114.4	−10.8	112.2	−13.0	125.2	0.0	125.2
1968.2	121.2	−12.7	111.3	−22.6	108.5	−25.4	123.6	−10.3	133.9
AFE		7.1		9.6		9.9		7.1	
Fourth Quarter of Forecast									
1966.1	123.4	−2.8	114.6	−11.6	113.9	−12.3	120.0	−6.2	126.2
1966.2	127.1	13.5	116.6	3.0	115.7	2.1	125.4	11.8	113.6
1966.3	126.7	17.3	117.7	8.3	117.2	7.8	127.2	17.8	109.4
1966.4	123.4	5.7	116.3	−1.4	117.3	−0.4	125.6	7.9	117.7
1967.1	112.6	−10.7	112.0	−11.3	114.5	−8.8	114.8	−8.5	123.3
1967.2	108.8	−10.6	115.1	−4.3	118.2	−1.2	106.3	−13.1	119.4
1967.3	122.1	−4.5	124.0	−2.6	126.3	−0.3	117.9	−8.7	126.6
1967.4	119.6	−5.6	116.2	−8.9	117.4	−7.8	123.5	−1.7	125.2
1968.1	118.6	−15.3	112.5	−21.4	112.6	−21.3	121.4	−12.5	133.9
AFE		9.6		8.1		6.9		9.8	
Fifth Quarter of Forecast									
1966.1	124.3	10.7	116.5	2.9	117.2	3.6	122.2	8.6	113.6
1966.2	130.1	20.7	120.2	10.8	120.6	11.2	130.1	20.7	109.4
1966.3	127.8	10.1	119.3	1.6	119.8	2.1	130.0	12.2	117.7
1966.4	124.3	1.0	118.5	−4.8	120.4	−2.9	127.2	3.9	123.3

(continued)

TABLE 4.3P (*concluded*)

Quarter in Which Forecast Was Made	Ex Post with AR Adjustments		Ex Post with GG Adjustments		Ex Post with No Adjustments		Ex Post ROS with AR Adjustments		Realized Revised Value
	Value	Error	Value	Error	Value	Error	Value	Error	
				Fifth Quarter of Forecast (continued)					
1967.1	116.2	−3.2	118.3	−1.1	121.1	1.7	115.1	−4.3	119.4
1967.2	116.6	−10.0	125.8	−0.8	128.6	2.0	112.4	−14.2	126.6
1967.3	116.1	−9.1	120.0	−5.2	122.3	−2.9	118.8	−6.4	125.2
1967.4	117.9	−16.0	115.7	−18.2	117.3	−16.6	120.5	−13.4	133.9
AFE		10.1		5.7		5.4		10.5	
				Sixth Quarter of Forecast					
1966.1	126.9	14.4	119.5	10.1	120.1	10.7	126.2	16.8	109.4
1966.2	130.9	13.2	121.0	3.3	121.2	3.5	132.6	15.0	117.7
1966.3	129.3	6.0	120.7	−2.6	120.8	−2.5	132.2	8.9	123.3
1966.4	128.9	9.5	123.6	4.2	124.9	5.5	128.9	9.5	119.4

1967.1	124.5	−2.1	128.1	1.5	130.1	3.5	121.4	−5.2	126.6
1967.2	110.5	−14.7	121.5	−3.7	123.6	−1.6	112.8	−12.4	125.2
1967.3	113.9	−20.0	118.6	−15.3	120.5	−13.4	115.9	−18.0	133.9
AFE		11.4		5.8		5.8		12.3	
Forecast One Year Ahead									
1966.1	119.6	−1.8	112.1	−9.3	108.1	−13.3	117.7	−3.7	121.4
1966.2	124.3	3.9	114.9	−5.5	110.4	−10.0	122.8	2.4	120.4
1966.3	122.9	5.7	114.7	−2.5	111.1	−6.1	122.0	4.8	117.2
1966.4	121.7	4.0	114.9	−2.8	112.4	−5.3	121.9	4.2	117.7
1967.1	112.6	−3.4	109.5	−6.5	108.9	−7.1	114.2	−1.8	116.0
1967.2	106.2	−11.2	108.0	−9.4	108.6	−8.8	106.5	−10.9	117.4
1967.3	114.1	−7.6	113.1	−8.6	112.7	−9.0	113.1	−8.6	121.7
1967.4	119.5	−4.1	114.8	−8.8	112.5	−11.1	119.7	−3.9	123.6
1968.1	122.8	−3.4	115.7	−10.5	111.0	−15.2	123.0	−3.2	126.2
AFE		5.0		7.1		9.5		4.8	

TABLE 4.4A

Comparison of Ex Ante Forecasts, Wharton-EFU Model, GNP in Constant Dollars

Quarter in Which Forecast Was Made	Reproduced Ex Ante Forecast Value	Reproduced Ex Ante Forecast Error	Ex Ante with AR Adjustments Value	Ex Ante with AR Adjustments Error	Ex Ante with GG Adjustments Value	Ex Ante with GG Adjustments Error	Ex Ante with No Adjustments Value	Ex Ante with No Adjustments Error	Ex Post with Actual Adjustments Value	Ex Post with Actual Adjustments Error	Realized Preliminary Value
					First Quarter of Forecast						
1966.1	630.9	−6.0	636.4	−0.5	637.9	1.0	629.1	−7.8	632.6	−4.3	636.9
1966.2	639.6	0.8	648.7	9.9	649.2	10.4	637.8	−1.0	639.7	0.9	638.8
1966.3	653.0	3.6	649.8	0.4	643.6	−5.8	636.0	−13.4	654.7	5.3	649.4
1966.4	655.2	−2.0	650.6	−6.6	644.6	−12.6	635.6	−21.6	659.7	2.5	657.2
1967.1	659.9	−4.5	657.7	2.3	652.2	−3.2	646.0	−9.4	666.9	11.5	655.4
1967.2	662.3	1.1	659.3	−1.9	657.8	−3.4	652.9	−8.3	666.4	5.2	661.2
1967.3	678.3	6.2	671.4	−0.7	672.4	0.3	666.0	−6.1	673.7	1.6	672.1
1967.4	*678.0	0.9									
	677.9	0.8	683.2	6.1	682.0	4.9	671.1	−6.0	673.1	−4.0	677.1
1968.1	*690.0	0.8									
	690.3	1.1	690.4	1.2	680.3	−8.9	663.3	−25.9	699.7	10.5	689.2
1968.2	699.8	−2.4	696.7	−5.5	704.4	2.2	675.8	−26.4	700.9	−1.3	702.2
1968.3	702.8	−6.5	701.1	−8.2	706.9	−2.4	682.3	−27.0	705.1	−4.2	709.3
1968.4	716.9	−0.8	705.2	−12.5	708.7	−9.0	681.2	−36.5	715.3	−2.4	717.7
AFE*		3.0									
AFE		3.0		4.7		5.3		15.8		4.5	

					Second Quarter of Forecast					
1966.1	638.6	−4.2	645.9	3.1	644.4	1.6	636.1	−6.7	642.6	−0.2	642.8
1966.2	646.7	2.7	659.1	15.1	655.7	11.7	644.0	0.0	648.4	4.4	644.0
1966.3	660.8	3.5	658.8	1.5	650.2	−7.1	644.7	−12.6	668.1	10.8	657.3
1966.4	658.1	2.5	656.1	0.5	646.3	−9.3	641.3	−14.3	666.2	10.6	655.6
1967.1	664.6	5.2	668.8	9.4	659.8	0.4	655.8	−3.6	671.5	12.1	659.4
1967.2	675.2	6.2	665.9	−2.8	665.0	−3.7	662.8	−5.9	677.1	8.4	668.7
1967.3	680.4	12.8	677.3	−0.3	681.6	4.0	677.5	−0.1	676.5	−1.1	677.6
1967.4	*681.1	5.8									
	696.0	−9.1	695.7	8.8	694.7	7.8	686.3	−0.6	698.6	11.7	686.9
1968.1	*694.5	−7.2									
	700.5	−1.2	700.5	−1.2	686.7	−15.0	674.6	−27.1	712.0	10.3	701.7
1968.2	701.1	−8.1	693.3	−15.9	696.1	−13.1	676.7	−32.5	699.1	−10.1	709.2
1968.3	707.7	−7.3	703.1	−11.9	704.8	−10.2	689.1	−25.9	708.9	−6.1	715.0
AFE*		5.9									
AFE		5.7		6.4		7.6		12.9		7.8	
					Third Quarter of Forecast						
1966.1	647.0	−1.0	651.1	3.1	647.0	−1.0	644.8	−3.2	654.6	6.6	648.0
1966.2	655.4	3.5	664.9	13.0	658.1	6.2	652.8	0.9	661.6	9.7	651.9
1966.3	664.4	8.7	664.7	9.0	658.7	3.0	658.5	2.8	679.1	23.4	655.7
1966.4	664.7	8.7	666.5	6.9	659.4	−0.2	661.8	2.2	671.8	12.2	659.6
1967.1	664.7	−2.2	673.9	7.0	668.2	1.3	670.3	3.4	668.2	1.3	666.9
1967.2	682.2	8.0	672.7	−1.5	675.7	1.5	678.5	4.3	678.7	4.5	674.2
1967.3	693.3	5.9	681.7	−5.7	689.8	2.4	691.6	4.2	692.6	5.2	687.4

(continued)

TABLE 4.4A (*continued*)

Quarter in Which Forecast Was Made	Reproduced Ex Ante Forecast		Ex Ante with AR Adjustments		Ex Ante with GG Adjustments		Ex Ante with No Adjustments		Ex Post with Actual Adjustments		Realized Prelimi-nary Value
	Value	Error	Value	Error	Value	Error	Value	Error	Value	Error	
Third Quarter of Forecast (continued)											
1967.4	*703.8	4.4									
	708.0	8.6	701.9	2.5	703.8	4.4	702.6	3.2	716.3	16.9	699.4
1968.1	*696.0	−12.7									
	703.9	−4.8	702.4	−6.3	693.4	−15.3	692.6	−16.1	702.2	−6.5	708.7
1968.2	701.2	−13.7	692.0	−22.9	692.2	−22.7	692.5	−22.4	700.4	−14.5	714.9
AFE		6.2		7.8		5.8		6.3		10.1	
Fourth Quarter of Forecast											
1966.1	654.5	−1.4	657.6	1.7	653.1	−2.8	652.5	−3.4	665.9	10.0	655.9
1966.2	662.2	11.9	672.4	22.1	664.5	14.2	661.6	11.3	673.9	23.6	650.3
1966.3	669.7	10.0	669.1	9.4	665.5	5.8	666.5	6.8	689.8	30.1	659.7
1966.4	669.9	2.8	675.3	8.2	670.7	3.6	674.0	6.9	674.0	6.9	667.1
1967.1	669.4	−3.0	678.7	6.3	677.3	4.9	681.1	8.7	669.2	−3.2	672.4
1967.2	694.6	10.6	683.5	−0.5	691.6	7.6	695.1	11.1	701.0	17.0	684.0
1967.3	702.7	2.8	690.1	−9.8	702.5	2.6	704.9	5.0	708.8	8.9	699.9
1967.4	*704.9	1.5									
	707.0	0.6	701.3	−5.1	706.1	−0.3	706.8	0.4	704.5	−1.9	706.4

1968.1	*698.2	−16.2									
	704.9	−9.5	704.3	−10.1	699.5	−14.9	700.8	−13.6	701.2	−13.2	714.4
AFE		5.8		8.1		4.6		7.5		12.8	
				Fifth Quarter of Forecast							
1966.1	658.2	3.9	658.6	4.3	653.9	−0.4	658.0	3.7	679.4	25.1	654.3
1966.2	664.8	10.5	669.5	15.2	661.2	6.9	664.5	10.2	683.4	29.1	654.3
1966.3	675.4	8.2	674.6	7.4	673.8	6.6	675.2	8.0	695.5	28.3	667.2
1966.4	678.0	5.4	685.0	12.4	684.2	11.6	688.1	15.5	678.7	6.1	672.6
1967.1	684.7	2.5	689.9	7.7	693.8	11.6	698.0	15.8	691.9	9.7	682.2
1967.2	699.6	3.1	690.1	−6.4	702.4	5.9	705.2	8.7	715.1	18.6	696.5
1967.3	711.5	4.6	697.0	−9.9	712.8	5.9	715.2	8.3	701.6	−5.3	706.9
1967.4	*702.6	−9.5									
	711.2	−0.9	708.6	−3.5	716.7	4.6	718.6	6.5	706.7	−5.4	712.1
AFE		4.9		8.4		6.7		9.6		16.0	
				Sixth Quarter of Forecast							
1966.1	663.3	5.0	663.3	5.0	660.6	2.3	663.8	5.5	689.0	30.7	658.3
1966.2	666.9	5.1	669.2	7.4	663.1	1.2	666.2	4.4	686.1	24.3	661.8
1966.3	679.0	6.3	677.6	4.9	679.7	7.0	681.9	9.2	699.8	27.1	672.7
1966.4	688.3	5.9	696.3	13.9	698.2	15.8	701.8	19.4	698.0	15.6	682.4
1967.1	695.3	0.6	701.0	6.3	708.3	13.6	712.4	17.7	709.1	14.4	694.7
1967.2	699.1	−4.4	691.8	−11.7	706.9	3.4	709.4	5.9	702.9	0.4	703.5
1967.3	718.5	5.9	705.5	−7.1	724.0	11.4	726.7	14.1	704.1	−8.5	712.6
AFE		4.7		8.0		7.8		10.9		17.3	

(continued)

TABLE 4.4A (*concluded*)

Quarter in Which Forecast Was Made	Reproduced Ex Ante Forecast		Ex Ante with AR Adjustments		Ex Ante with GG Adjustments		Ex Ante with No Adjustments		Ex Post with Actual Adjustments		Realized Prelimi- nary Value
	Value	Error	Value	Error	Value	Error	Value	Error	Value	Error	
					Forecast One Year Ahead						
1966.1	642.7	−3.2	647.7	1.8	645.6	−0.3	640.6	−5.3	648.9	3.0	645.9
1966.2	650.9	4.7	661.2	15.0	656.8	10.6	649.0	2.8	655.9	9.7	646.2
1966.3	661.9	6.4	660.6	5.1	654.5	−1.0	651.4	−4.1	672.9	17.4	655.5
1966.4	661.9	2.1	662.1	2.3	655.2	−4.6	653.1	−6.7	667.9	8.1	659.8
1967.1	664.6	1.1	669.7	6.2	664.3	0.8	663.3	−0.2	668.9	5.4	663.5
1967.2	678.5	6.5	670.3	−1.7	672.5	0.5	672.3	0.3	680.8	8.8	672.0
1967.3	688.6	4.4	680.1	−4.1	686.5	2.3	685.0	0.8	687.9	3.7	684.2
1967.4	*691.9	−0.5									
	697.2	4.8	695.5	3.1	696.6	4.2	691.7	−0.7	698.1	5.7	692.4
1968.1	*694.6	−8.9									
	699.9	−3.6	699.5	−4.0	690.0	−13.5	682.8	−20.7	703.8	0.3	703.5
		*4.2									
AFE		4.0		4.8		4.2		4.6		6.9	

TABLE 4.4P

Comparison of Ex Post Forecasts, Wharton Model, GNP in Constant Dollars

Quarter in Which Forecast Was Made	Ex Post with AR Adjustments		Ex Post with GG Adjustments		Ex Post with No Adjustments		Ex Post ROS with AR Adjustments		Realized Revised Value
	Value	Error	Value	Error	Value	Error	Value	Error	
				First Quarter of Forecast					
1966.1	642.4	−6.7	663.5	−10.6	629.2	−19.9	639.3	−9.8	649.1
1966.2	659.2	4.2	651.8	−3.2	641.5	−13.5	656.0	1.0	655.0
1966.3	660.1	−0.1	654.3	−5.9	646.0	−14.2	658.4	−1.8	660.2
1966.4	669.0	0.9	666.2	−1.9	658.3	−9.8	667.3	−0.8	668.1
1967.1	663.1	−3.4	663.4	−3.1	658.6	−7.9	665.5	−1.0	666.5
1967.2	660.0	−10.5	664.3	−6.2	660.4	−10.1	661.5	−9.0	670.5
1967.3	672.3	−5.7	672.2	−5.8	666.2	−11.8	672.3	−5.7	678.0
1967.4	676.2	−7.3	673.0	−10.5	664.6	−18.9	680.4	−3.1	683.5
1968.1	699.0	5.7	694.8	1.5	682.5	−10.8	695.2	1.9	693.3
1968.2	712.1	6.3	705.4	−0.4	691.1	−14.7	707.8	2.0	705.8
1968.3	698.8	−14.0	692.4	−20.4	680.0	−32.2	701.2	−11.6	712.8
1968.4	711.1	−7.4	700.7	−17.8	686.5	−32.0	713.3	−5.2	718.5
AFE		6.0		7.3		16.3		4.4	

(continued)

TABLE 4.4P (*continued*)

Quarter in Which Forecast Was Made	Ex Post with AR Adjustments		Ex Post with GG Adjustments		Ex Post with No Adjustments		Ex Post ROS with AR Adjustments		Realized Revised Value
	Value	Error	Value	Error	Value	Error	Value	Error	
Second Quarter of Forecast									
1966.1	650.2	−4.8	643.9	−11.1	637.8	−17.2	644.7	−10.3	655.0
1966.2	666.8	6.6	655.9	−4.3	648.7	−11.5	662.6	2.4	660.2
1966.3	674.6	6.5	666.2	−1.9	660.2	−7.9	670.6	2.5	668.1
1966.4	680.7	14.2	676.2	9.7	671.2	4.7	679.3	12.8	666.5
1967.1	668.6	−1.9	671.2	0.7	669.0	−1.5	669.9	−0.6	670.5
1967.2	660.5	−17.5	670.4	−7.6	669.3	−8.7	661.0	−17.0	678.0
1967.3	671.6	−11.9	674.4	−9.1	671.2	−12.4	675.2	−8.3	683.5
1967.4	698.0	4.7	694.5	−1.2	688.5	−4.8	695.4	2.1	693.3
1968.1	710.5	4.7	705.3	−0.5	696.2	−9.6	707.2	1.4	705.8
1968.2	702.8	−10.0	695.6	−17.2	685.7	−27.1	704.0	−8.8	712.8
1968.3	701.4	−17.1	696.0	−22.5	688.2	−30.3	701.7	−16.8	718.5
AFE		9.1		7.8		12.3		7.5	
Third Quarter of Forecast									
1966.1	660.1	−0.1	655.3	−4.9	655.2	−5.0	653.3	−6.9	660.2
1966.2	679.2	11.1	670.6	2.5	669.9	1.8	674.9	6.8	668.1
1966.3	686.8	20.3	680.8	14.2	680.3	13.8	684.8	18.3	666.5
1966.4	686.5	16.0	684.6	14.1	686.0	15.5	688.4	17.9	670.5

1967.1	667.9	−10.1	676.1	−1.9	679.5	1.5	669.9	−8.1	678.0
1967.2	661.6	−21.9	677.7	−5.8	681.8	−1.7	663.6	−20.0	683.5
1967.3	693.7	0.4	701.3	8.0	704.1	10.8	689.8	−3.5	693.3
1967.4	713.3	7.5	714.4	8.6	715.2	9.4	710.2	4.4	705.8
1968.1	700.1	−12.7	700.3	−12.5	700.1	−12.7	703.7	−9.1	712.8
1968.2	702.5	−16.0	702.5	−16.0	702.9	−15.5	704.0	−14.5	718.5
AFE		11.6		8.9		8.8		11.0	
				Fourth Quarter of Forecast					
1966.1	673.7	5.6	670.1	2.0	671.1	3.0	666.4	−1.7	668.1
1966.2	691.6	25.1	684.8	18.3	685.4	18.9	688.8	22.3	666.5
1966.3	694.6	24.1	690.3	19.8	691.2	20.7	696.2	25.7	670.5
1966.4	689.1	11.1	690.2	12.2	693.2	15.2	693.2	15.2	678.0
1967.1	670.0	−13.5	684.4	0.9	689.2	5.7	674.2	−9.3	683.5
1967.2	683.0	−10.3	706.4	13.1	711.4	18.1	677.6	−15.7	693.3
1967.3	710.6	4.8	723.7	17.9	727.7	21.9	705.6	−0.2	705.8
1967.4	702.6	−10.2	708.3	−4.5	711.2	−1.6	707.7	−5.1	712.8
1968.1	701.8	−16.7	707.5	−11.0	710.2	−8.3	704.3	−14.2	718.5
AFE		13.5		11.1		12.6		12.2	
				Fifth Quarter of Forecast					
1966.1	684.3	17.8	683.6	17.1	686.0	19.4	679.4	12.9	666.5
1966.2	700.6	30.1	695.8	25.3	697.2	26.7	700.2	29.7	670.5
1966.3	698.7	20.7	696.1	18.1	697.3	19.3	702.1	24.1	678.0
1966.4	694.5	11.0	698.8	15.3	702.1	18.5	700.4	16.9	683.5

(continued)

TABLE 4.4P (*concluded*)

Quarter in Which Forecast Was Made	Ex Post with AR Adjustments Value	Ex Post with AR Adjustments Error	Ex Post with GG Adjustments Value	Ex Post with GG Adjustments Error	Ex Post with No Adjustments Value	Ex Post with No Adjustments Error	Ex Post ROS with AR Adjustments Value	Ex Post ROS with AR Adjustments Error	Realized Realized Revised Value
				Fifth Quarter of Forecast (continued)					
1967.1	690.1	−3.2	710.3	17.0	714.8	21.5	687.1	−6.2	693.3
1967.2	697.9	−7.9	727.0	21.2	730.7	24.9	691.9	−13.9	705.8
1967.3	701.2	−11.6	717.7	4.9	720.5	7.7	704.3	−8.5	712.8
1967.4	708.7	−9.8	717.4	−1.1	719.6	1.1	711.7	−6.8	718.5
AFE		14.0		15.0		17.4		14.9	
				Sixth Quarter of Forecast					
1966.1	693.6	23.1	694.4	23.9	696.5	26.0	690.6	20.1	670.5
1966.2	703.3	25.3	699.6	21.6	701.1	23.1	704.6	26.6	678.0
1966.3	704.6	21.1	703.1	19.6	704.2	20.7	709.9	26.4	683.5
1966.4	714.8	21.5	721.3	28.0	724.2	30.9	714.1	20.8	693.3

1967.1	706.2	0.4	730.6	24.8	734.5	28.7	702.1	−3.7	705.8
1967.2	689.1	−23.7	721.9	9.1	725.6	12.8	690.5	−22.4	712.8
1967.3	706.5	−12.0	725.7	7.2	729.4	10.9	708.0	−10.5	718.5
AFE		18.2		19.2		21.9		18.6	
Forecast One Year Ahead									
1966.1	656.6	−1.5	658.2	0.1	648.3	−9.8	650.9	−7.2	658.1
1966.2	674.2	11.8	665.7	3.3	661.3	−1.1	670.6	8.2	662.4
1966.3	679.0	12.7	672.9	6.6	669.4	3.1	677.5	11.2	666.3
1966.4	681.3	10.6	679.3	8.6	677.1	6.4	682.0	11.3	670.7
1967.1	667.4	−7.2	673.7	−0.9	674.0	−0.6	669.8	−4.8	674.6
1967.2	666.2	−15.1	679.7	−1.6	680.7	−0.6	665.9	−15.4	681.3
1967.3	687.0	−3.1	692.9	2.8	692.3	2.2	685.7	−4.4	690.1
1967.4	697.5	−1.3	697.5	−1.3	694.8	−4.0	698.4	−0.4	698.8
1968.1	702.8	−4.8	701.9	−5.7	697.2	−10.4	702.6	−5.0	707.6
AFE		7.5		3.4		4.2		7.5	

TABLE 4.5A

Comparison of Ex Ante Forecasts, Wharton-EFU Model, Unemployment

Quarter in Which Forecast Was Made	Reproduced Ex Ante Forecast		Ex Ante with AR Adjustments		Ex Ante with GG Adjustments		Ex Ante with No Adjustments		Ex Post with Actual Adjustments		Realized Prelimi-nary Value
	Value	Error	Value	Error	Value	Error	Value	Error	Value	Error	
					First Quarter of Forecast						
1966.1	3.98	0.18	4.80	1.00	4.71	0.91	4.18	0.38	3.88	0.08	3.80
1966.2	3.63	−0.23	3.66	−0.20	4.07	0.21	3.82	−0.04	3.54	−0.32	3.86
1966.3	3.82	−0.02	5.40	1.56	4.32	0.48	5.20	1.36	3.68	−0.16	3.84
1966.4	4.09	0.32	4.71	0.94	5.23	1.46	5.87	2.10	3.95	0.18	3.77
1967.1	4.21	0.38	2.94	−0.89	3.98	0.15	5.05	1.22	3.72	−0.11	3.83
1967.2	4.09	0.16	4.30	0.37	5.06	1.13	5.92	1.99	4.11	0.18	3.93
1967.3	3.63	−0.30	3.99	0.06	4.87	0.94	6.34	2.41	3.82	−0.11	3.93
1967.4	*4.18	0.25									
	4.17	0.24	3.12	−0.81	4.18	0.25	6.23	2.30	4.22	0.29	3.93
1968.1	*3.61	0.04									
	3.60	0.03	6.71	3.14	5.17	1.60	7.54	3.97	2.67	−0.90	3.57
1968.2	3.47	−0.13	3.47	−0.13	4.01	0.41	7.25	3.65	3.27	−0.33	3.60
1968.3	4.25	0.65	4.25	0.65	4.54	0.94	6.88	3.28	3.53	−0.07	3.60
1968.4	3.80	0.40	3.80	0.40	5.44	2.04	7.47	4.07	4.01	0.61	3.40
AFE*		0.26									
AFE		0.25		0.84		0.87		2.23		0.27	

					Second Quarter of Forecast						
1966.1	3.74	−0.09	4.15	0.32	3.95	0.12	4.03	0.20	3.49	−0.34	3.83
1966.2	3.29	−0.54	2.75	−1.08	3.17	−0.66	3.59	−0.24	3.16	−0.67	3.83
1966.3	3.89	0.18	5.44	1.73	4.83	1.12	5.57	1.86	3.18	−0.53	3.71
1966.4	4.53	0.73	5.26	1.46	6.26	2.45	6.83	3.03	4.24	0.44	3.80
1967.1	4.01	0.05	2.77	−1.19	4.34	0.38	5.17	1.21	4.28	0.32	3.96
1967.2	3.55	−0.48	4.35	0.32	5.33	1.30	5.92	1.89	3.67	−0.36	4.03
1967.3	3.19	−0.74	4.39	0.46	5.37	1.44	6.54	2.61	3.85	−0.08	3.93
1967.4	*4.21	0.61									
	3.32	−0.28	2.86	−0.74	4.24	0.64	5.93	2.33	2.91	−0.69	3.60
1968.1	*3.65	0.08									
	3.36	−0.21	6.39	2.82	5.69	2.12	7.73	4.16	2.25	−1.32	3.57
1968.2	3.79	0.19	5.40	1.80	5.47	1.87	8.28	4.68	3.25	−0.35	3.60
1968.3	4.36	0.96	5.30	1.90	5.35	1.95	7.49	4.09	3.78	0.38	3.40
AFE*		0.42									
AFE		0.40		1.25		1.27		2.39		0.49	
					Third Quarter of Forecast						
1966.1	3.42	−0.38	3.90	0.10	3.78	−0.02	3.71	−0.09	2.91	−0.89	3.80
1966.2	3.13	−0.57	2.59	−1.11	3.19	−0.51	3.46	−0.24	2.83	−0.87	3.70
1966.3	3.84	0.10	5.63	1.89	4.92	1.18	5.09	1.35	3.06	−0.68	3.74
1966.4	4.31	0.38	4.89	0.96	5.65	1.72	5.50	1.57	4.88	0.95	3.93
1967.1	4.17	0.11	2.81	−1.25	4.15	0.09	4.25	0.19	4.78	0.72	4.06
1967.2	3.82	−0.21	4.59	0.56	5.32	1.29	5.30	1.27	4.14	0.11	4.03
1967.3	3.32	−0.28	4.64	1.04	5.44	1.84	5.84	2.24	3.16	−0.44	3.60

(continued)

TABLE 4.5A (*continued*)

Quarter in Which Forecast Was Made	Reproduced Ex Ante Forecast		Ex Ante with AR Adjustments		Ex Ante with GG Adjustments		Ex Ante with No Adjustments		Ex Post with Actual Adjustments		Realized Preliminary Value
	Value	Error	Value	Error	Value	Error	Value	Error	Value	Error	
					Third Quarter of Forecast (continued)						
1967.4	*3.71	0.11									
	3.26	−0.34	3.20	−0.40	4.47	0.87	5.23	1.63	2.09	−1.51	3.60
1968.1	*4.19	0.62									
	3.70	0.13	6.75	3.18	5.96	2.39	6.74	3.17	2.84	−0.73	3.57
1968.2	4.46	1.06	6.25	2.85	6.85	3.45	7.57	4.17	3.91	0.51	3.40
AFE*		0.38									
AFE		0.36		1.33		1.33		1.59		0.74	
					Fourth Quarter of Forecast						
1966.1	3.12	−0.55	3.68	0.01	3.57	−0.10	3.40	−0.27	2.35	−1.42	3.67
1966.2	2.95	−0.78	2.31	−1.42	2.99	−0.74	3.11	−0.62	2.59	−1.14	3.73
1966.3	3.88	0.01	5.86	1.99	5.00	1.13	4.92	1.05	3.27	−0.60	3.87
1966.4	4.01	−0.02	4.45	0.42	4.90	0.87	4.55	0.52	4.91	−.88	4.03
1967.1	4.04	−0.02	2.96	−1.10	3.84	−0.22	3.61	−0.45	5.08	1.02	4.06
1967.2	3.60	−0.10	4.31	0.61	4.57	0.88	4.34	0.64	3.31	−0.39	3.70
1967.3	3.26	−0.34	4.65	1.05	5.16	1.56	5.26	1.66	2.23	−1.37	3.60
1967.4	*4.26	0.66									
	4.36	0.76	3.98	0.38	5.07	1.47	5.38	1.78	3.21	−0.39	3.60

1968.1	*4.64	1.27									
	4.24	0.87	7.17	3.80	6.16	2.79	6.43	3.06	3.75	0.38	3.37
AFE*		0.42									
AFE		0.38		1.19		1.08		1.12		0.84	
					Fifth Quarter of Forecast						
1966.1	3.44	−0.26	4.05	0.35	3.93	0.23	3.59	−0.11	2.06	−1.64	3.70
1966.2	2.98	−0.88	2.56	−1.30	3.28	−0.58	3.13	−0.73	2.84	−1.02	3.86
1966.3	3.81	−0.16	6.25	2.28	4.76	0.79	4.80	0.83	3.09	−0.88	3.97
1966.4	3.73	−0.30	4.16	0.13	4.14	0.11	3.94	−0.09	4.96	0.93	4.03
1967.1	3.56	−0.17	2.64	−1.09	3.05	−0.68	2.88	−0.85	4.22	0.48	3.73
1967.2	3.81	0.11	4.26	0.56	4.13	0.43	4.08	0.38	2.70	−1.00	3.70
1967.3	3.22	−0.38	5.58	1.98	4.81	1.21	4.94	1.34	2.77	−0.83	3.60
1967.4	*4.79	1.39									
	4.39	0.99	4.19	0.79	4.94	1.54	5.29	1.89	3.47	0.07	3.40
AFE		0.41		1.06		0.69		0.78		0.86	
					Sixth Quarter of Forecast						
1966.1	3.54	−0.29	4.22	0.39	4.00	0.17	3.61	−0.22	1.76	−2.07	3.83
1966.2	3.05	−0.91	2.88	−1.08	3.51	−0.45	3.22	−0.74	2.66	−1.30	3.96
1966.3	3.96	−0.01	6.61	2.64	4.82	0.85	4.90	0.93	3.20	−0.77	3.97
1966.4	3.35	−0.35	3.93	0.23	3.59	−0.11	3.48	−0.22	3.92	0.22	3.70
1967.1	3.03	−0.70	2.20	−1.53	2.39	−1.34	2.21	−1.52	3.13	−0.60	3.73
1967.2	4.39	0.69	4.51	0.81	4.13	0.43	4.17	−.47	3.52	−0.18	3.70
1967.3	3.64	0.24	4.80	1.40	4.80	1.40	4.96	1.56	3.50	0.10	3.40
AFE		0.46		1.15		0.67		0.81		0.75	

(continued)

TABLE 4.5A (*concluded*)

Quarter in Which Forecast Was Made	Reproduced Ex Ante Forecast Value	Error	Ex Ante with AR Adjustments Value	Error	Ex Ante with GG Adjustments Value	Error	Ex Ante with No Adjustments Value	Error	Ex Post with Actual Adjustments Value	Error	Realized Preliminary Value
					Forecast One Year Ahead						
1966.1	3.56	−0.21	4.13	0.36	4.00	0.23	3.83	0.06	3.15	−0.62	3.77
1966.2	3.25	−0.53	2.82	−0.96	3.35	−0.43	3.49	−0.29	3.03	−0.75	3.78
1966.3	3.85	0.06	5.58	1.79	4.77	0.89	5.19	1.40	3.29	−0.50	3.79
1966.4	4.23	0.35	4.82	0.94	5.51	1.63	5.68	1.80	4.49	0.61	3.88
1967.1	4.10	0.13	2.87	−1.10	4.08	0.10	4.52	0.55	4.46	0.49	3.97
1967.2	3.76	−0.16	4.38	0.46	5.07	1.15	5.37	1.45	3.80	−0.12	3.92
1967.3	3.35	−0.41	4.41	0.65	5.21	1.45	5.99	2.23	3.26	−0.50	3.76
1967.4	*4.09	0.41									
	3.77	0.09	3.29	−0.39	4.49	0.81	5.69	2.01	3.10	−0.58	3.68
1968.1	*4.02	0.50									
	3.72	0.20	6.75	3.23	5.75	2.23	7.11	3.59	2.88	−0.64	3.52
AFE		*0.30									
		0.23		1.09		0.99		1.48		0.53	

TABLE 4.5P

Comparison of Ex Post Forecasts, Wharton Model, Unemployment

Quarter in Which Forecast Was Made	Ex Post with AR Adjustments		Ex Post with GG Adjustments		Ex Post with No Adjustments		Ex Post ROS with AR Adjustments		Realized Revised Value
	Value	Error	Value	Error	Value	Error	Value	Error	
				First Quarter of Forecast					
1966.1	2.46	−1.3	2.68	−1.1	3.37	−0.4	2.76	−1.0	3.80
1966.2	1.69	−2.1	2.08	−1.7	2.70	−1.1	1.93	−1.9	3.83
1966.3	2.08	−1.7	2.30	−1.5	2.76	−1.0	2.25	−1.6	3.80
1966.4	1.92	−1.7	2.00	−1.7	2.68	−1.0	2.04	−1.6	3.67
1967.1	3.43	−0.3	3.30	−0.4	3.95	0.2	3.31	−0.4	3.70
1967.2	4.79	1.0	4.50	0.7	5.37	1.5	4.79	1.0	3.83
1967.3	3.61	−0.3	3.93	0.0	5.16	1.2	3.64	−0.3	3.93
1967.4	3.84	−0.1	4.28	0.3	5.74	1.8	3.61	−0.3	3.93
1968.1	2.99	−0.6	3.16	−0.4	5.20	1.6	3.18	−0.4	3.60
1968.2	2.29	−1.3	2.62	−1.0	4.90	1.3	2.49	−1.1	3.60
1968.3	3.09	−0.5	3.29	−0.3	5.14	1.5	3.02	−0.6	3.60
1968.4	2.97	−0.4	2.97	−0.4	4.78	1.4	2.88	−0.5	3.40
AFE		0.94		0.79		1.17		0.89	

(continued)

TABLE 4.5P (*continued*)

Quarter in Which Forecast Was Made	Ex Post with AR Adjustments		Ex Post with GG Adjustments		Ex Post with No Adjustments		Ex Post ROS with AR Adjustments		Realized Revised Value
	Value	Error	Value	Error	Value	Error	Value	Error	
				Second Quarter of Forecast					
1966.1	2.39	−1.4	2.81	−1.0	3.45	−0.4	2.95	−0.9	3.83
1966.2	1.90	−1.9	2.50	−1.3	3.14	−0.7	2.29	−1.5	3.80
1966.3	1.95	−1.7	2.28	−1.4	2.86	−0.8	2.27	−1.4	3.67
1966.4	2.30	−1.4	2.44	−1.3	3.17	−0.5	2.40	−1.3	3.70
1967.1	4.49	0.7	4.09	0.3	4.84	1.0	4.48	0.7	3.83
1967.2	5.37	1.4	4.55	0.6	5.46	1.5	5.44	1.5	3.93
1967.3	4.27	0.3	4.36	−0.4	5.59	1.7	4.12	0.2	3.93
1967.4	2.95	−0.7	3.32	−0.3	4.84	1.2	3.03	−0.6	3.60
1968.1	2.95	−0.7	3.32	−0.3	4.84	1.2	3.03	−0.6	3.60
1968.2	2.58	−1.0	2.75	−0.8	4.90	1.3	2.77	−0.8	3.60
1968.3	2.78	−0.8	3.16	−0.4	5.54	1.9	2.85	−0.8	3.60
1968.4	3.64	−0.2	3.56	1.2	5.64	2.2	3.73	0.3	3.40
AFE		1.05		0.82		1.20		0.91	
				Third Quarter of Forecast					
1966.1	2.41	−1.4	2.60	−1.2	2.61	−1.2	3.01	−0.8	3.80
1966.2	2.03	−1.6	2.21	−1.5	2.45	−1.4	2.32	−1.3	3.67

1966.3	2.27	−1.4	2.22	−1.5	2.32	−1.4	2.40	−1.3	3.70
1966.4	3.22	−0.6	3.02	−0.8	3.19	−0.6	3.10	−0.7	3.83
1967.1	5.05	1.1	4.03	0.1	4.36	0.4	5.04	1.1	3.93
1967.2	5.87	1.9	4.34	0.4	4.86	0.9	5.92	2.0	3.93
1967.3	3.34	−0.3	2.84	−0.8	3.52	−0.1	3.55	−0.1	3.60
1967.4	2.13	−1.5	1.94	−1.7	2.88	−1.7	2.33	−1.3	3.60
1968.1	3.22	−0.4	2.84	−0.8	4.24	0.6	3.07	−0.5	3.60
1968.2	3.62	0.2	3.17	−0.2	4.67	1.3	3.58	0.2	3.40
Fourth Quarter of Forecast									
1966.1	2.34	−1.3	2.28	−1.4	2.07	−1.6	2.82	−0.8	3.67
1966.2	2.44	−1.3	2.25	−1.4	2.08	−1.6	2.53	−1.2	3.70
1966.3	3.06	−0.8	2.71	−1.1	2.64	−1.2	2.90	−0.9	3.83
1966.4	3.59	−0.3	3.02	−0.9	2.99	−0.9	3.29	−0.6	3.93
1967.1	5.51	1.6	3.76	−0.2	3.96	0.0	5.37	1.4	3.93
1967.2	4.89	1.3	2.53	−1.1	2.98	−0.6	5.33	1.7	3.60
1967.3	2.32	−1.3	1.22	−2.4	1.73	−1.9	2.66	−0.9	3.60
1967.4	2.81	−0.8	2.10	−1.5	2.77	−0.8	2.59	−1.0	3.60
1968.1	3.88	0.5	2.84	−0.6	3.90	0.5	3.73	0.3	3.40
AFE		1.02		1.18		1.01		0.98	
Fifth Quarter of Forecast									
1966.1	2.52	−1.2	2.23	−1.5	2.04	−1.7	2.81	−0.9	3.70
1966.2	2.80	−1.0	2.48	−1.4	2.40	−1.4	2.77	−1.1	3.83
1966.3	3.11	−0.8	2.61	−1.3	2.66	−1.3	2.82	−1.1	3.93
1966.4	3.66	−0.3	2.78	−1.2	2.90	−1.0	3.30	−0.6	3.93

(continued)

TABLE 4.5P (*concluded*)

Quarter in Which Forecast Was Made	Ex Post with AR Adjustments Value	Ex Post with AR Adjustments Error	Ex Post with GG Adjustments Value	Ex Post with GG Adjustments Error	Ex Post with No Adjustments Value	Ex Post with No Adjustments Error	Ex Post ROS with AR Adjustments Value	Ex Post ROS with AR Adjustments Error	Realized Realized Revised Value
Fifth Quarter of Forecast (continued)									
1967.1	4.66	1.1	2.31	−1.3	2.70	−0.9	4.92	1.3	3.60
1967.2	3.94	0.3	1.15	−2.5	1.84	−1.8	4.49	0.9	3.60
1967.3	2.82	−0.8	1.57	−2.0	2.25	−1.3	2.73	−0.9	3.60
1967.4	3.15	−0.3	2.21	−1.2	3.02	−0.4	2.95	−0.5	3.40
AFE		0.73		1.55		1.22		0.91	
Sixth Quarter of Forecast									
1966.1	3.01	−0.8	2.63	−1.2	2.55	−1.3	3.16	−0.7	3.83
1966.2	2.92	−1.0	2.56	−1.4	2.60	−1.3	2.84	−1.1	3.93
1966.3	3.18	−0.8	2.59	−1.3	2.75	−1.2	2.88	−1.1	3.93
1966.4	2.82	−0.8	1.74	−1.9	1.99	−1.6	2.84	−0.8	3.60

1967.1	3.64	0.0	1.07	−2.5	1.57	−2.0	4.05	0.5	3.60
1967.2	4.40	0.8	1.55	−2.0	2.24	−1.4	4.52	0.9	3.60
1967.3	3.25	−0.1	2.04	−1.4	2.62	−0.8	3.14	−0.3	3.40
AFE		0.61		1.67		1.37		0.77	
Forecast One Year Ahead									
1966.1	2.40	−1.37	2.59	−1.18	2.87	−0.90	2.88	−0.89	3.77
1966.2	2.01	−1.74	2.26	−1.49	2.59	−1.16	2.26	−1.49	3.75
1966.3	2.34	−1.41	2.37	−1.38	2.64	−1.11	2.45	−1.30	3.75
1966.4	2.75	−1.03	2.62	−1.16	3.00	−0.78	2.70	−1.08	3.78
1967.1	4.62	0.78	3.79	−0.05	4.27	0.43	4.55	0.71	3.84
1967.2	5.23	1.41	3.98	0.16	4.66	0.84	5.37	1.55	3.82
1967.3	3.38	−0.38	3.08	−0.68	4.00	0.24	3.49	−0.27	3.76
1967.4	2.93	−0.93	2.91	−0.95	4.05	0.19	2.89	−0.97	3.86
1968.1	3.26	−0.29	3.04	−0.51	4.54	0.99	3.25	−0.30	3.55
AFE		1.03		0.84		0.73		0.95	

TABLE 4.6

Comparison of Ex Ante and Ex Post Forecasts, Evans Model, GNP in Current Dollars

Quarter in Which Forecast Was Made	Reproduced Ex Ante Forecast Value	Reproduced Ex Ante Forecast Error	Ex Post with Actual Adjustments Value	Ex Post with Actual Adjustments Error	Realized Preliminary Value
		First Quarter of Forecast			
1964.1	609.4	0.6	605.9	−2.9	608.8
1964.2	620.4	1.8	618.9	0.3	618.6
1964.3	632.6	4.2	634.3	5.9	628.4
1964.4	636.6	2.0	637.2	2.6	634.6
1965.1	649.3	0.5	645.2	−3.6	648.8
1965.2	659.2	1.2	659.3	1.3	658.0
AFE		1.7		2.8	
		Second Quarter of Forecast			
1964.1	623.0	4.4	618.1	−0.5	618.6
1964.2	632.3	3.9	629.7	1.3	628.4
1964.3	644.8	10.2	648.8	14.2	634.6
1964.4	649.3	0.5	640.4	−8.4	648.8
1965.1	664.8	6.8	664.2	6.2	658.0
AFE		5.2		6.1	
		Third Quarter of Forecast			
1964.1	636.5	8.1	630.7	2.3	628.4
1964.2	641.7	7.1	639.2	4.6	634.6
1964.3	656.0	7.2	659.0	10.2	648.8
1964.4	659.9	1.9	655.1	−2.9	658.0
AFE		6.1		5.0	
		Fourth Quarter of Forecast			
1964.1	647.9	13.3	640.3	5.7	634.6
1964.2	651.5	2.7	647.4	−1.4	648.8
1964.3	669.2	11.2	676.6	18.6	658.0
AFE		9.1		8.6	
		Forecast One Year Ahead			
1964.1	629.2	6.6	623.7	1.1	622.6
1964.2	636.4	3.8	633.8	1.2	632.6
1964.3	650.6	8.2	654.6	12.2	642.4
AFE		6.2		4.8	

TABLE 4.7

Comparison of Ex Ante and Ex Post Forecasts, Evans Model, Consumption

Quarter in Which Forecast Was Made	Reproduced Ex Ante Forecast Value	Reproduced Ex Ante Forecast Error	Ex Post with Actual Adjustments Value	Ex Post with Actual Adjustments Error	Realized Preliminary Value
		First Quarter of Forecast			
1964.1	385.9	−4.1	385.1	−4.9	390.0
1964.2	392.9	−3.2	392.3	−3.8	396.1
1964.3	403.9	−0.7	403.9	−0.7	404.6
1964.4	407.3	0.8	406.2	−0.3	406.5
1965.1	417.3	−0.8	415.2	−2.9	418.1
1965.2	421.7	−1.3	421.5	−1.5	423.0
AFE		1.8		2.4	
		Second Quarter of Forecast			
1964.1	395.4	−0.7	393.7	−2.4	396.1
1964.2	402.0	−2.6	400.3	−4.3	404.6
1964.3	411.2	4.7	412.1	5.6	406.5
1964.4	416.6	−1.5	413.9	−4.2	418.1
1965.1	424.2	1.2	423.4	0.4	423.0
AFE		2.1		3.4	
		Third Quarter of Forecast			
1964.1	404.1	−0.5	401.6	−3.0	404.6
1964.2	407.8	1.3	406.0	−0.5	406.5
1964.3	417.4	−0.7	419.6	1.5	418.1
1964.4	423.9	0.9	420.8	−2.2	423.0
AFE		0.8		1.8	
		Fourth Quarter of Forecast			
1964.1	411.1	4.6	408.0	1.5	406.5
1964.2	414.3	−3.8	413.3	−4.8	418.1
1964.3	424.7	1.7	428.6	5.6	423.0
AFE		3.4		4.0	
		Forecast One Year Ahead			
1964.1	399.1	−0.2	397.1	−2.2	399.3
1964.2	404.2	−2.1	402.9	−3.4	406.3
1964.3	414.3	1.3	416.0	3.0	413.0
AFE		1.2		2.8	

TABLE 4.8

Comparison of Ex Ante and Ex Post Forecasts, Evans Model, Investment

Quarter in Which Forecast Was Made	Reproduced Ex Ante Forecast		Ex Post with Actual Adjustments		Realized Preliminary Value
	Value	Error	Value	Error	
		First Quarter of Forecast			
1964.1	88.8	2.9	88.0	2.1	85.9
1964.2	91.8	4.6	91.3	4.1	87.2
1964.3	91.8	4.5	92.0	4.7	87.3
1964.4	91.5	1.1	93.3	2.9	90.4
1965.1	93.6	−1.1	93.9	−0.8	94.7
1965.2	96.4	2.1	97.1	2.8	94.3
AFE		2.7		2.9	
		Second Quarter of Forecast			
1964.1	90.9	3.7	89.2	2.0	87.2
1964.2	93.6	6.3	93.0	5.7	87.3
1964.3	94.9	4.5	95.8	5.4	90.4
1964.4	93.8	−0.9	90.5	−4.2	94.7
1965.1	99.8	5.5	100.2	5.9	94.3
AFE		4.2		4.6	
		Third Quarter of Forecast			
1964.1	94.2	6.9	92.6	5.3	87.3
1964.2	96.2	5.8	95.5	5.1	90.4
1964.3	98.1	3.4	99.4	4.7	94.7
1964.4	95.9	1.6	93.6	−0.7	94.3
AFE		4.4		4.0	
		Fourth Quarter of Forecast			
1964.1	97.1	6.7	94.7	4.3	90.4
1964.2	98.5	3.8	98.0	4.3	94.7
1964.3	102.2	7.9	104.1	9.8	94.3
AFE		6.1		6.2	
		Forecast One Year Ahead			
1964.1	92.7	5.0	91.1	3.4	87.7
1964.2	95.0	5.1	94.4	4.5	89.9
1964.3	96.7	5.1	97.8	6.2	91.6
AFE		5.0		4.7	

TABLE 4.9

Comparison of Ex Ante and Ex Post Forecasts, Evans Model GNP in Constant Dollars

Quarter in Which Forecast Was Made	Reproduced Ex Ante Forecast Value	Reproduced Ex Ante Forecast Error	Ex Post with Actual Adjustments Value	Ex Post with Actual Adjustments Error	Realized Preliminary Value
		First Quarter of Forecast			
1964.1	508.3	0.3	505.5	−2.5	508.0
1964.2	515.3	1.8	514.9	1.4	513.5
1964.3	523.2	3.6	524.8	5.2	519.6
1964.4	523.5	0.8	524.4	1.7	522.7
1965.1	532.2	0.0	528.7	−3.5	532.2
1965.2	539.0	2.3	537.1	0.4	536.7
AFE		1.5		2.4	
		Second Quarter of Forecast			
1964.1	517.4	3.9	514.3	0.8	513.5
1964.2	520.8	1.2	519.5	−0.1	519.6
1964.3	531.1	8.4	534.2	11.5	522.7
1964.4	531.7	−0.5	524.5	−7.7	532.2
1965.1	542.7	6.0	540.3	−3.6	536.7
AFE		3.9		4.7	
		Third Quarter of Forecast			
1964.1	526.0	6.4	522.7	3.1	519.6
1964.2	528.6	5.9	527.4	4.7	522.7
1964.3	537.7	5.5	539.7	7.5	532.2
1964.4	538.2	1.5	532.7	−4.0	536.7
AFE		4.8		4.8	
		Fourth Quarter of Forecast			
1964.1	532.8	10.1	528.4	5.7	522.7
1964.2	534.5	2.3	531.8	−0.4	532.2
1964.3	545.8	9.1	549.8	13.1	536.7
AFE		7.2		6.4	
		Forecast One Year Ahead			
1964.1	521.1	5.2	517.7	1.8	515.9
1964.2	524.8	2.8	523.4	1.4	522.0
1964.3	534.4	6.6	537.1	9.3	527.8
AFE		4.8		4.1	

TABLE 4.10

Comparison of Ex Ante and Ex Post Forecasts, Evans Model, Unemployment Rate

Quarter in Which Forecast Was Made	Reproduced Ex Ante Forecast Value	Reproduced Ex Ante Forecast Error	Ex Post with Actual Adjustments Value	Ex Post with Actual Adjustments Error	Realized Preliminary Value
		First Quarter of Forecast			
1964.1	5.60	0.17	5.65	0.22	5.43
1964.2	5.33	0.03	5.37	0.07	5.30
1964.3	5.07	0.00	5.02	–0.05	5.07
1964.4	5.00	–0.03	5.00	–0.03	5.03
1965.1	4.80	–0.03	5.00	0.17	4.83
1965.2	4.60	–0.13	5.39	0.66	4.73
AFE		0.06		0.20	
		Second Quarter of Forecast			
1964.1	5.53	0.23	5.70	0.40	5.30
1964.2	5.11	0.04	5.20	0.13	5.07
1964.3	4.73	–0.30	4.57	–0.46	5.03
1964.4	4.90	0.07	5.08	0.25	4.83
1965.1	4.50	–0.23	4.63	–0.10	4.73
AFE		0.17		0.27	
		Third Quarter of Forecast			
1964.1	5.37	0.30	5.60	0.53	5.07
1964.2	4.94	–0.09	5.05	0.02	5.03
1964.3	4.55	–0.28	4.29	–0.54	4.83
1964.4	4.70	–0.03	5.00	0.27	4.73
AFE		0.17		0.34	
		Fourth Quarter of Forecast			
1964.1	5.27	0.24	5.58	0.55	5.03
1964.2	4.85	0.02	5.03	0.20	4.83
1964.3	4.43	–0.30	3.95	–0.78	4.73
AFE		0.19		0.51	
		Forecast One Year Ahead			
1964.1	5.44	0.24	5.63	0.43	5.20
1964.2	5.05	0.00	5.16	0.11	5.05
1964.3	4.69	–0.22	4.45	–0.46	4.91
AFE		0.15		0.33	

TABLE 4.11A

Comparison of Ex Ante Forecasts, OBE Model, GNP in Current Dollars

Quarter in Which Forecast Was Made	Reproduced Ex Ante Forecast		Ex Ante with AR Adjustments		Ex Ante with GG Adjustments		Ex Ante with No Adjustments		Ex Post with Actual Adjustments		Realized Prelimi- nary Value
	Value	Error	Value	Error	Value	Error	Value	Error	Value	Error	
					First Quarter of Forecast						
1967.2	774.1	1.8	779.6	7.3	776.0	3.7	777.1	4.8	773.9	1.6	772.3
1967.3	792.3	2.1	793.3	3.1	797.7	7.5	803.4	13.2	786.4	−3.8	790.2
1967.4	804.7	−2.1	802.5	−4.3	811.5	4.6	818.7	11.8	802.1	−4.8	806.9
1968.1	827.4	−0.0	824.1	−3.3	827.4	−0.0	831.8	4.3	834.4	6.9	827.5
1968.2	846.6	−2.3	841.4	−7.5	845.9	−3.0	846.7	−2.2	851.1	2.1	849.0
1968.3	860.9	−7.9	860.0	−8.8	857.3	−11.5	853.6	−15.2	863.3	−5.6	868.9
1968.4	884.4	−2.9	882.0	−5.3	882.6	−4.7	879.8	−7.5	880.6	−6.8	887.4
AFE		2.8		5.7		5.1		8.5		4.5	
					Second Quarter of Forecast						
1967.2	788.8	1.4	794.5	7.1	793.6	6.2	793.6	6.2	783.8	−3.6	787.4
1967.3	812.4	6.5	814.4	8.5	823.5	17.6	831.8	25.9	797.8	−9.9	805.9
1967.4	827.9	0.8	816.6	−10.4	831.1	4.0	841.1	14.0	833.4	6.3	827.1
1968.1	835.3	−13.8	837.2	−11.9	841.8	−7.3	847.0	−2.1	849.2	0.0	849.2
1968.2	860.3	−6.7	849.7	−17.3	858.0	−9.0	857.3	−9.7	867.2	0.1	867.1
1968.3	869.0	−16.2	862.5	−22.7	860.0	−25.2	856.4	−28.8	868.1	−17.2	885.3
AFE		7.6		13.1		11.6		14.5		6.2	

(*continued*)

TABLE 4.11A (*concluded*)

Quarter in Which Forecast Was Made	Reproduced Ex Ante Forecast		Ex Ante with AR Adjustments		Ex Ante with GG Adjustments		Ex Ante with No Adjustments		Ex Post with Actual Adjustments		Realized Prelimi-nary Value
	Value	Error	Value	Error	Value	Error	Value	Error	Value	Error	
					Third Quarter of Forecast						
1967.2	806.9	3.8	810.1	7.0	814.6	11.5	813.2	10.1	796.9	−6.2	803.1
1967.3	833.5	7.4	832.8	6.7	843.6	17.5	850.1	24.0	821.5	−4.6	826.1
1967.4	845.6	−3.1	834.5	−14.2	849.3	0.5	856.9	8.1	858.7	9.9	848.8
1968.1	846.1	−21.1	851.5	−15.7	855.6	−11.6	860.5	−6.7	864.1	−3.2	867.3
1968.2	868.3	−15.1	855.0	−28.4	867.1	−16.3	864.7	−18.7	869.7	−13.8	883.5
AFE		10.1		14.5		11.5		13.6		7.5	
					Fourth Quarter of Forecast						
1967.2									818.1	−5.2	823.3
1967.3	852.5	4.7	849.8	2.0	863.5	15.7	869.6	21.8	847.9	0.1	847.8
1967.4	857.9	−8.9	853.2	−13.6	867.7	0.8	874.4	7.5	875.4	8.5	866.9
1968.1	854.5	−29.1	862.7	−20.9	865.7	−17.9	870.0	−13.6	867.2	−16.5	883.7
AFE		14.3		12.2		11.5		14.3		7.6	

					Fifth Quarter of Forecast						
1967.2									840.8	−4.2	845.0
1967.3	864.7	−1.1	864.5	−1.3	882.7	16.8	889.4	23.5	867.1	1.2	865.9
1967.4	870.3	−12.9	867.2	−16.0	883.0	−0.2	889.8	6.5	885.2	1.9	883.3
AFE		7.1		8.7		8.5		15.0		2.4	
					Sixth Quarter of Forecast						
1967.2									861.9	−1.2	863.1
1967.3	882.9	0.6	880.0	−2.2	903.2	20.9	909.9	27.6	879.0	−3.3	882.3
AFE		0.6		2.3		20.9		27.6		2.3	
					Forecast One Year Ahead						
1967.2									793.2	−3.3	796.5
1967.3	822.7	5.2	822.6	5.1	832.1	14.6	838.8	21.2	813.4	4.1	817.5
1967.4	834.1	−3.3	826.7	−10.6	839.9	2.5	847.8	10.3	842.4	5.0	837.4
1968.1	840.9	−16.0	843.9	−13.0	847.7	−9.2	852.4	−4.5	853.7	3.2	856.9
AFE		8.2		9.6		8.8		12.1		5.2	

TABLE 4.11P

Comparison of Ex Post Forecasts, OBE Model, GNP in Current Dollars

Quarter in Which Forecast Was Made	Ex Post with AR Adjustments		Ex Post with GG Adjustments		Ex Post with No Adjustments		Realized Revised Value
	Value	Error	Value	Error	Value	Error	
First Quarter of Forecast							
1967.2	788.8	8.6	789.7	9.5	787.6	7.4	780.2
1967.3			791.0	−4.3	789.4	−5.9	795.3
1967.4			809.3	−1.7	809.2	−1.8	811.0
1968.1	837.7	6.5	835.8	4.6	833.5	2.3	831.2
1968.2	856.5	3.6	856.2	3.3	847.8	−5.1	852.9
1968.3	868.5	−2.5	861.1	−9.9	856.4	−14.6	871.0
1968.4	878.0	−9.4	879.3	−8.1	877.1	−10.3	887.4
AFE		6.1		5.9		6.8	
Second Quarter of Forecast							
1967.2	814.7	19.4	807.3	12.0	803.5	8.2	795.3
1967.3			803.7	−7.3	803.4	−7.6	811.0
1967.4			826.3	−4.9	829.1	−2.1	831.2
1968.1	859.0	6.1	850.3	−2.6	847.1	−5.8	852.9
1968.2	876.9	5.9	874.9	3.9	862.7	−8.3	871.0
1968.3	875.4	−12.0	862.8	−24.6	858.4	−29.0	887.4
AFE		10.9		9.2		10.2	
Third Quarter of Forecast							
1967.2	839.3	28.3	826.6	15.6	821.7	10.7	811.0
1967.3			820.1	−11.1	821.3	−9.9	831.2
1967.4			842.7	−10.2	847.1	−5.8	852.9
1968.1	879.0	8.0	863.0	−8.0	860.2	−10.8	871.0
1968.2	883.6	−3.8	886.1	−1.3	873.2	−14.2	887.4
AFE		13.4		9.2		10.3	

TABLE 4.11P (*concluded*)

Quarter in Which Forecast Was Made	Ex Post with AR Adjustments Value	Error	Ex Post with GG Adjustments Value	Error	Ex Post with No Adjustments Value	Error	Realized Revised Value
			Fourth Quarter of Forecast				
1967.2	860.1	28.9	845.7	14.5	839.3	8.1	831.2
1967.3			840.3	−12.6	841.1	−11.8	852.9
1967.4			858.6	−12.4	862.9	−8.1	871.0
1968.1	887.5	0.1	865.5	−21.9	863.2	−24.2	887.4
AFE		14.5		15.3		13.0	
			Fifth Quarter of Forecast				
1967.2	880.4	27.5	865.8	12.9	858.0	5.1	852.9
1967.3			860.9	−10.1	860.8	−10.2	871.0
1967.4			868.5	−18.9	872.2	−15.2	887.4
AFE		27.5		14.0		10.2	
			Sixth Quarter of Forecast				
1967.2	899.0	28.0	884.7	13.7	876.0	5.0	871.0
1967.3			875.4	−12.0	874.6	−12.8	887.4
AFE		28.0		12.8		8.9	
			Forecast One Year Ahead				
1967.2	825.8	20.4	817.4	13.0	813.1	8.6	804.4
1967.3			813.8	−8.7	813.8	−8.7	822.5
1967.4			834.3	−7.2	837.1	−4.4	841.5
1968.1	865.8	5.2	853.7	−6.9	851.0	−9.6	860.6
AFE		12.8		9.0		7.8	

TABLE 4.12A

Comparison of Ex Ante Forecasts, for OBE Model, Consumption Except Housing Services in Constant Dollars

Quarter in Which Forecast Was Made	Reproduced Ex Ante Forecast		Ex Ante with AR Adjustments		Ex Ante with GG Adjustments		Ex Ante with No Adjustments		Ex Post with Actual Adjustments		Realized Prelimi-nary Value
	Value	Error	Value	Error	Value	Error	Value	Error	Value	Error	
First Quarter of Forecast											
1967.2	363.3	−4.0	362.3	−5.0	362.7	−4.6	363.9	−3.4	363.8	−3.6	367.4
1967.3	369.9	1.9	366.8	−1.1	368.0	0.0	368.1	0.1	369.3	1.3	368.0
1967.4	371.1	1.4	370.3	0.6	372.6	2.9	373.2	3.5	371.0	1.3	369.7
1968.1	376.7	−2.4	374.6	−4.5	378.1	−1.0	381.4	2.2	376.6	−2.6	379.2
1968.2	382.1	2.5	378.7	−0.8	384.7	5.1	388.4	8.8	383.0	3.4	379.6
1968.3	382.7	−5.4	385.4	−2.7	385.9	−2.2	386.0	−2.1	382.9	−5.3	388.2
1968.4	391.6	3.3	390.0	1.7	392.5	4.2	391.7	3.4	391.4	3.1	388.3
AFE		3.0		2.4		2.9		3.4		2.9	
Second Quarter of Forecast											
1967.2	366.9	−0.6	365.6	−1.9	366.8	−0.7	367.9	0.3	364.7	−2.9	367.6
1967.3	374.2	4.4	371.5	1.7	372.9	3.1	374.1	4.3	372.7	2.9	369.8
1967.4	377.6	−1.7	373.2	−6.1	375.9	−3.4	377.6	−1.7	378.2	−1.2	379.4
1968.1	377.4	−3.5	377.1	−3.8	382.7	1.7	385.5	4.5	379.1	−1.9	381.0
1968.2	384.0	−2.7	378.9	−7.8	387.2	0.4	389.3	2.5	384.9	−1.9	386.8

1968.3	383.9	−3.0	385.7	−1.2	387.4	0.4	387.2	0.2	384.3	−2.7	387.0
AFE		2.7		3.8		1.6		2.3		2.3	
Third Quarter of Forecast											
1967.2	371.1	1.7	368.8	−0.5	371.6	2.2	372.3	2.9	367.4	−2.0	369.4
1967.3	380.6	1.1	376.8	−2.6	378.6	−0.8	379.9	0.4	377.2	−2.3	379.5
1968.1	382.8	1.6	377.8	−3.3	380.7	−0.4	382.6	1.4	384.7	3.5	381.2
1968.2	379.2	−8.9	380.4	−7.7	387.2	−0.9	389.6	1.4	381.6	−6.6	388.2
1968.3	385.8	0.2	379.1	−6.4	388.8	3.2	389.8	4.2	386.3	0.7	385.6
AFE		2.7		4.2		1.6		2.1		3.2	
Fourth Quarter of Forecast											
1967.2									371.8	−7.3	379.1
1967.3	385.9	4.6	380.9	−0.3	382.8	1.5	383.8	2.5	385.0	3.7	381.3
1967.4	386.1	−2.2	383.2	−5.1	384.9	−3.4	386.1	−2.2	388.2	−0.2	388.4
1968.1	380.8	−6.1	383.0	−3.9	390.7	3.7	392.8	5.8	382.7	−4.3	387.0
AFE		4.4		3.2		2.9		3.5		3.9	
Fifth Quarter of Forecast											
1967.2									378.1	−2.8	380.9
1967.3	389.3	0.8	384.1	−4.3	386.5	−1.9	387.4	−1.0	390.1	1.6	388.5
1967.4	389.0	1.8	385.9	−1.2	388.4	1.2	389.4	2.2	391.3	4.1	387.2
AFE		1.3		2.9		1.6		1.7		2.8	

(continued)

TABLE 4.12A (*concluded*)

Quarter in Which Forecast Was Made	Reproduced Ex Ante Forecast Value	Reproduced Ex Ante Forecast Error	Ex Ante with AR Adjustments Value	Ex Ante with AR Adjustments Error	Ex Ante with GG Adjustments Value	Ex Ante with GG Adjustments Error	Ex Ante with No Adjustments Value	Ex Ante with No Adjustments Error	Ex post with Actual Adjustments Value	Ex post with Actual Adjustments Error	Realized Preliminary Value
Sixth Quarter of Forecast											
1967.2									383.5	–4.6	388.1
1967.3	393.0	5.7	387.4	0.1	390.5	3.2	391.2	3.9	394.3	7.0	387.3
AFE		5.7		0.1		3.2		3.9		5.8	
Forecast One Year Ahead											
1967.2									367.0	–5.2	370.9
1967.3	377.7	3.0	374.1	–0.5	375.6	0.9	376.5	1.8	376.1	1.5	374.6
1967.4	379.5	–0.2	376.2	–3.5	378.6	–1.1	379.9	0.2	380.5	0.8	379.7
1968.1	378.6	–5.2	378.8	–5.0	384.7	0.8	387.4	3.5	380.0	–3.8	383.8
AFE		2.9		3.1		1.0		1.8		2.8	

TABLE 4.12P

Comparison of Ex Post Forecasts, OBE Model, Consumption Except Housing Services in Constant Dollars

Quarter in Which Forecast Was Made	Ex Post with AR Adjustments Value	Ex Post with AR Adjustments Error	Ex Post with GG Adjustments Value	Ex Post with GG Adjustments Error	Ex Post with No Adjustments Value	Ex Post with No Adjustments Error	Realized Revised Value
			First Quarter of Forecast				
1967.2	363.0	−5.8	366.2	−2.6	367.4	−1.4	368.8
1967.3	377.8		370.7	1.7	367.1	−1.9	369.0
1967.4	385.7		374.0	3.2	372.2	1.4	370.8
1968.1	373.3	−7.2	375.9	−4.6	377.6	−2.9	380.5
1968.2	383.0	0.7	387.0	4.7	384.8	2.5	382.3
1968.3	387.6	−1.9	385.7	−3.8	383.9	−5.6	389.5
1968.4	389.4	1.1	392.2	3.9	391.4	3.1	388.3
AFE		5.8		3.5		2.7	
			Second Quarter of Forecast				
1967.2	361.7	−7.3	367.6	−1.4	368.6	−0.4	369.0
1967.3	384.3		372.7	1.9	370.9	0.1	370.8
1967.4	392.3		375.7	−4.8	375.4	−5.1	380.5
1968.1	375.1	−7.2	377.1	−5.2	378.1	−4.2	382.3
1968.2	385.3	−4.2	388.4	−1.1	386.3	−3.2	389.5
1968.3	389.9	1.6	386.9	−1.4	385.9	−2.4	388.3
AFE		5.1		2.6		2.6	
			Third Quarter of Forecast				
1967.2	361.1	−9.7	370.4	−0.4	371.4	0.6	370.8
1967.3	388.8		375.8	−4.7	375.3	−5.2	380.5
1967.4	400.9		380.9	−1.4	381.7	−0.6	382.3
1968.1	377.9	−11.6	379.7	−9.8	380.3	−9.2	389.5
1968.2	387.6	−0.7	389.9	1.6	388.2	−0.1	388.3
AFE		7.3		3.6		3.1	

(*continued*)

TABLE 4.12P (*concluded*)

Quarter in Which Forecast Was Made	Ex Post with AR Adjustments Value	Ex Post with AR Adjustments Error	Ex Post with GG Adjustments Value	Ex Post with GG Adjustments Error	Ex Post with No Adjustments Value	Ex Post with No Adjustments Error	Realized Revised Value
			Fourth Quarter of Forecast				
1967.2	360.0	−20.5	373.3	−7.2	374.3	−6.2	380.5
1967.3	395.9		382.5	0.2	382.5	0.2	382.3
1967.4	408.7		385.4	−4.1	386.5	−3.0	389.5
1968.1	379.9	−8.4	381.5	−6.8	382.3	−6.0	388.3
AFE		14.5		4.6		3.9	
			Fifth Quarter of Forecast				
1967.2	360.2	−22.1	377.6	−4.7	378.4	−3.9	382.3
1967.3	401.1		387.9	−1.6	387.9	−1.6	389.5
1967.4	416.2		389.6	1.3	390.6	2.3	388.3
AFE		−22.1		2.5		2.6	
			Sixth Quarter of Forecast				
1967.2	359.6	−29.9	380.8	−8.7	381.5	−8.0	389.5
1967.3			392.8	4.5	392.6	4.3	388.3
AFE		−29.9		6.6		6.1	
			Forecast One Year Ahead				
1967.2	361.5	−10.7	369.4	−2.8	370.5	−1.7	372.2
1967.3			375.5	−0.1	374.0	−1.6	375.6
1967.4			379.1	−1.6	379.0	−1.7	380.7
1968.1	376.6	−8.4	378.6	−6.5	379.6	−5.4	385.1
AFE		9.6		2.8		2.7	

TABLE 4.13A

Comparison of Ex Ante Forecasts, OBE Model, Investment in Constant Dollars

Quarter in Which Forecast Was Made	Reproduced Ex Ante Forecast		Ex Ante with AR Adjustments		Ex Ante with GG Adjustments		Ex Ante with No Adjustments		Ex Post with Actual Adjustments		Realized Prelimi-nary Value
	Value	Error	Value	Error	Value	Error	Value	Error	Value	Error	
					First Quarter of Forecast						
1967.2	92.1	2.2	96.2	6.3	92.2	2.3	92.3	2.4	89.8	−0.1	89.9
1967.3	94.7	1.3	96.7	3.3	95.1	1.7	95.1	1.7	94.0	0.6	93.4
1967.4	96.4	−8.2	96.6	−8.0	97.5	−7.1	97.2	−7.4	96.4	−8.3	104.7
1968.1	105.1	5.3	103.5	3.7	102.2	2.4	100.4	0.6	104.9	5.1	99.8
1968.2	103.6	−3.0	104.3	−2.3	98.7	−7.9	96.2	−10.4	104.7	−2.0	106.7
1968.3	103.7	−0.8	104.4	−0.1	100.7	−3.8	99.7	−4.8	103.2	−1.4	104.6
1968.4	109.0	−4.0	108.4	−4.6	106.2	−6.8	101.9	−11.1	108.8	−4.3	113.1
AFE		3.6		4.1		4.6		5.5		1.7	
					Second Quarter of Forecast						
1967.2	92.3	0.3	97.4	5.4	94.6	2.6	94.1	2.1	94.0	2.0	92.0
1967.3	97.9	−3.7	100.3	−1.3	102.9	1.2	102.9	1.2	94.7	−7.0	101.7
1967.4	102.7	1.2	98.1	−3.3	103.7	2.2	106.3	4.8	101.4	−0.1	101.5

(*continued*)

TABLE 4.13A (*concluded*)

Quarter in Which Forecast Was Made	Reproduced Ex Ante Forecast		Ex Ante with AR Adjustments		Ex Ante with GG Adjustments		Ex Ante with No Adjustments		Ex Post with Actual Adjustments		Realized Prelimi-nary Value
	Value	Error	Value	Error	Value	Error	Value	Error	Value	Error	
1968.1	103.3	−2.2	104.0	−1.5	102.5	−3.0	103.9	−1.6	105.2	−0.4	105.6
1968.2	104.0	−1.1	103.2	−1.9	96.7	−8.4	94.9	−10.2	105.5	0.3	105.2
1968.3	102.8	−9.0	100.1	−11.7	96.9	−14.9	95.7	−16.1	102.5	−9.4	111.9
AFE		3.0		4.3		5.4		6.0		3.2	
Third Quarter of Forecast											
1967.2	95.5	−4.7	99.7	−0.5	99.9	−0.3	98.4	−1.8	98.9	−1.4	100.3
1967.3	101.4	2.9	103.0	4.5	103.5	5.0	103.9	5.4	98.0	−0.5	98.5
1967.4	105.3	−1.9	100.2	−7.0	105.9	−1.3	106.9	−0.3	106.7	−0.6	107.3
1968.1	101.1	−2.9	102.8	−1.2	101.6	−2.4	104.6	0.5	104.1	0.0	104.1
1968.2	101.3	−11.1	100.7	−11.7	93.5	−18.9	91.9	−20.5	102.9	−9.6	112.5
AFE		4.8		5.1		5.7		5.8		2.4	
Fourth Quarter of Forecast											
1967.2									96.3	−0.8	97.1
1967.3	104.9	0.6	105.5	1.2	105.1	0.8	105.1	0.8	103.6	−0.7	104.3
1967.4	104.1	−1.6	103.1	−2.6	107.3	1.5	107.1	1.3	106.3	0.5	105.8

1968.1	98.3	−13.0	101.2	−10.1	100.9	−10.4	104.8	−6.5	102.4	−9.0	111.4
AFE		5.1		4.7		4.3		2.9		2.8	
Fifth Quarter of Forecast											
1967.2									102.8	−0.1	102.9
1967.3	102.8	0.0	107.0	4.2	108.1	5.3	107.6	4.8	102.9	0.1	102.8
1967.4	103.8	−9.2	104.0	−9.0	107.8	−5.2	107.4	−5.6	106.9	−6.2	113.1
AFE		4.7		6.7		5.3		5.3		2.1	
Sixth Quarter of Forecast											
1967.2									101.9	0.5	101.4
1967.3	103.6	−6.4	107.9	−2.1	110.0	−0.0	109.2	−0.8	104.0	−6.1	110.1
AFE		6.5		2.2		0.1		0.9		3.3	
Forecast One Year Ahead											
1967.2									94.8	−3.9	94.8
1967.3	99.8	0.2	101.4	1.9	101.7	2.2	101.8	2.3	97.6	1.9	99.5
1967.4	102.2	−2.6	99.5	−5.2	103.6	−1.1	104.4	−0.3	102.7	2.1	104.8
1968.1	102.0	−3.2	102.9	−2.2	101.8	−3.3	103.5	−1.7	104.2	1.0	105.2
AFE		2.1		3.2		2.3		1.5		2.2	

TABLE 4.13P

Comparison of Ex Post Forecasts, OBE Model, Investment in Constant Dollars

Quarter in Which Forecast Was Made	Ex Post with AR Adjustments Value	Ex Post with AR Adjustments Error	Ex Post with GG Adjustments Value	Ex Post with GG Adjustments Error	Ex Post with No Adjustments Value	Ex Post with No Adjustments Error	Realized Revised Value
			First Quarter of Forecast				
1967.2	100.8	1.0	99.9	0.1	100.1	0.3	99.8
1967.3			95.8	1.5	95.1	0.8	94.3
1967.4			101.2	4.8	99.8	3.4	96.4
1968.1	104.8	0.1	102.0	−2.7	99.2	−5.5	104.7
1968.2	108.6	7.1	103.1	1.6	100.5	−1.0	101.5
1968.3	107.4	0.1	102.6	−4.7	103.0	−4.3	107.3
1968.4	108.2	2.4	106.4	0.6	102.4	−3.4	105.8
AFE		2.1		2.3		2.7	
			Second Quarter of Forecast				
1967.2	100.7	6.4	103.0	8.7	102.6	8.3	94.3
1967.3			100.6	4.2	99.8	3.4	96.4
1967.4			105.0	0.3	104.5	−0.2	104.7
1968.1	108.0	6.5	102.3	0.8	100.4	−1.1	101.5
1968.2	113.2	5.9	101.9	−5.4	97.4	−9.9	107.3
1968.3	109.0	3.2	102.3	−3.5	101.9	−3.9	105.8
AFE		5.5		3.8		4.5	
			Third Quarter of Forecast				
1967.2	100.1	3.7	106.4	10.0	105.1	8.7	96.4
1967.3			102.1	−2.6	101.9	−2.8	104.7
1967.4			107.2	5.7	108.1	6.6	101.5
1968.1	107.7	0.4	102.1	−5.2	102.1	−5.2	107.3
1968.2	113.5	7.7	99.8	−6.0	96.0	−9.8	105.8
AFE		3.9		5.9		6.6	

TABLE 4.13P (*concluded*)

Quarter in Which Forecast Was Made	Ex Post with AR Adjustments Value	Ex Post with AR Adjustments Error	Ex Post with GG Adjustments Value	Ex Post with GG Adjustments Error	Ex Post with No Adjustments Value	Ex Post with No Adjustments Error	Realized Revised Value
			Fourth Quarter of Forecast				
1967.2	94.3	−10.4	105.3	0.6	102.9	−1.8	104.7
1967.3			104.7	3.2	104.4	2.9	101.5
1967.4			107.7	0.4	108.7	1.4	107.3
1968.1	106.4	0.6	102.2	−3.6	103.2	−2.6	105.8
AFE		5.5		1.9		2.2	
			Fifth Quarter of Forecast				
1967.2	90.4	−11.1	105.7	4.2	102.5	1.0	101.5
1967.3			106.9	−0.4	106.2	−1.1	107.3
1967.4			110.0	4.2	110.3	4.5	105.8
AFE		−11.1		2.9		2.2	
			Sixth Quarter of Forecast				
1967.2	88.0	−19.3	106.4	−0.9	102.8	−4.5	107.3
1967.3		−19.3	110.3	4.5	109.3	3.5	105.8
AFE				2.7		4.0	
			Forecast One Year Ahead				
1967.2	99.0	0.3	103.7	5.0	102.7	4.0	98.7
1967.3			100.8	1.6	100.3	1.1	99.2
1967.4			105.3	2.9	105.3	2.8	102.4
1968.1	106.8	1.9	102.2	−2.5	101.3	−3.5	104.8
AFE		1.1		3.0		2.9	

TABLE 4.14A

Comparison of Ex Ante Forecasts, OBE Model, GNP in Constant Dollars

Quarter in Which Forecast Was Made	Reproduced Ex Ante Forecast		Ex Ante with AR Adjustments		Ex Ante with GG Adjustments		Ex Ante with No Adjustments		Ex Post with Actual Adjustments		Realized Prelimi-nary Value
	Value	Error	Value	Error	Value	Error	Value	Error	Value	Error	
First Quarter of Forecast											
1967.2	660.5	–0.1	664.3	3.6	661.8	1.1	663.1	2.4	660.7	0.0	660.7
1967.3	674.4	3.3	675.0	3.9	673.9	2.8	677.5	6.4	670.5	–0.6	671.1
1967.4	677.6	–0.5	677.4	–0.7	681.2	3.0	684.9	6.7	675.1	–3.1	678.2
1968.1	690.8	0.3	687.8	–2.6	690.0	–0.4	692.9	2.4	695.3	4.8	690.5
1968.2	699.1	–1.2	695.8	–4.5	697.4	–2.9	697.1	–3.2	701.8	1.4	700.4
1968.3	703.7	–6.8	703.9	–6.6	701.9	–8.6	700.8	–9.7	705.8	–4.8	710.6
1968.4	718.9	0.5	717.3	–1.0	718.3	–0.0	717.5	–0.8	716.1	–2.3	718.4
AFE		1.9		3.3		2.7		4.6		2.4	
Second Quarter of Forecast											
1967.2	667.5	0.4	671.7	4.6	671.2	4.1	671.8	4.7	662.4	–4.7	667.1
1967.3	684.9	7.6	686.1	8.8	688.0	10.7	693.1	15.8	674.9	–2.4	677.3
1967.4	692.5	3.4	685.5	–3.5	692.7	3.6	698.9	9.8	694.5	5.4	689.1

1968.1	692.6	−8.5	693.6	−7.5	698.0	−3.1	702.5	1.3	701.2	0.0	701.2
1968.2	703.9	−5.3	696.8	−12.4	699.7	−9.5	698.8	−10.4	708.4	−0.9	709.3
1968.3	705.4	−11.2	701.0	−15.6	701.0	−15.6	699.6	−17.0	705.5	−11.2	716.7
AFE		6.1		8.8		7.8		9.9		4.1	
Third Quarter of Forecast											
1967.2	677.3	4.0	679.8	6.5	683.0	9.7	682.8	9.5	668.6	−4.7	673.3
1967.3	697.3	9.1	696.4	8.2	698.6	10.4	701.5	13.3	689.7	1.5	688.2
1967.4	702.5	2.7	694.0	−5.7	702.1	2.3	705.9	6.1	708.5	8.7	699.8
1968.1	695.7	−14.3	698.1	−11.9	705.1	−4.9	710.1	0.0	707.2	−2.9	710.1
1968.2	705.5	−9.8	696.3	−19.0	700.5	−14.8	689.6	−25.7	706.4	−9.0	715.4
AFE		8.0		10.3		8.5		10.9		5.4	
Fourth Quarter of Forecast											
1967.2									682.3	−1.9	684.2
1967.3	707.2	8.3	705.0	6.1	707.9	9.0	709.6	10.7	704.9	6.0	698.9
1967.4	706.6	−2.0	703.9	−4.7	710.1	1.4	712.4	3.7	715.0	6.3	708.7
1968.1	697.9	−18.2	703.3	−12.8	711.3	−4.8	716.4	0.2	705.8	−10.4	716.2
AFE		9.6		7.9		5.1		4.9		6.2	

(continued)

TABLE 4.14A (*concluded*)

Quarter in Which Forecast Was Made	Reproduced Ex Ante Forecast		Ex Ante with AR Adjustments		Ex Ante with GG Adjustments		Ex Ante with No Adjustments		Ex Post with Actual Adjustments		Realized Preliminary Value
	Value	Error	Value	Error	Value	Error	Value	Error	Value	Error	
					Fifth Quarter of Forecast						
1967.2									696.7	1.8	694.9
1967.3	711.2	3.4	711.8	4.0	716.3	8.5	717.8	10.0	712.8	5.0	707.8
1967.4	711.8	–2.9	711.3	–3.4	716.9	2.1	718.7	3.9	717.8	3.0	714.8
AFE		3.2		3.8		5.3		7.0		3.3	
					Sixth Quarter of Forecast						
1967.2									710.0	6.2	703.8
1967.3	718.8	4.9	718.2	4.3	724.7	10.8	725.3	11.4	717.4	3.5	713.9
AFE		4.9		4.3		10.8		11.4		4.9	
					Forecast One Year Ahead						
1967.2									668.5	–2.8	671.3
1967.3	691.0	7.1	690.7	6.8	692.1	8.2	695.5	11.6	685.0	1.1	683.9
1967.4	694.8	0.9	690.2	–3.7	696.6	2.6	700.6	6.6	698.3	4.4	693.9
1968.1	694.3	–10.2	695.7	–8.7	701.1	–3.3	705.5	1.0	702.4	–2.1	704.5
AFE		6.1		6.4		4.7		6.4		2.8	

TABLE 4.14P

Comparison of Ex Post Forecasts, OBE Model, GNP in Constant Dollars

Quarter in Which Forecast Was Made	Ex Post with AR Adjustments Value	Ex Post with AR Adjustments Error	Ex Post with GG Adjustments Value	Ex Post with GG Adjustments Error	Ex Post with No Adjustments Value	Ex Post with No Adjustments Error	Realized Revised Value
			First Quarter of Forecast				
1967.2	684.2	15.0	685.8	16.6	687.6	18.4	669.2
1967.3			675.7	0.1	674.5	−1.1	675.6
1967.4			683.5	1.7	683.6	1.8	681.8
1968.1	692.6	−0.1	694.1	1.4	694.0	1.3	692.7
1968.2	705.1	1.7	704.8	1.4	699.7	−3.7	703.4
1968.3	710.7	−1.6	705.4	−6.9	704.0	−8.3	712.3
1968.4	714.4	−4.0	715.8	−2.6	715.6	−2.8	718.4
AFE		4.5		4.4		5.3	
			Second Quarter of Forecast				
1967.2	683.6	8.0	690.5	14.9	691.9	16.3	675.6
1967.3			683.4	1.6	683.3	1.5	681.8
1967.4			696.3	3.6	698.1	5.4	692.7
1968.1	700.7	−2.7	700.9	−2.5	700.6	−2.8	703.4
1968.2	714.4	2.1	708.6	−3.7	702.0	−10.3	712.3
1968.3	712.5	−5.9	705.2	−13.2	703.9	−14.5	718.4
AFE		4.7		6.6		8.5	
			Third Quarter of Forecast				
1967.2	686.0	4.2	698.7	16.9	699.5	17.7	681.8
1967.3			695.1	2.4	696.3	3.6	692.7
1967.4			706.9	3.5	710.1	6.7	703.4
1968.1	707.5	−4.8	708.0	−4.3	708.6	−3.7	712.3
1968.2	715.1	−3.3	707.1	−11.3	701.7	−16.7	718.4
AFE		4.1		7.7		9.7	

(*continued*)

TABLE 4.14P (*concluded*)

Quarter in Which Forecast Was Made	Ex Post with AR Adjustments		Ex Post with GG Adjustments		Ex Post with No Adjustments		Realized Revised Value
	Value	Error	Value	Error	Value	Error	Value
			Fourth Quarter of Forecast				
1967.2	687.9	–4.8	708.0	15.3	707.9	15.2	692.7
1967.3			708.0	4.6	708.8	5.4	703.4
1967.4			716.2	3.9	719.0	6.7	712.3
1968.1	707.4	–11.0	709.3	–9.1	710.6	–7.8	718.4
AFE		–7.9		8.2		8.8	
			Fifth Quarter of Forecast				
1967.2	688.9	–14.5	716.4	13.0	715.6	12.2	703.4
1967.3			719.0	6.7	719.3	7.0	712.3
1967.4			721.8	3.4	723.6	5.2	718.4
AFE		–14.5		7.7		8.1	
			Sixth Quarter of Forecast				
1967.2	691.6	–20.7	725.5	13.2	724.2	11.9	712.3
1967.3			725.7	7.3	725.5	7.1	718.4
AFE		–20.7		10.3		9.5	
			Forecast One Year Ahead				
1967.2	685.5	5.7	695.8	16.0	696.8	17.0	679.8
1967.3			690.6	2.3	690.8	2.5	688.3
1967.4			700.8	3.3	702.7	5.2	697.5
1968.1	702.1	–4.6	703.1	–3.4	703.5	–3.2	706.7
AFE		5.2		6.3		7.0	

TABLE 4.15A

Comparison of Ex Ante Forecasts, OBE Model, Unemployment Rate

Quarter in Which Forecast Was Made	Reproduced Ex Ante Forecast Value	Reproduced Ex Ante Forecast Error	Ex Ante with AR Adjustments Value	Ex Ante with AR Adjustments Error	Ex Ante with GG Adjustments Value	Ex Ante with GG Adjustments Error	Ex Ante with No Adjustments Value	Ex Ante with No Adjustments Error	Ex Post with Actual Adjustments Value	Ex Post with Actual Adjustments Error	Realized Preliminary Value
First Quarter of Forecast											
1967.2	3.9	0.0	3.7	−0.1	3.8	−0.0	4.5	0.6	3.9	0.0	3.9
1967.3	3.8	0.0	4.1	0.3	3.8	0.0	3.7	−0.0	3.8	0.0	3.8
1967.4	4.0	0.1	4.0	0.1	3.4	−0.4	3.3	−0.5	4.1	0.2	3.9
1968.1	3.7	0.0	4.0	0.3	4.2	0.5	4.4	0.7	3.7	0.0	3.7
1968.2	3.6	0.0	3.6	0.0	3.2	−0.3	3.1	−0.4	3.6	0.0	3.6
1968.3	3.7	0.1	3.7	0.1	3.8	0.2	3.6	0.0	3.7	0.1	3.6
1968.4	3.7	0.3	3.7	0.3	3.7	0.3	3.7	0.3	3.8	0.4	3.4
AFE		0.1		0.2		0.3		0.4		0.1	
Second Quarter of Forecast											
1967.2	4.0	0.1	3.7	−0.1	3.7	−0.1	4.9	1.0	4.2	0.3	3.9
1967.3	3.7	−0.0	3.9	0.1	3.6	−0.1	3.3	−0.4	4.1	0.3	3.8
1967.4	4.0	0.4	4.2	0.6	3.5	−0.0	3.2	−0.3	4.0	0.4	3.6

(continued)

TABLE 4.15A (*concluded*)

Quarter in Which Forecast Was Made	Reproduced Ex Ante Forecast		Ex Ante with AR Adjustments		Ex Ante with GG Adjustments		Ex Ante with No Adjustments		Ex Post with Actual Adjustments		Realized Prelimi-nary Value
	Value	Error	Value	Error	Value	Error	Value	Error	Value	Error	
					Second Quarter of Forecast (continued)						
1968.1	4.0	0.4	4.4	0.8	4.7	1.1	4.6	1.0	3.9	0.3	3.6
1968.2	3.7	0.1	3.7	0.1	3.2	−0.3	3.2	−0.3	3.6	0.0	3.6
1968.3	3.8	0.4	3.8	0.4	4.0	0.6	4.0	0.6	3.9	0.5	3.4
AFE		0.3		0.4		0.4		0.7		0.3	
					Third Quarter of Forecast						
1967.2	3.9	0.0	3.7	−0.1	3.5	−0.3	5.1	1.2	4.5	0.6	3.9
1967.3	3.5	0.0	3.7	0.2	3.3	−0.1	3.1	−0.3	4.0	0.5	3.5
1967.4	3.8	0.3	4.3	0.8	3.4	−0.0	3.1	−0.3	3.6	0.1	3.5
1968.1	4.1	0.5	4.5	0.9	4.7	1.1	4.5	0.9	4.0	0.4	3.6
1968.2	3.8	0.4	3.9	0.5	3.3	−0.0	3.3	−0.0	3.9	0.5	3.4
AFE		0.2		0.5		0.4		0.6		0.4	
					Fourth Quarter of Forecast						
1967.2									4.5	0.9	3.6
1967.3	3.3	−0.0	3.6	0.2	3.1	−0.2	2.9	−0.4	3.7	0.3	3.4
1967.4	3.8	0.3	4.3	0.8	3.3	−0.1	3.1	−0.3	3.5	0.0	3.5

1968.1	4.2	0.8	4.6	1.2	4.8	1.4	4.5	1.1	4.1	0.7	3.4
AFE		0.4		0.7		0.6		0.7		0.5	
Fifth Quarter of Forecast											
1967.2									4.5	0.9	3.6
1967.3	3.3	−0.0	3.5	0.1	3.0	−0.3	2.8	−0.5	3.6	0.2	3.4
1967.4	3.8	0.5	4.3	1.0	3.3	0.0	3.1	−0.1	3.7	0.4	3.3
AFE		0.3		0.6		0.2		0.4		0.5	
Sixth Quarter of Forecast											
1967.2									4.3	0.7	3.6
1967.3	3.2	0.0	3.5	0.3	2.8	−0.3	2.7	−0.4	3.7	0.5	3.2
AFE		0.0		0.3		0.4		0.5		0.6	
Forecast One Year Ahead											
1967.2									4.3	0.5	3.8
1967.3	3.6	−0.0	3.9	0.2	3.5	−0.1	3.3	−0.3	3.9	0.3	3.6
1967.4	3.9	0.3	4.2	0.6	3.4	−0.1	3.2	−0.3	3.8	0.2	3.6
1968.1	4.0	0.4	4.4	0.8	4.6	1.0	4.5	0.9	4.0	0.4	3.6
AFE		0.2		0.5		0.5		0.6		0.5	

TABLE 4.15P

Comparison of Ex Post Forecasts, OBE Model, Unemployment

Quarter in Which Forecast Was Made	Ex Post with AR Adjustments		Ex Post with GG Adjustments		Ex Post with No Adjustments		Realized Revised Value
	Value	Error	Value	Error	Value	Error	Value
			First Quarter of Forecast				
1967.2	2.3	−1.6	3.2	−0.7	4.0	0.1	3.9
1967.3			4.5	0.6	4.5	0.6	3.9
1967.4			4.3	0.4	4.3	0.4	3.9
1968.1	3.9	0.2	4.5	0.8	4.8	1.1	3.7
1968.2	3.6	0.0	2.4	−1.2	2.5	−1.1	3.6
1968.3	3.6	0.0	3.8	0.2	3.7	0.1	3.6
1968.4	3.8	0.4	3.8	0.4	3.7	0.3	3.4
AFE		0.6		0.6		0.5	
			Second Quarter of Forecast				
1967.2	2.0	−1.9	3.1	−0.8	4.3	0.4	3.9
1967.3			5.0	1.1	5.1	1.2	3.9
1967.4			4.8	1.1	4.8	1.1	3.7
1968.1	4.0	0.4	5.1	1.5	5.2	1.6	3.6
1968.2	3.4	−0.2	1.9	−1.7	2.3	−1.3	3.6
1968.3	3.6	0.2	4.1	0.7	4.1	0.7	3.4
AFE		0.7		1.1		1.1	
			Third Quarter of Forecast				
1967.2	2.1	−1.8	3.2	−0.7	4.8	0.9	3.9
1967.3			5.2	1.5	5.2	1.5	3.7
1967.4			4.9	1.3	4.7	1.1	3.6
1968.1	4.0	0.4	5.3	1.7	5.3	1.7	3.6
1968.2	3.4	0.0	1.6	−1.8	2.1	−1.3	3.4
AFE		0.7		1.4		1.3	

TABLE 4.15P (*concluded*)

Quarter in Which Forecast Was Made	Ex Post with AR Adjustments Value	Error	Ex Post with GG Adjustments Value	Error	Ex Post with No Adjustments Value	Error	Realized Revised Value
			Fourth Quarter of Forecast				
1967.2	2.5	−1.2	3.3	−0.4	5.2	1.5	3.7
1967.3			5.1	1.5	5.0	1.4	3.6
1967.4			4.9	1.3	4.7	1.1	3.6
1968.1	4.1	0.7	5.5	2.1	5.4	2.0	3.4
AFE		0.9		1.3		1.5	
			Fifth Quarter of Forecast				
1967.2	2.8	−0.8	3.3	−0.3	5.5	1.9	3.6
1967.3			4.8	1.2	4.8	1.2	3.6
1967.4			4.8	1.4	4.7	1.3	3.4
AFE		0.8		1.0		1.5	
			Sixth Quarter of Forecast				
1967.2	3.2	−0.4	3.3	−0.3	5.7	2.1	3.6
1967.3			4.7	1.3	4.7	1.3	3.4
AFE		0.4		0.8		1.7	
			Forecast One Year Ahead				
1967.2	2.3	−1.5	3.2	−0.6	4.6	0.8	3.8
1967.3			5.0	1.3	5.0	1.3	3.7
1967.4			4.8	1.1	4.7	1.0	3.7
1968.1	4.0	0.5	5.1	1.6	5.2	1.7	3.5
AFE		1.0		1.1		1.2	

CHART 4.1

Forecast vs. Realization
Wharton Model with Actual Constant Adjustments
(GNP: Billion 1958 Dollars)

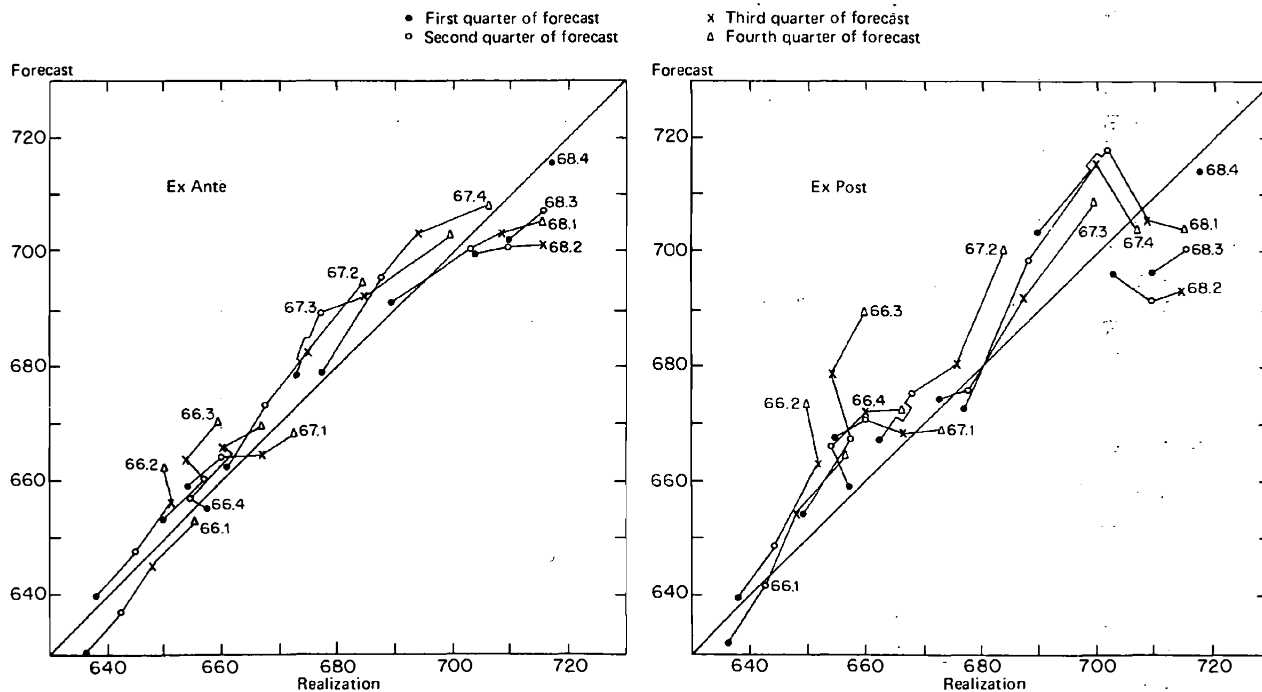


CHART 4.2

Forecast vs. Realization
Wharton Model with AR Constant Adjustments
(GNP: Billion 1958 Dollars)

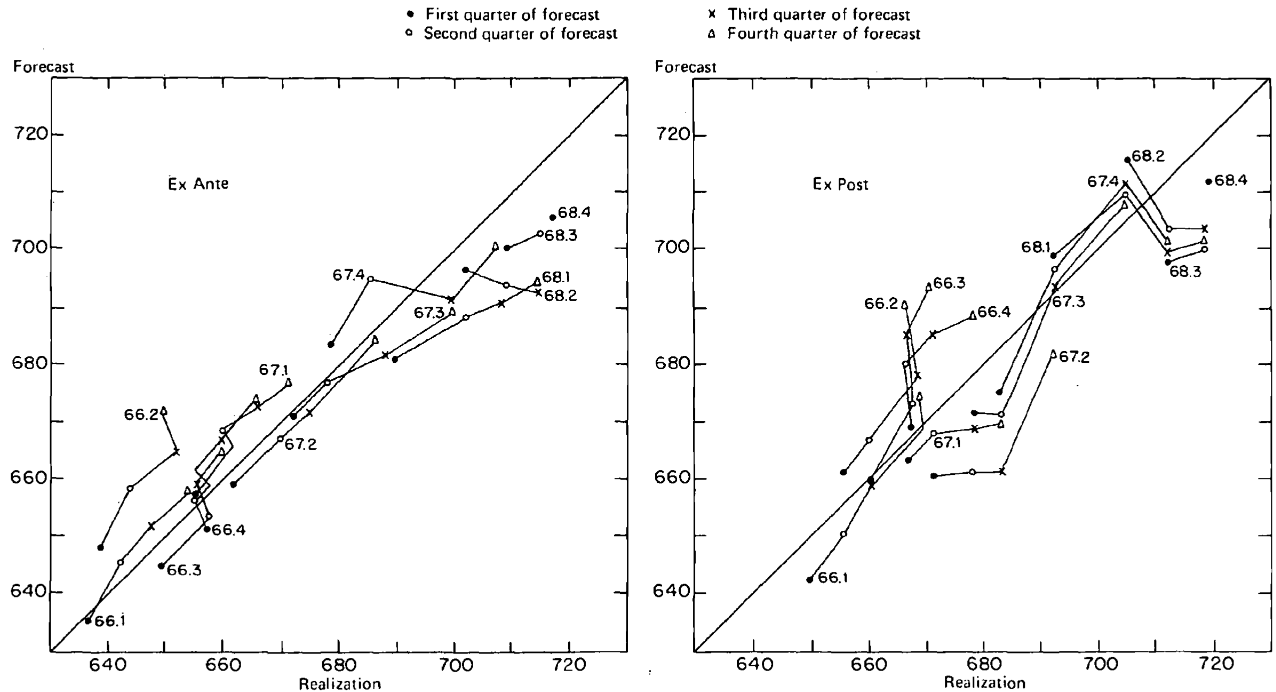


CHART 4.3

Forecast vs. Realization
Wharton Model with GG Constant Adjustments
(GNP: Billion 1958 Dollars)

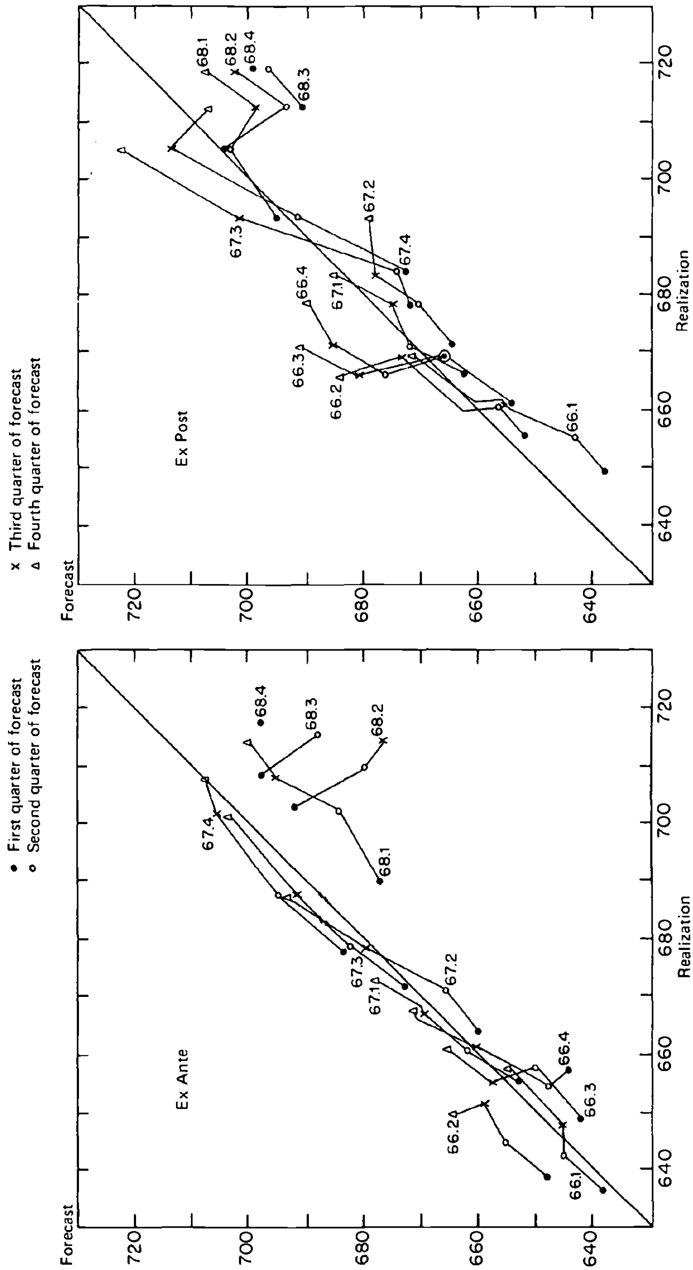


CHART 4.4

Forecast vs. Realization
Wharton Model with No Constant Adjustments
(GNP: Billion 1958 Dollars)

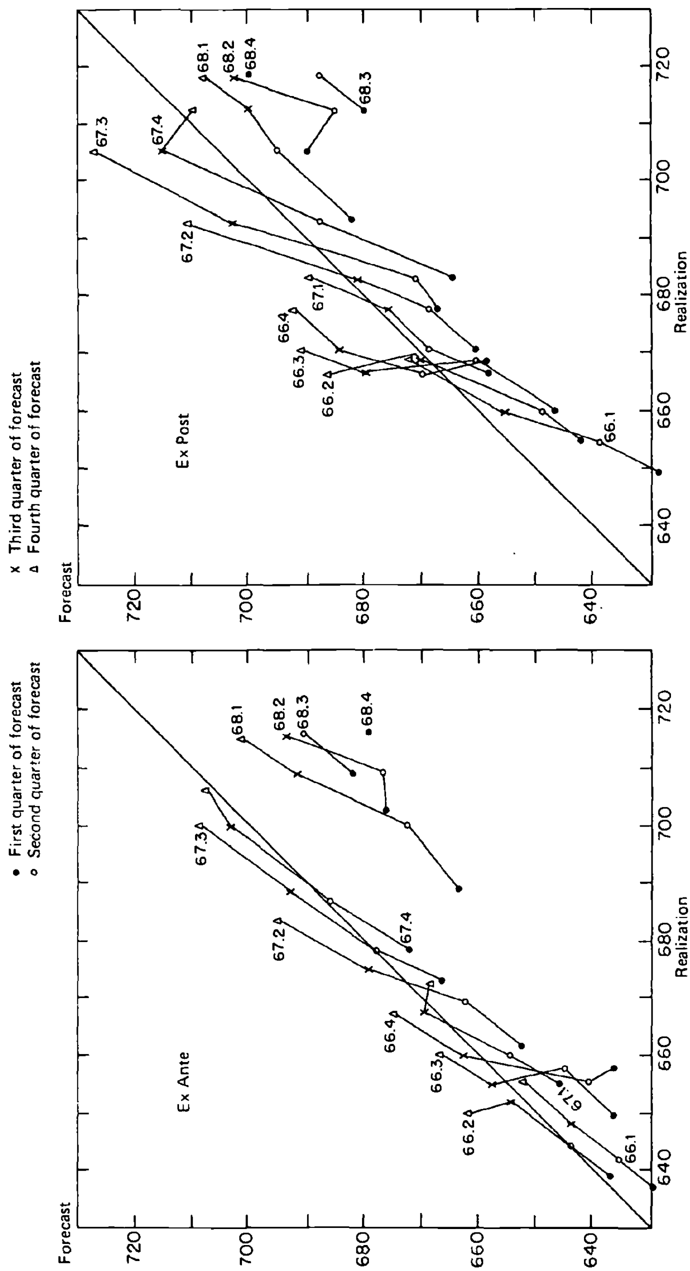


CHART 4.5

Forecast vs. Realization

OBE Model with Actual Constant Adjustments

(GNP: Billion 1958 Dollars)

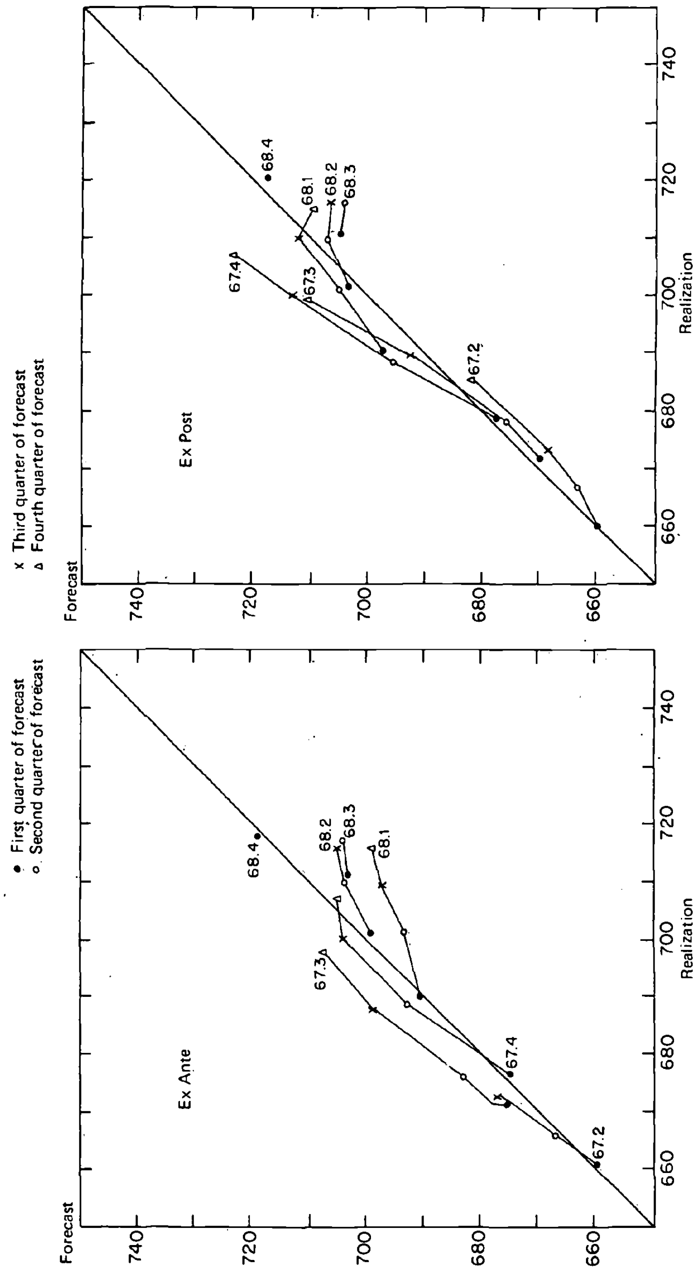


CHART 4.6

Forecast vs. Realization
OBE Model with AR Constant Adjustments
(GNP: Billion 1958 Dollars)

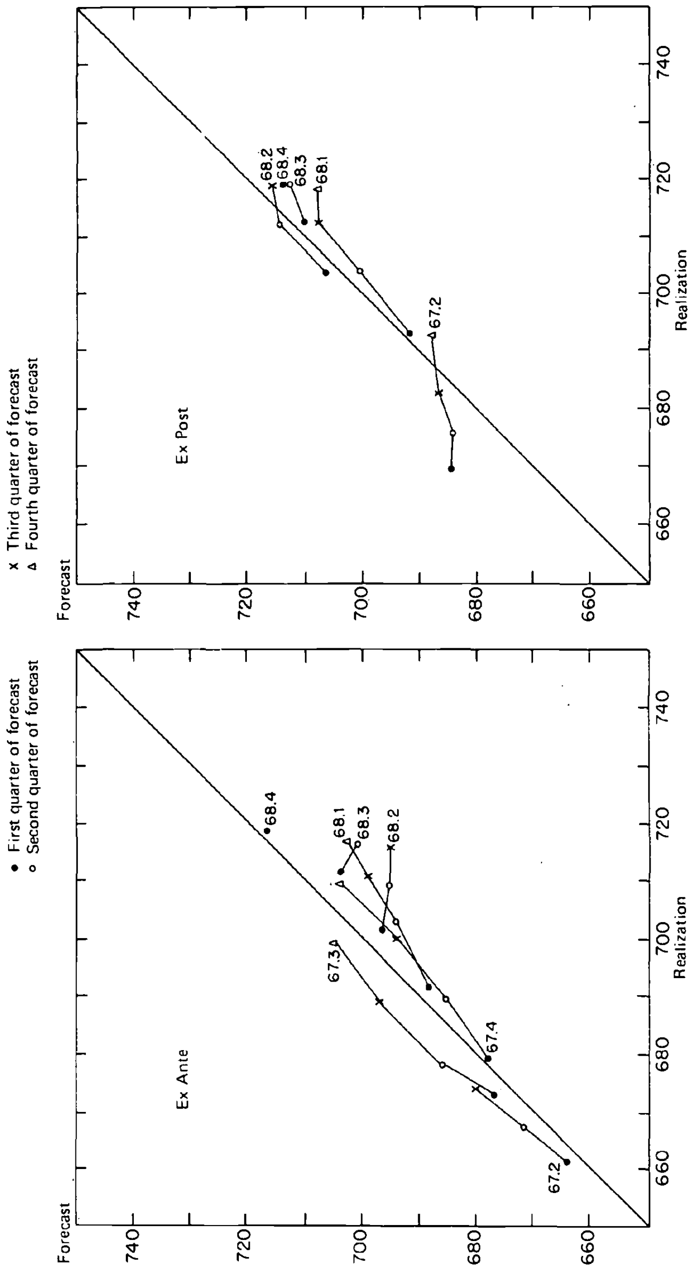


CHART 4.7

Forecast vs. Realization
OBE Model with GG Constant Adjustments
(GNP: Billion 1958 Dollars)

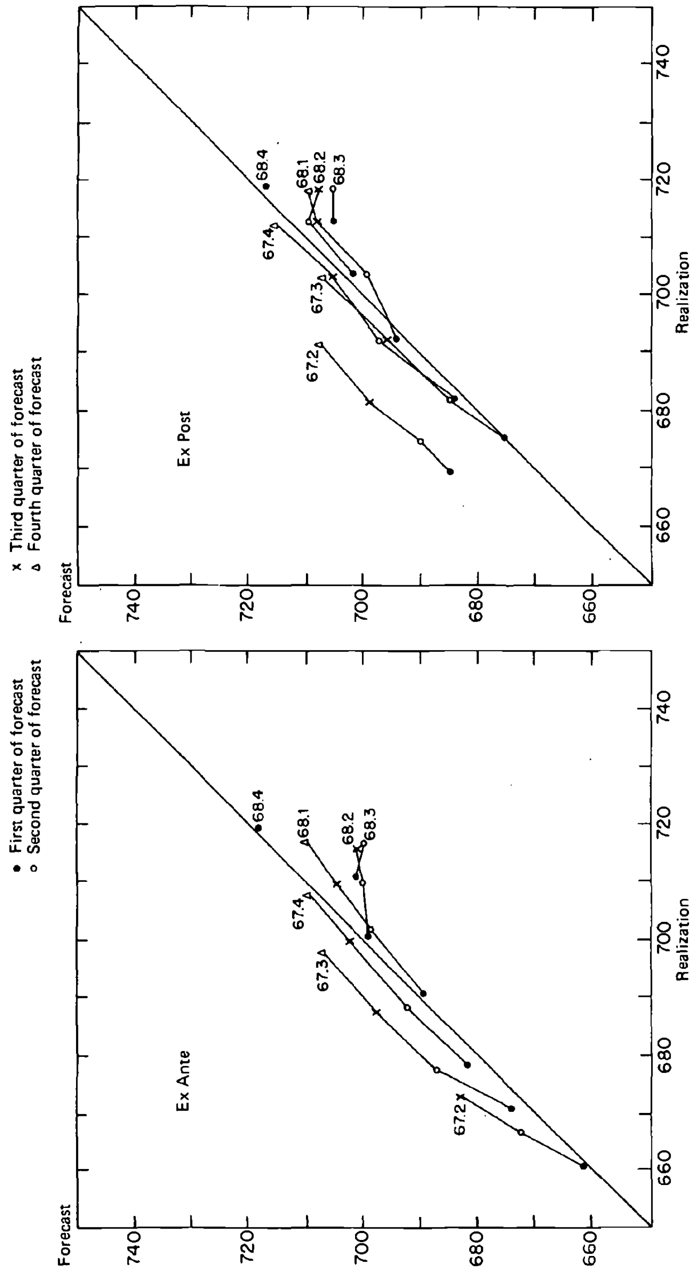
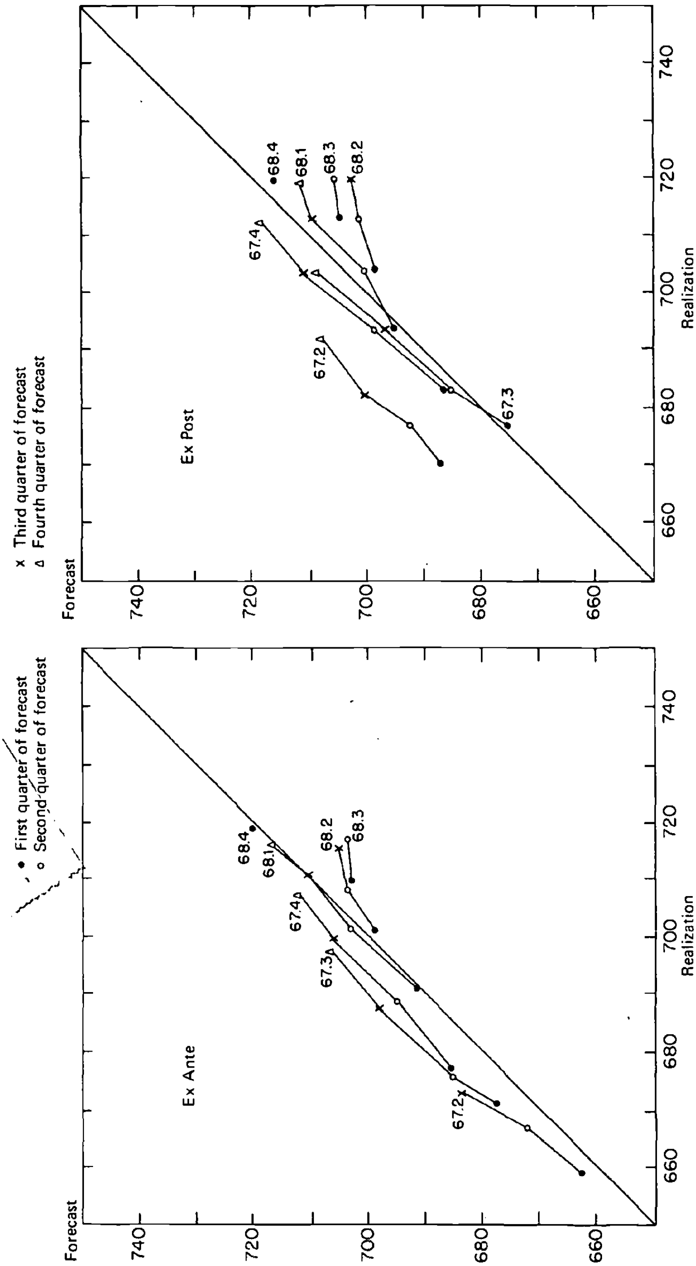


CHART 4.8

Forecast vs. Realization

OBE Model with No Constant Adjustments

(GNP: Billion 1958 Dollars)



ments but utilizing the *actual* values of the exogenous variables. The OBE results show no advantage for either method.

2. For both the Wharton and OBE forecasts, about half of the ex ante forecasts with mechanical adjustments have smaller error than the respective ex post forecasts.

3. The GG adjustments are considerably better than any other mechanical adjustments (including no constant adjustments) for the OBE Model, but no one mechanical method is definitely superior for the Wharton-EFU Model.

4. The true ex ante forecasts are much better than any of the ex ante forecasts generated by mechanical methods for both the Wharton-EFU and OBE Models.

We consider first, points 4 and 3; and then, points 1 and 2. The fourth point is easily explained and provides substantive evidence for the widespread belief that there is a considerable amount of fine-tuning of econometric models when they are used for true ex ante forecasting. This finding in large part explains why errors of the true ex ante forecasts are so much smaller than corresponding sample-period statistics.

It is not possible to draw any definite conclusions about the third point, since the two models present conflicting evidence. In view of the comments in the previous section, one would expect that the GG adjustments would provide the best results of any of the mechanical methods which were tried. In this respect, the OBE Model results agree with a priori reasoning, but the Wharton-EFU Model results do not. Closer examination of the results reveals a rather peculiar pattern. For the shorter period forecasts (one or two quarters), when the AR and GG adjustments should be most similar, the AR adjustments usually give a smaller error. However, for the longer time spans, when the GG adjustments are quite small, the latter give the better forecasts. In other words, in the first two periods very large adjustments are needed —almost the full amount of the residuals—while in later periods almost no adjustments are needed. There is no unique explanation for this dichotomy, but it does agree with the decomposition of error analysis discussed in the previous section. At that point, it was shown that for the sample period and ex post simulations, the Wharton-EFU Model was unable to track minor fluctuations in the first few periods, although it did much better in staying close to the actual values for longer periods.

We shall next consider the first conclusion. It was originally thought that the subjective adjustment of constants was in large part a method of offsetting bad guesses for the exogenous variables. For example, suppose that the econometric forecaster expects government expenditures for the next quarter to increase by $5 billion; inserting this assumption in the model generates a $15 billion increase in *GNP* for the next quarter. However, given his "feeling" about the economy, buttressed by additional information about orders, construction starts, and so on, the forecaster thinks that $10 billion will be a better estimate. This would lead to a downward adjustment in the constant terms of the consumption and investment functions until the *GNP* forecast is reduced to a $10 billion increase. Later, the actual figures reveal that government expenditures increased by only $2 billion; the rise in *GNP* is in fact $10 billion. Since most econometric models have impact multipliers for government purchases of 1.5 to 2.0, this would reduce the increase in *GNP* which was predicted ex post to about $5 billion. If the additional constant adjustments had not been made, the ex post forecast would have shown an increase of about $10 billion. In this case, ex post forecasts would be inferior to the ex ante forecasts when the ex ante constant adjustments are used.

This example illustrates only a conjecture; there may be other reasons why the ex ante forecasts are better than the ex post forecasts for the Wharton Model. If we introduce the evidence summarized in the second conclusion, that conjecture must be rejected, for the ex ante forecasts are superior to the ex post forecasts in almost half the cases, even when the *same* method of constant adjustment is used. This is potentially a much more damaging argument against the use of econometric models for forecasting and policy analysis than is the first conclusion. Even if we eschew all judgment in the adjustment of the constant terms, the forecast error increases almost as often as it decreases when we introduce the correct values of the exogenous variables into the solution. The first conclusion could be explained by offsetting errors; the forecaster is able to gauge the change in the economy accurately for the next one or two quarters, so he offsets his bad guesses for the values of the exogenous variables by adjusting the rest of the model. With mechanical (or no) constant adjustments, this is no longer an admissible procedure. Inserting the correct exogenous values often pushes the solution farther away from the true value. This might occur either because the actual data series are faulty, or because the fiscal policy multipliers are overstated in the Wharton-EFU and OBE Models. Each of these possibilities will be considered in turn.

The only exogenous variables for which the differences between estimated and actual values make much difference are government expenditures, tax rates, and monetary policy variables (discount rate and free reserve ratio). Of these, only ex post figures for government expenditures are likely to be subject to distortion in reporting. In particular, defense spending may be entered in the National Income Accounts as inventory investment while the goods are being produced, becoming government purchases only when they are finished and are transferred to the military authorities. While the same problem also exists for producers' durable equipment, it is not as serious a problem because the quarterly fluctuations are not as acute.

To illustrate this problem, consider a situation where the government orders an additional $10 billion of military hardware. We make the extreme assumption that all of this equipment is ordered at the same time, and that it all takes exactly one year to complete, at which time it is delivered to the government. Work progresses on this equipment steadily during the year. There are two polar positions for presenting this in the national income accounts.

Case I:						
	$\Delta(\Delta I_i)$	$2.5	$2.5	$2.5	$2.5	−$10.0
	ΔG_d	0.0	0.0	0.0	0.0	$10.0
Case II:						
	$\Delta(\Delta I_i)$	0.0	0.0	0.0	0.0	0.0
	ΔG_d	$2.5	$2.5	$2.5	$2.5	0.0

The net increase in *GNP* in each quarter is the same for both cases. In the final quarter, the only activity occurring is the transfer of finished goods from the manufacturer to the government. However, if one is trying to predict the level of government expenditures, it makes a great difference whether Case I or Case II accounting methodology is used.

If the forecaster is in our hypothetical Period 4 (above), if he is trying to predict Period 5, and if he knows that Case I is being used, it is then a simple matter to make an adjustment of −$10 billion to the inventory investment equation. However, one is usually not sure how much of recent movements in inventory investment is due to changes in semifinished defense goods. Thus the adjustment may be only partial, or may not be made at all. In the case of mechanical constant adjustments, it has been noted earlier that no adjustment is made for the inventory investment equations at all. In this case, an adjustment based on the previous residuals would lead to an even larger error. If the ex ante forecaster does not foresee the large rise in G_d, then his prediction of G_d would be understated by $10 billion, but his estimate of GNP (assuming no other errors) would be perfect. However, if he uses the ex post figures and raises G_d by $10 billion without including offsetting constant adjustments elsewhere in the model, the GNP prediction is almost sure to be overstated. This is what appears to have happened, particularly in the first two quarters in 1967, when government defense expenditures rose $8.5 billion and manufacturing inventory investment dropped $8.1 billion (total ΔI_i dropped $17.5 billion).

With respect to the other possibility for the superior performance of the ex ante forecasts mentioned above, there is some evidence to suggest that the early quarter government expenditure (and tax) multipliers are overstated by the Wharton-EFU Model. The first-quarter change in constant-dollar GNP, due to a $1 billion change in constant-dollar government expenditure, is $2.0 billion. In an updated version of the model, this multiplier is reduced to about 1.6.[28] Furthermore, the OBE Model, the FRB-MIT Model, the Brookings Model, and the Michigan Model all have impact multipliers of about 1.5 for government purchases. However, even these multipliers may be overstated, as explained in the next section. The Wharton forecasters may have compensated for this deficiency in their models by choosing exogenous values that would yield forecasts in line with their good a priori view of a reasonable forecast, or the good ex ante results may have been caused by random occurrences in a small sample.

[28] These results are reported in M. K. Evans, "Computer Simulations of Non-Linear Econometric Models," in T. H. Naylor, ed., *The Design of Computer Simulation Experiments*. New York, John Wiley & Sons, Inc., 1969.

5 AN ANALYSIS OF PROCEDURES FOR MINIMIZING EX ANTE FORECAST ERROR

WE SHALL examine four techniques that might be used to reduce forecast error. The methods that we will examine are: (*a*) the introduction of judgment during the forecasting process, (*b*) the adjustment of equations on the basis of previous residuals, (*c*) the use of new estimating procedures to reduce forecast error for complete system solutions, and (*d*) the use of alternative specifications and estimating procedures to reduce error propagation within a simultaneous model. It will be seen that both the third and fourth sources of error stem from a common problem.

A. THE INTRODUCTION OF JUDGMENT DURING THE FORECASTING PROCESS

We shall consider three ways that judgment can be used in the forecasting process after the model has been specified and estimated, and after the preliminary lagged values have been collected. The forecaster first exercises his judgment when he chooses the values of the exogenous variables, again when he adjusts the constant terms of the equations, and again when he modifies these decisions on the basis of preliminary forecasts. We shall consider each of these problems in turn.

In order to make an econometric forecast, one must project the values for the exogenous variables. We can see, in Table 4.1, that forecasts of constant-dollar *GNP* when actual values of the exogenous variables were used are not any better than results achieved when the guessed values were employed. Since it is obvious that a forecaster would benefit from future information, we must conclude that some factors tend to offset the inherent advantage that ex post data should have in tracking the actual path of the economy. The method used in the National Income Accounts in reporting government expenditure (which was explained in Section 4) is clearly one such factor.

When we specify an equation we cannot include every conceivable variable as an explanatory variable. Thus, only a priori reasonable variables are included in our specification of an econometric equation.

This procedure will not bias the values of the coefficients in our equation as long as the omitted variables are not correlated with an included variable. When the econometrician is making a forecast, he may have some information about an excluded variable which is pertinent to the determination of the dependent variable. He may also have some knowledge of the coefficient that relates changes in the excluded variable to changes in the dependent variable. Examples of special extraneous events would include the 1964 automobile strike, the 1965 dock strike, and the 1966 credit crunch. Evidence that reflects on whether or not extraneous constant adjustments, taken alone, improved forecast performance, can be seen by comparing the ex post forecasts with the actual constant adjustments to those with mechanical constant adjustments (*see Tables 4.1–4.5 and 4.11–4.15*). The ex post forecasts with the actual adjustments are only superior to mechanically adjusted forecasts about one-half of the time. Thus, there is no strong evidence that constant adjustments made a major contribution to forecast accuracy.

Econometricians have been rejecting preliminary specifications and substituting other maintained hypotheses on the basis of preliminary coefficient estimation ever since econometric model-building started. The method of introducing a priori information before making estimates has not been utilized by practicing econometricians. Instead, econometricians have continued to select equations on the basis of reasonableness. Likewise, it appears that econometric forecasters have subjected their forecasts to the test of "reasonableness" before making them official. That this check on forecasts has improved forecast performance can be seen clearly in the superiority of the ex ante results over the ex post results.

It appears that the most significant way in which judgment has been used to improve the forecasts that would have been made, had the models been used mechanically, consists of adjusting the exogenous assumptions and constant terms in such a way that the final forecast is a compromise between the econometricians' a priori idea of what a reasonable forecast would be, and the forecast that would have emerged if the exogenous variables and constants had been chosen without regard to the effect of such guesses on the forecast values of the endogenous variables.

B. THE ADJUSTMENT OF EQUATIONS ON THE BASIS OF PREVIOUS RESIDUALS

Ex post forecasts with both the regular and the anticipations version of the Wharton-EFU Model show a reduction of error in one- and sometimes two-quarter forecasts when AR adjustments are made on the basis of past residual values. The relative advantage of the adjusted forecast is lost for three or more quarters.

The results shown in the tables in Section IV suggest that one obtains the best ex post forecasts by multiplying the residuals by powers of the autocorrelation coefficient, and that the use of the same residual for four or more quarters may be too rigid and unrealistic. With few exceptions, the ex ante results support this position.

C. THE USE OF NEW ESTIMATING PROCEDURES TO REDUCE FORECAST ERROR FOR COMPLETE SYSTEM SOLUTIONS

We can examine the error for an individual equation in four different situations. We can distinguish between the fit in the sample period and in the forecast period, and we can differentiate between the error when the dependent variable in the equations is determined using the observed values of the explanatory variables and when it is found using the complete system solution values of these variables. The situation can be pictured as follows:

	Sample Period	Forecast Period
Observed explanatory endogenous variables	2	1
System-determined explanatory endogenous variables	3	4

The econometrician who wanted to minimize the sum of squared error in Quadrant 2 would use ordinary least squares (OLS) as his estimation technique. Widespread recognition of the inconsistency introduced by OLS estimates has led to the belief that they probably yield results inferior to the consistent estimating techniques in Quadrant 1. Since in actual forecasts the values of the endogenous explanatory variables are, of course, unknown, we should be concerned primarily with minimizing error in Quadrants 3 and 4. To accomplish this, we must calculate regression equations where the explanatory variables are *system-determined values* rather than actual observations.

Another related problem which arises is the buildup of error over time. Classical methods of estimation do not take into account the situation where error buildup is introduced into the equation because the lagged dependent variable is used as an independent variable. Some method is needed which not only reduces the dependence on simultaneous variables, but which does not overstate the importance of lagged dependent variables in complete system solutions.

Such a method has been worked out by Cooper and Jorgenson[29] and extended by L. R. Klein;[30] the idea was mentioned at an earlier date by Houthakker, and was reported by Theil.[31] Klein refers to the method as iterative TSLS; we call it ROS (regression on simulated values). The essence of the method is to regress the equations on *simulated* values of the simultaneous and lagged dependent variables, instead of either actual values or TSLS-calculated values.

Informally, the five-step procedure that we used to find and test the ROS coefficients can be described as follows:

1. The coefficients in the model were estimated using TSLS with principal components as the exogenous instruments. These coefficients are the same coefficients that have been published for the Wharton-EFU Model.

2. Sample-period forecasts were calculated one quarter ahead for each point in the sample period. These forecasts were made using the AR constant adjustments mentioned earlier.

3. The forecast values for each of the endogenous variables were used as explanatory variables for ordinary least squares regressions in

[29] R. L. Cooper and D. W. Jorgenson, "The Predictive Performance of Quarterly Econometric Models of the U.S.," Working Paper in Mathematical Economics and Econometrics, No. 113, University of California, Berkeley, August, 1967.

[30] Lawrence R. Klein, *An Essay on the Theory of Economic Prediction*. Helsinki, American Book Store, 1968.

[31] H. Theil, *Economic Forecasts and Policy*. Amsterdam, North-Holland Publishing Co., 1958, 1st edition only.

this step. This regression of the observed dependent variables on the "forecast" explanatory variables was performed for all equations in which the dependent variable was one of the main components of aggregate demand.

4. The new coefficients were used in the model, and sample-period simulations one quarter ahead were made, using the same rule-of-thumb constant adjustments.

5. The average absolute errors and the root mean-squared errors of the predictions in the forecast period—using the new coefficients—were compared to forecast errors using the old coefficients. The error, measured either way, was lower using the ROS than the TSLS coefficients for *GNP* and almost all of the other important variables.

As can be seen from this description, our approach was only partial. We did not reestimate the complete model; we did not estimate lagged dependent-variables by this method; and we did not iterate to obtain fully consistent estimates. Formally, we can extend this method to include the dynamic situation where lagged variables are also estimated in this same scheme. The exposition here follows L. R. Klein (*op. cit.*, pp. 69–70).

Consider the general linear model

$$\sum_{i=0}^{p} A_i y_{t-i} + BX_t = e_t$$

First, let us estimate $\hat{A}_i$ and $\hat{B}$ by the standard method of TSLS, using principal components as the exogenous instruments if the number of exogenous variables is large relative to the number of degrees of freedom.

We can then obtain elements $\hat{\hat{y}}_t$ as a solution of the general model

$$\sum_{i=0}^{p} \hat{A}_i y_{t-i} + \hat{B}X_t = 0$$

We stress that the $\hat{\hat{y}}_t$ are complete system solution values.

We may solve the model for the complete sample period without restarting, but, in general, we are interested in solving at most p periods at a time. We would then obtain complete system solution values $\hat{\hat{y}}_{t,1}, \hat{\hat{y}}_{t,2}, \ldots \hat{\hat{y}}_{t,p}$ where the first subscript indicates the particular quarter in which the solution starts (e.g., 1955.1), and the second subscript, the number of quarters ahead the solution is carried. For practical purposes, we would have $p \leq 4$ in the Wharton Models.

Having obtained these $\hat{\hat{y}}_{t,i}$, we can now reestimate the whole system of equations

$$\sum_{i=0}^{p} \hat{\hat{A}}_i \hat{y}_{t-i} + \hat{\hat{B}} X_t = 0$$

and obtain a new set of parameter estimates: A and B. The process may be continued until convergence is reached, defined as

$$\frac{\overset{n\wedge}{A_i} - \overset{(n-1)\wedge}{A_i}}{\overset{(n-1)\wedge}{A_i}} < \epsilon, \quad \frac{\overset{n\wedge}{B} - \overset{(n-1)\wedge}{B}}{\overset{(n-1)\wedge}{B}} < \epsilon$$

where ϵ is some predesigned level of tolerance and $n\wedge$ represents the nth iteration of estimation.

The theory for this class of estimation has not yet been developed, and the solution algorithm has never been fully tested. In particular, it is not clear whether asymptotically the $\overset{n\wedge}{A}$, $\overset{n\wedge}{B}$ are of the limited-information or full-information class of estimation. While they take into account all the information in the system, they do not do so in the usual manner of full-information methods. (No attention is paid to intercorrelation of residuals from different equations.) Also, Theil suggests that this method does not converge, and some preliminary calculations on Klein Model I also suggest this. In Table 5.1, the original coefficients are compared with the ROS coefficients.

The mean square error of the aggregate demand components of current dollar GNP in the sample period (1953.1–1964.4), using the complete system solution values of the explanatory variables and mechanical constant adjustments, was \$12.75 billion for the ROS coefficients, compared with \$17.21 billion for the TSLS coefficients. In the forecast period, the values were \$45.78 and \$51.55 billion, respectively. This suggests that single equation forecast error in the first quarter might be significantly reduced using some variation of the ROS coefficient estimation method.

D. THE USE OF ALTERNATIVE SPECIFICATIONS AND ESTIMATING PROCEDURES TO REDUCE ERROR PROPAGATION WITHIN A SIMULTANEOUS MODEL

The error of forecast for an aggregate variable such as *GNP* occurs not only because each component of the aggregate variable cannot be predicted exactly, but also because errors in individual equations reverberate throughout the system and reinforce or cancel out each other. In the limiting case, where no equation has any individual equation error, the simultaneous solution for the system will yield the realized values and there will be no error propagation. On the other hand, a forecast error in any equation in the system will cause all other simultaneously determined variables to be in error, unless there is an offsetting error elsewhere in the system.

If the forecast of a particular variable is relatively unreliable under the restrictions of the model, a regression on the predicted values of this variable will lead to a smaller coefficient than was the case with the original TSLS coefficients. Conversely, a variable that is predicted better under the restrictions of the model than in the first stage of TSLS will have a larger weight under the ROS procedure than it had under the TSLS procedure.

The shifting weight in the equations from those variables that are not predicted reliably to those that are can easily be seen in Table 5.1. In general, the shift is from endogenous to lagged variables. Particularly dramatic shifts away from variables that are not reliably predicted in the Wharton-EFU Model can be seen by looking at the reduced importance of unemployment under the ROS procedure in the car equation, and at the reduction of the importance of ΔX_m in the nonmanufacturing inventory investment equation.

It can be seen from Table 5.1 that the principal effect of reestimating the model using ROS coefficients is to decrease the amount of simultaneity. This appears to reduce forecast error substantially by relying less on those simultaneously determined variables which cannot be predicted accurately. We now present additional evidence that forecast error might also be reduced by diminishing the propagation of error in simultaneously determined models.

Before we look at propagation, we might reasonably ask whether

TABLE 5.1

Comparison of ROS Coefficients with TSLS Coefficients

(The ROS coefficients are written in above the TSLS coefficients in these selected equations from the Wharton-EFU Model.)

1. $$\frac{C_{ns}}{Y} = \overset{.2405}{0.2273} - \underset{(0.0485)}{\overset{0.2910}{0.4590}}\left[\left(\frac{\Delta Y}{Y}\right) + .75\left(\frac{\Delta Y}{Y}\right)_{-1} + .50\left(\frac{\Delta Y}{Y}\right)_{-2} + .25\left(\frac{\Delta Y}{Y}\right)_{-3}\right] + \underset{(0.0512)}{\overset{.7005}{0.7232}}\,\frac{1}{4}\sum_{i=1}^{4}\left(\frac{C_{ns}}{Y}\right)_{-i}$$

2. $$C_{na} = \overset{-8.61}{-11.52} + \underset{(0.0274)}{\overset{0.1086}{0.1570}}Y - \underset{(0.0251)}{\overset{0.0108}{0.0574}}K_{na_{-1}}$$

3. $$C_a = \overset{1.26}{48.54} + \underset{(0.0228)}{\overset{.1143}{0.1346}}\left(Y - \frac{Tr}{P_c}\right) - \underset{(10.20)}{\overset{7.64}{54.19}}\,\frac{P_a}{P_c} - \underset{(0.175)}{\overset{0.017}{0.430}}Un - \underset{(0.458)}{\overset{2.440}{4.129}}\delta_s + \underset{(0.478)}{\overset{1.710}{1.835}}Cr - \underset{(0.0180)}{\overset{0.0484}{0.0744}}K_{a_{-1}}$$

7. $$I_h = \overset{58.63}{58.26} + \underset{(0.0033)}{\overset{0.0237}{0.0249}}Y - \underset{(4.76)}{\overset{45.83}{45.52}}(p_h/p_r)_{-3} + \underset{(0.282)}{\overset{1.444}{1.433}}(i_L - i_s)_{-3}$$

9. $$\Delta I_{in} = \overset{-25.03}{-14.94} + \underset{(0.0456)}{\overset{0.1276}{0.0668}}S_{n_{-1}} - \underset{(0.0476)}{\overset{0.1849}{0.1173}}I_{in_{-2}} + \underset{(0.0634)}{\overset{0.2680}{0.2180}}C_{d_{-1}} + \underset{(0.0686)}{\overset{0.0314}{0.3325}}\Delta X_m + \underset{(11.82)}{\overset{34.54}{40.43}}(p_m - p_{m_{-2}})$$

10. $$\frac{F_{if}}{N} = \overset{.0127}{0.0117} + \underset{(0.0013)}{\overset{0.0060}{0.0064}}\,\frac{Y}{N} - \underset{(0.0015)}{\overset{0.0044}{0.0041}}\,\frac{P_{if}}{p_f}$$

11. $$F_{im} = \overset{2.47}{3.51} + \underset{(0.0022)}{\overset{0.0348}{0.0329}}S_m + \underset{(0.0194)}{\overset{0.0605}{0.0960}}\Delta I_m - \underset{(0.74)}{\overset{1.37}{2.14}}\,\frac{P_{im}}{P_m}$$

12. $$F_{ic} = \overset{-2.83}{-2.57} + \underset{(0.0073)}{\overset{0.0287}{0.0293}}Y - \underset{(1.48)}{\overset{1.73}{1.97}}\,\frac{P_{ic}}{P_m} + \underset{(0.1109)}{\overset{0.6121}{0.6014}}\,\frac{1}{4}\sum_{i=1}^{4}(F_{ic})_{-i}$$

13. $$F_e = \overset{-26.25}{-38.88} + \underset{(0.0128)}{\overset{0.1132}{0.1665}}X_{wt} + \underset{(4.78)}{\overset{23.88}{34.33}}\,\frac{P_{wt}}{P_e} + \underset{(0.0534)}{\overset{0.6200}{0.4663}}\,\frac{1}{4}\sum_{i=1}^{4}(F_e)_{-i}$$

the errors in single equations are related to each other. This can be tested by utilizing the well-known theorem that the sum of the squared error of random variables is equal to the squared error of the sum of the variables when all of these variables are independent. Thus, we can find out if there is a significant difference between the sum of the squared error of the individual equation residuals and the squared error of the sum of these residuals.

In the first part of Table 5.2, we can see that in most cases there is a slight negative relationship among the errors in single equations. There is a very large negative relationship for the TSLS's in the forecast period, and a pronounced but smaller negative relationship for the ROS in the forecast period. Yet, due to the simultaneous nature of an econometric model, we should expect that in any complete system forecast, the errors for many of the variables will have the same sign. For example, since C_{ns}, C_{na}, and C_a are all positively dependent on disposable income, a forecast of disposable income that is too high will cause C_{ns}, C_{na}, and C_a all to be too high; this will, in turn, increase the error in the forecast of disposable income. Thus, as long as we look at forecasts for the entire system, we may find a positive correlation of errors. In the lower half of Table 5.2, it can be seen that the mean-squared error for individual variables is lower for the lower level of aggregation. This is true whether we use forecasts with or without anticipations equations, with or without constant adjustments, or with or without ROS coefficients. It should be noted that the positive correlation of forecast error is less in the simulations using ROS coefficients than in other forecasts. This is especially significant when we notice that the single-equation errors showed less of a tendency to cancel out each other for ROS in the forecast period than they did for TSLS. This suggests that the ROS coefficients tend to reduce the propagation of error.

The propagation of error seems to cause 28 per cent of the error in the 1965–1968 TSLS forecast, thus offsetting the 83 per cent reduction that we might have anticipated when looking at the single-equation results. Comparing the 1953.1–1964.4 record of the no-constant-adjustment simulations with the regular and anticipations versions, it can be seen that almost all of the difference in forecast error of *GNP* can be attributed to the smaller propagation of error in the anticipations version.

This result might be anticipated a priori, because the ROS coefficients give smaller weight to endogenous explanatory variables than do the TSLS coefficients; and because the addition of anticipations variables to consumption and investment equations reduces interdependence within the equation system. This reduced interdependence

TABLE 5.2

Mean Square Error in Current Dollars at Different Levels of Aggregation for Various Methods of Calculation (One Quarter Ahead Only)

Time Period	Method of Calculating Predicted Values	Sum of MSE of Individual Demand Equations	MSE of *GNP*	Ratio to Column One
	Single-Equation Residuals			
1948.3–1964.4	TSLS – Regular	13.4	11.2	0.84
1948.3–1964.4	ROS – Regular	15.7	15.0	0.96
1953.1–1964.4	ROS – Regular	12.3	14.4	1.17
1953.1–1964.4	TSLS – Regular	11.2	10.8	0.96
1965.1–1968.4	TSLS – Regular	82.2	13.6	0.17
1965.1–1968.4	ROS – Regular	88.0	49.2	0.56
	Systems Forecasts			
1953.1–1964.4	TSLS – AR Adjustments – Regular	17.21	47.20	2.74
1953.1–1964.4	ROS – AR Adjustments – Regular	12.75	27.67	2.17
1953.1–1964.4	TSLS – AR Adjustments – Anticipations	11.66	26.52	2.27
1953.1–1964.4	TSLS – No Constant Adjustments – Anticipations	18.96	26.11	1.38
1953.1–1964.4	TSLS – No Constant Adjustments – Regular	20.58	45.56	2.21
1953.1–1964.4	TSLS – GG Adjustments – Regular	15.78	37.33	2.37
1965.1–1968.4	ROS – AR Adjustments – Regular	45.78	46.24	1.01
1965.1–1968.4	TSLS – AR Adjustments – Regular	51.55	66.10	1.28

means that an error in one equation has less tendency to reverberate through the system than it does when all of the equations are closely dependent on each other. While the ROS coefficients give poorer results for each individual equation, they give better results for complete system solutions.

We now return to our earlier surmise that impact multipliers of econometric models are generally overstated. While TSLS removes bias asymptotically, there is little question that much of this bias remains when we are working with short sample periods with strong time trends, and are using instruments which explain well over 90 per cent of the variance of the exogenous variables. The ROS coefficients are one step more removed from the stochastic disturbances that cause such bias than TSLS estimators are. Thus, the ROS coefficients are less likely to reflect small-sample bias than are TSLS estimates, and may give us a more accurate estimation of impact multipliers than we get from a model estimated by TSLS.

The calculations reported in Sections V-C and V-D, while clearly of a tentative and experimental nature, do suggest that forecasting accuracy could be improved if simultaneous equation systems were estimated by methods which removed more of the small-sample bias than do TSLS and other *k*-class limited-information estimators. By doing so, one would obtain better estimates of the structural parameters of the system as well. While such methods would lower single-equation measures of goodness of fit and *t*-ratios, they would probably give greater insight into the true structure of the economy, and would result in better models for both forecasting and policy-simulation purposes.

6 CONCLUSION

OUR analysis of the forecasting properties of the Wharton and the OBE econometric models supports six major conclusions:

1. The first two quarters of forecast for both models are significantly improved by including mechanical constant adjustments based on single-equation residuals of previous periods. This result holds for

both methods of constant adjustment that we used in this study, and corroborates the logical argument that constant adjustments will improve forecasts if models are mis-specified and have autocorrelated residuals. Specifically, when the Wharton Model is used without adjustment, the errors for *GNP* and its major components in the first two quarters of forecast are almost twice as large as the first two quarters of simulation error when this error is measured as root mean square per cent error, or as root mean square error divided by the root mean error of a no-change forecast. This difference disappears in longer forecasts.

2. The true ex ante forecasts are significantly better than other ex ante forecasts for virtually all variables and all time periods for the Wharton Models, and for most of the variables and time periods for the OBE Models. The true ex ante forecasts differ from the other ex ante forecasts only because the constant adjustments actually used by the forecasters were included, instead of either no-constant-adjustment or a mechanical adjustment based on previous single-equation residuals. These actual adjustments differed from the other adjustments because they included judgment in addition to previous residuals. This judgment was based on information about events that would affect endogenous variables but which was not included in the specification of individual equations, and also on the forecaster's a priori expectations of what was a reasonable prediction. The fact that the true ex ante forecasts are better than the mechanical ex ante forecasts suggests that the use of judgment in adjusting the constant terms appreciably improved the Wharton and OBE forecasts.

3. The Wharton true ex ante forecasts are better than ex post forecasts with the same constant adjustments. The OBE ex post forecasts were no better or no worse than the ex ante forecasts. For both models, the ex ante forecasts with mechanical constant adjustments are better than the ex post forecasts with the same adjustments in almost half of the cases. The superiority of the Wharton true ex ante forecasts over the ex post forecasts where the actual ex ante constant adjustments are used was contrary to our expectations. One would expect that when realized values were substituted for the estimated values of the exogenous variables, forecasts would be improved if

the structure of the model is correct. We tried to explain the observed superiority of the true ex ante forecast as follows: after the forecaster selected the values of the exogenous variables, his preliminary forecast may have been out of line with his a priori forecast for the current quarter and for the next quarter. He may then have reconsidered some of the constant adjustments in order to make his forecast reasonable. If we now substitute the realized values of the exogenous variables, this will lead to a forecast not in line with either a forecast by the model or a forecast based entirely on a priori notions. But this explanation does not explain the superiority of mechanically adjusted ex ante to ex post forecasts in almost half of the cases. This can be explained by incorrect reporting of government expenditures in the national income accounts, or by the overstatement of the degree of simultaneity and short-run fiscal multipliers, which leads to our next point.

4. Closer analysis of both the sample-period simulations and ex ante and ex post forecast errors suggests that these errors might have been reduced if the fiscal multipliers estimated by the models were smaller, and if the monetary multipliers were larger. Since fiscal variables tend to enter all the models covered here as simultaneous determinants of *GNP*, and monetary variables enter through the lagged structure, this suggests that the degree of simultaneity in the models is overstated, and that the contribution of the lagged variables is understated. This hypothesis is strengthened by the finding that there is substantial propagation of error in the system: the mean square error of total *GNP* is much larger than the mean square error of the sum of the individual aggregate demand components. Part of this problem may be caused by faulty estimation techniques. This would be consistent with recent findings that the results obtained by using two-stage least squares are virtually indistinguishable from those obtained with ordinary least squares for macromodels of the size used in this study.

5. Most of the ex post forecast error generated when mechanical constant adjustments are used is due to imperfect covariation, rather than to imperfect central tendency or unequal variation. Thus, the errors in the forecasts are due primarily to random fluctuations, rather than to consistent errors in forecasting trends or cyclical fluctuations. In addition, it should be noted that the annual forecast error

for *GNP* is substantially smaller than the sum of the absolute value of the first four quarters of error. This indicates that in spite of the quarterly nature of the models, they may be best suited for predicting annual, rather than quarterly, movements.

6. In order to mitigate some of these difficulties, we tried a method of estimation which we called ROS (regression on simulated values). In using this method, one estimates the complete model a first time by the usual methods, and then uses the *complete system solution* values, instead of the observed values of the independent endogenous variables to reestimate the coefficients. It is found that this method reduces the average forecast error for the first two quarters, and also reduces the size of the impact multipliers, the degree of simultaneity, and the propagation of error. However, the errors using the ROS coefficients are slightly larger than the other methods for later quarters, which might indicate that the ROS coefficients will be most useful if they are estimated with complete system solution values for lagged, as well as current, values.

This study has shown that econometricians have had a better forecasting record to date than an analysis of the econometric models that they used would have led us to predict. Our results offer no substantive evidence that the same econometricians, forecasting without the "benefit" of an econometric model, would have done any better or any worse in their predictions. This recognition of the limitations of current models need not lead to pessimism about the future development of accurate econometric forecasting models. With a finer understanding of how changes in monetary and fiscal policy actually influence economic activity, closer attention to the short-run specifications and lag adjustments of the system, possible improvements in the National Income Accounts, and refinement of existing estimation and forecasting techniques, the next few years could offer substantial advances in the art and the science of econometric forecasting.

DISCUSSION

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IN READING this paper by Evans, Haitovsky, and Treyz, I am once again impressed by the vast amount of detailed manipulation that is required before an econometric model can be used to make economic forecasts. The OBE and Wharton School econometricians are to be complimented for keeping such meticulous records that this reconstruction of the forecasting record of their model could be undertaken. The task of reconstructing the forecasting record of econometric models and then comparing the accuracy of these predictions against naive standards and judgmental forecasts is essential. It is precisely through such analyses that we learn about the relative advantages of the various approaches. Subsequently, the profession can select the favored forecasting approach, or approaches, or it may choose to combine the several techniques in some fashion.

Econometricians have long known, and the authors again remind us, that models cannot be used in a mechanistic manner. A priori information about events which the model cannot be expected to predict should be, and has been, incorporated into these models. The constant terms of equations must frequently be adjusted; and the authors' discussion of alternative techniques which might be used is of general interest.

While there are mechanistic rules for adjusting constants which might be followed, we are told that "no single rule explains all of the adjustments which were made" to the constant terms of the Wharton Model. We can thus infer that sometimes the constants were adjusted in an ad hoc fashion. This finding reveals the extent to which forecasts obtained from an econometric model are a blend of judgmental and econometric techniques.

However, the fact that constant adjustments are made should not be entirely considered a virtue. The necessity for making these adjustments indicates that the model is not a completely accurate representation of the economy. Such adjustments might be required if there were systematic errors, which are obvious indications of structural inaccuracies, or if it were constantly necessary to incorporate information about exogenous events, such as strikes. If these exogenous events occurred periodically, and if they had an economic impact on automobile sales, inventories, and so forth, it might be more appropriate to reestimate the relevant equations by including a "strike variable" than to make the constant adjustments.

I seem, also, to have a major philosophical difference with the three authors of this paper about the appropriate criteria to be used in evaluating the forecasting accuracy of econometric models. I believe that such an evaluation should be based on the model's ex post predictions. Although the authors present these ex post results, they indicate that the ex ante predictions are the *more* relevant forecasts. There is an obvious interaction between a model and the econometricians who issue the actual forecasts; and they argue (1) that forecasting with an econometric model involves judgment, (2) that a model must be "fine-tuned" before a prediction is issued, and (3) that no one uses unadjusted econometric models to make forecasts. Therefore, they say, one should determine how well econometric models *cum* econometricians performed.

I disagree with this view. Since econometric models are subject to inaccuracies, it might be just as appropriate to determine how well the econometricians would have done had they ignored the model and relied solely on their judgment. Only the ex post approach allows one to distinguish between the ability of the analyst in estimating the predetermined variables, and that of the model in simulating the economy.

The entire rationale behind evaluating the forecasting record of alternative approaches and different models is to select the *technique* which is superior. The profession is less interested in knowing which man had the best batting average. On the other hand, some judgmental adjustments are obviously useful and necessary in generating forecasts. It is, therefore, appropriate to examine the ex post forecasts for which mechanical constant adjustments have been made. The authors have developed this measure, and I will use it in evaluating the predictive usefulness of the econometric models which are discussed in this paper.

While I argue that it is necessary to use ex post forecasts in order to evaluate properly the accuracy of econometric models *qua* forecasting technique, I recognize, too, that there are no ex post judgmental predictions. Since it is necessary to compare the accuracy of judgmental and econometric *techniques,* ex ante judgmental and econometric forecasts must be examined. Rather than comparing the predictive record of econometricians and judgmental forecasters, I would like to suggest an alternative approach which will compare the relative accuracy of the two techniques.

If judgmental forecasts are to be compared with econometric predictions, in order to be consistent the ex ante econometric forecasts must be utilized as the basis of comparison. Moreover, both sets of ex ante forecasts must utilize the same assumption about exogenous events. The two types of forecasts should have been made at the same time, using the same data. In addition, the estimates of the exogenous variables which are used in the model should be those of the judgmental forecaster whose procedures are being compared with the model.[1] The difference in the two sets of forecasting errors now measures the relative accuracy of the techniques.

Any different procedure would yield results failing to reflect the relative forecasting accuracy of the two approaches. It should, however, be noted that the accuracy of a model can only be judged relative to that of a specific forecaster. Just as some models or forecasters outperform other models or forecasters, the performance of a particular model might be more accurate than the record of some judgmental forecasters and inferior to that of others. Consequently, to obtain a valid comparison of the accuracy of the two techniques, this procedure would have to be repeated a number of times—for different forecasters and different models.

Turning aside from this philosophical difference, I would like to comment on some of the methodology used in the study under consideration. There is as yet no agreement about the best method for evaluating multiperiod predictions. In this paper, the levels of economic variables which are forecast 1–6 quarters in advance are compared with the actual levels observed in those quarters. While it is not incorrect to use this approach in evaluating multiperiod forecasts, there is one dan-

[1] A mechanical constant-adjustment method would, of course, be incorporated into the model. If the judgmental forecaster takes into account the impact of some exogenous variable not considered by the model, an adjustment must also be made for this factor.

ger which must be recognized. It is possible that the level predictions made n quarters in advance were identical to the actual levels observed in that quarter; but that accuracy could have resulted from underestimates of the changes in the first j quarters, followed by overestimates in the remaining $n-j$ quarters.[2] It is for this reason that I prefer to examine the intraperiod quarterly *changes*.[3] In fact, the results will show that neither the OBE nor Wharton Model tracked quarterly changes very well, but both do return to the path.

There is also no agreement about the preferred naive standard with which multiperiod predictions should be compared. The authors use an appropriate naive standard which is based upon a form of the second Naive Model $(\Delta X_t = \Delta X_{t-1})$[4]

$$X_{t+j} = X_{t-1} + (j+1)(X_{t-1} - X_{t-2}) \qquad j = 0, 1 \ldots n$$

This is not an overly severe standard and some auto-regressive scheme based on n lags might have been preferred. I would prefer that the specifications of this lag structure be chosen in advance, rather than seeking out that structure which maximizes R^2.

Another possible difficulty involved in the paper is that the errors of all forecasts made n quarters in advance are averaged and tabulated with an average of all the forecast errors made $n-1$ and $n+1$ quarters in advance. I have previously noted that such a procedure may introduce biases should observations be missing for some quarters. I believe that it is appropriate to compare the errors only of those quarters which had common forecasts made n and $n+1$ quarters in advance.[5]

[2] It should be remembered that policies which are based on forecasts would not be invariant with respect to the time pattern of the errors.

[3] This approach, however, requires that we decide how to measure the predicted and actual changes. It turns out that for multiperiod forecasts there may be a difference between the methodology used to measure the ex ante predicted changes and that utilized to obtain the ex post predicted changes. In the first case, it is $\Delta P_t = P_t - P_{t-1}$; in the second instance, it may be either $P_t - A_{t-1}$ or $P_t - P_{t-1}$.

[4] If the naive standard $X_{t+j} = X_{t-1} + (X_{t-1} - X_{t-2})\, j = 0.\ 1 \ldots n$ were used, there would be a downward bias in a period of growth. If *changes* are analyzed, then an appropriate standard might be $\Delta X_{t+j} = \Delta X_{t-i}$.

[5] H. O. Stekler, "An Evaluation of Quarterly Judgmental Economic Forecasts," *Journal of Business*, XLI (July, 1968), pp. 329–339.

A point on the data which is used in this study is also in order. In analyzing the forecasts of the Wharton Model, the *published* ex ante forecasts—which are generated from preliminary data (and even estimates, in some cases)—are compared with the actual changes, which are derived from the revised figures available in 1969. This may be an inappropriate procedure because the inputs to the forecasts are not revised, whereas the outcome and actual data are. There may be no relationship between the state of the economy which was assumed to exist at the time that the forecast was prepared, and that which the currently available figures reveal as actually having existed. Consequently, it is possible that an ex ante forecast accurately predicted the currently available *GNP* data, but that the forecast was based on assumptions which did not reflect actuality; the prediction may have been right for the wrong reasons. It is even possible that these ex ante forecasts would become more and more accurate as the National Income data are revised.[6] This method of analyzing the forecasts may, in fact, provide a clue to a finding that our authors have difficulty explaining.

The authors compare the Wharton ex ante predicted changes with the actual changes now recorded in the National Income Accounts. They then replace the estimates of the exogenous variables with values which they call actual values. At the same time, the lagged predetermined variables are left unchanged, generating a set of data which is inconsistent. The forecasts generated from these data are called ex post with preliminary lags; the ex ante forecasts are superior. I believe that the implied changes in the predetermined variables should also have been revised in order to achieve consistency. Then, if the ex ante forecasts had still been superior, we could have concluded that the inadequate estimates of all of these variables more than offset all of the errors in the model.

The other results of this study are quite revealing. For the period of fit, the no-change or same-change Naive Model has lower errors than do the ex post predictions—with constant adjustments—made one quarter in advance, for the following variables: *GNP*, real *GNP*, Consumption; and for all six quarters: unemployment. The errors of the ex post extrapolations beyond the sample period are also larger than the

[6] The ex ante forecasts may also be compared with either the preliminary or the revised data, but this point is not discussed.

errors of these naive standards: *GNP* (1, 2 quarters in advance), *C* (1, 2), *I* (1, 2, 3), *GNP*, real (1, 2), unemployment (1–6).

The OBE forecasts are not compared with naive data, and comparisons with the Wharton Model should not be made because different periods are involved.

Furthermore, when the National Income data were revised in 1965, the econometricians at the Wharton School discovered that their previous model no longer adequately represented the economy. The authors also indicated that "mechanical forecast errors were very sensitive to slight modifications of models." Given this great sensitivity to revisions in the data and model adjustments, it is appropriate to question the degree to which a model adequately describes an economy. This query could then cause one to question whether econometric models are useful for short-run forecasting.

I believe that the accuracy of economic forecasts can only be improved by using systematic analytical techniques which can be replicated. Then the source of forecast errors can be determined and eliminated. Econometric models can obviously fulfill this role, and it is, therefore, the task of the econometrician to improve the quality of his models. The authors suggest a new estimating procedure, called regression on predictions, which, in this case, has reduced the size of the ex post forecast errors. Unfortunately, these errors still seem to be larger than those obtained from the naive standard (Tables 3.2A and 5.2).

In closing, I want to indicate that the usefulness of an econometric model does not depend solely on its ability to forecast aggregate economic activity one or two quarters in the future. Furthermore, we should all recognize that analyses of the forecasting properties of models are new and difficult tasks, for many problems are still unresolved; and we should thank Messrs. Evans, Haitovsky, and Treyz for this pioneering effort.

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THOSE of us who forecast with econometric models should be grateful to the authors of this paper for the labor that went into it, and for the candor with which they report the results. Their primary purpose is to discover the sources of error in the ex ante forecasts and to suggest methods for improving them.

Their fundamental conclusion is that models forecast very badly, indeed, but that econometricians using econometric models forecast with an accuracy that compares favorably with forecasts made by other methods. They find themselves on the horns of an uncomfortable dilemma. At one point, they argue that forecasts made by the unaided efforts of a model are not very meaningful. Elsewhere, they offer suggestions for improving the forecast accuracy of models. The main concrete proposal for improving the forecast performance of models is a new method of estimation, which they call "regression on simulated values" (ROS).

I do not believe that they have a satisfactory explanation of why the models they report on have behaved so badly. As a consequence, I think that their understanding of model adjustment is not clear, and that their prescription for improvement in models is unsatisfactory. Moreover, it appears to me that a major improvement in the specification of models to reduce simulation errors will be required before the potential benefits of ROS can be realized.

The forecast errors made by a linear simultaneous econometric model depend on the inverse of the matrix of coefficients of the simultaneous variables (the multipliers); the size and sign distribution of the vector of errors of the stochastic functions; and the matrix of coefficients of the lagged endogenous variables. In a nonlinear model, the same general statement would hold, but we could not be precise in our statement of the algebra involved. It is, of course, true that there is an intimate relationship between these sources of error. But I suspect that the major problem stems from the errors made by the individual stochastic functions, given correct independent variables for those functions (single-equation errors); that a substantial number of the single-equation forecast errors have means significantly different from zero; and that the variance is significantly different from the variance of the sample-period residuals.

The Theil decomposition of the mean-square errors reported by the authors tends to support the notion that an important source of the poor model forecasts are mean forecast errors which are significantly different from zero. The decomposition of the *simulation* errors of both the OBE and Wharton Models indicates that almost all of the error results from imperfect *covariation* between the simulated and actual values. The contribution to the simulation errors from *unequal central tendency* is virtually zero. This is what we should expect in a simulation of a model where the mean single-equation errors in that model are zero. The results for the *ex post* forecasts are quite different. With no constant adjustment, almost all the error in the first two quarters results from *unequal central tendency.* The importance of this factor diminishes as the span of the forecast increases but this, I suspect, results from the errors made in the earlier quarters of the forecast, which affect the later forecasts through distributed lags.

I do not claim to have a definitive answer regarding the main source of forecast error in the Wharton Model, but I will present some evidence that makes my hypothesis—that it is single-equation errors—seem plausible.

On the basis of an educated guess about where the Wharton Model was having major trouble, I made calculations using seven of the stochastic functions in the model. The functions examined were: (1) consumer expenditure on durables except cars, (2) consumer expenditure on cars, (3) manufacturing investment, (4) regulated and mining-industry investment, (5) commercial and other investment, (6) nonfarm housing, (7) manufacturing inventory-investment. (See List of Variables, pp. 1157–1158.)

The purpose of my calculations is to determine the single-equation forecast errors that would be made by these functions on the assumption that the independent variables were correct for 1965-I to 1968-IV. The results are given in Table 1. Positive errors mean that actual values are greater than forecast. It is evident that the errors in this group of functions are predominantly positive and that they are large. The sum of the errors is positive in every quarter shown in the table. The mean of the sum is \$9.1 billion. The Wharton Model multiplier of government

TABLE 1

Wharton Model Single-Equation Forecast Errors (billion 1958 dollars)

	C_{na}	C_a	I_{pm}	I_{pr}	I_{pc}	I_h	ΔI_{im}	*Sum*
1965.1	1.9	2.8	.8	.2	.9	1.3	−1.6	6.3
1965.2	1.5	.6	.4	.1	1.2	1.2	−1.9	3.1
1965.3	1.1	.3	1.1	.3	1.3	1.3	1.4	6.8
1965.4	2.5	−.5	1.3	.8	2.0	1.0	1.2	8.3
1966.1	3.9	.1	2.0	1.5	1.3	1.0	0	9.8
1966.2	4.2	−2.8	1.1	1.7	.3	−.4	1.9	6.0
1966.3	5.1	−2.1	.9	1.1	2.6	−1.8	3.8	9.6
1966.4	4.8	−1.9	.2	1.5	1.2	−3.7	6.0	11.9
1967.1	4.4	−4.4	−.3	1.0	2.1	−3.9	4.3	3.2
1967.2	5.0	−1.8	−.8	1.7	1.5	−2.3	2.4	5.7
1967.3	5.2	−2.2	−1.4	2.0	1.6	−.3	.4	5.3
1967.4	5.9	−.1	−1.5	3.0	1.9	1.1	1.5	11.8
1968.1	5.4	−.8	−1.3	4.4	3.6	−.2	−1.6	9.5
1968.2	6.1	−.6	−1.9	3.0	1.0	1.6	2.1	11.3
1968.3	7.1	3.6	−1.2	3.1	.8	.7	3.7	17.8
1968.4	6.9	3.8	−1.0	4.9	−.2	2.1	2.3	18.8

purchases on constant-dollar *GNP* is approximately two. I would guess that this is about the multiplier on these errors. It more than accounts for the average one-quarter-ahead forecast errors of the model, and one would therefore conclude that there are counteracting single-equation errors elsewhere in the model.

We generally assume that forecasts made with econometric functions have errors whose mean is zero and variance not significantly different from the variance of the sample-period residuals. Table 2 compares the variance of the forecast errors to the variance of the period-of-fit residuals, and gives the mean error of the forecast for the seven functions whose forecast errors are shown in Table 1. The statistics calculated indicate that the mean of the forecast error is significantly different from zero at the 5 per cent level for four of the seven functions. In six of the seven cases, the variance of the forecast is greater than the variance of the sample-period residuals; and in five of those cases, the difference is significant at the 5 per cent level.

These results have wider implications than the question of whether we can expect to get reasonably accurate forecasts from a medium-size simultaneous econometric model. They raise the issue of whether we can expect to get reasonably accurate forecasts from aggregate econometric functions with existing econometric estimation and test procedures. It may be, of course, that these functions in the Wharton Model are exceptionally poor, but I do not believe that this is the case. I suspect that the literature is filled with econometric functions whose forecast properties are as bad as these.

The two functions in the set of seven which behaved particularly poorly are those for consumer expenditure on durables except cars, and regulated and mining-industry investment. The calculations reported in Table 3 were made to find out what went wrong with the forecast of consumer expenditure on durables except cars, and Table 5 contains a similar set of calculations for regulated and mining-industry investment.

The consumption function was computed for the period 1965-I–1968-IV (using OLS for obvious reasons) and compared with an OLS function for the sample period of the Wharton Model. Table 4 contains the ex post forecast from the Wharton Model TSLQ function, a similar forecast from the OLS function, and the residuals from an OLS function fit over the period 1965-I–1968-IV. When looking at

TABLE 2

Analysis of Single-Equation Forecast Errors

	Ratio of Variance, Forecast Error to Residuals [a]	Mean Forecast Error	
		Mean	*t(15)*
C_{na}	F(15,64) = 3.79	4.44	9.70
C_a	F(15,60) = 3.21	−0.36	−0.64
I_{pm}	F(15,61) = 3.29	−0.09	−0.29
I_{pr}	F(15,61) = 6.67	1.89	5.33
I_{pc}	F(15,58) = 0.72	1.45	6.54
I_h	F(15,61) = 2.69	−0.08	−0.17
I_{im}	F(15,60) = 1.88	1.61	2.90

[a] Variance corrected for degrees of freedom.

TABLE 3

Consumer Expenditure on Durables Except Cars

(1948-II–1964-IV)

	Mean	Standard Deviation	Correlation Matrix Y	K_{na-1}	C_{na}
Y	307.39	51.23	1.0		
K_{na-1}	256.24	56.22	0.996	1.0	
C_{na}	22.07	5.05	0.979	0.968	1.0

	Equation	$\bar{R}^2$	SE	d
(OLS)	$C_{na} = -14.07 + 0.1855Y - 0.0815K_{na-1}$ (2.079) (0.027) (0.024)	.963	0.97	1.24
(TSLS)	$C_{na} = -11.52 + 0.1570Y - 0.0574K_{na-1}$ (0.0274) (0.0251)	.965	0.94	1.29

(1965-I–1968-IV)

	Mean	Standard Deviation	Correlation Matrix Y	K_{na-1}	C_{na}
Y	467.25	24.97	1.0		
K_{na-1}	440.97	42.01	0.986	1.0	
C_{na}	40.96	3.32	0.981	0.958	1.0

	Equation	$\bar{R}^2$	SE	d
(OLS)	$C_{na} = -29.22 + 0.1765Y - 0.0279K_{na-1}$ (8.887) (0.042) (0.025)	.960	0.67	1.14

Table 4, it is hard to avoid remarking on the power of the least squares fit during the sample period, and the contrast between the residuals and the forecasts.

Returning now to Table 3 to find out what produced the astonishing contrast, the source appears to be a modest change in the coefficients—principally the coefficient for K_{na-1}—and a compensating change in the constant. Remembering the formula

$$b_{13.2} = \frac{r_{13} - r_{12}r_{23}}{1 - r_{23}^2} \frac{S_1}{S_3}$$

examine Table 3. You will find little difference in S_1/S_3 in the two periods, and the changes in the intercorrelation matrix hardly appear to be large. However, it turns out, when the arithmetic is done, that what appears to be a very small change in the correlation coefficient between the independent variables Y and K_{na-1} (from 0.996 in the 1948-II–1964-IV period, to 0.986 in the 1965-I–1968-IV period) has an overwhelming effect on changing the coefficient of K_{na-1}.

We all pay lip service to the problems of multicollinearity, but these results indicate that we should, perhaps, think again. Economic theory leads us to look for, and to assume, stability in the relationships

TABLE 4

Consumer Expenditure on Durables Except Cars
(Constant Prices)
(billion dollars)

	Forecast Errors TSLQ	OLS	Residuals
1965.1	1.9	1.5	0.2
1965.2	1.5	1.2	−0.5
1965.3	1.1	.5	−1.3
1965.4	2.5	1.8	−0.4
1966.1	3.9	3.4	0.7
1966.2	4.2	3.9	0.7
1966.3	5.1	4.8	1.1
1966.4	4.8	4.7	.5
1967.1	4.4	4.3	−0.3
1967.2	5.0	5.0	0
1967.3	5.2	5.2	−0.2
1967.4	5.9	6.0	0.2
1968.1	5.4	5.5	−0.7
1968.2	6.1	6.3	−0.3
1968.3	7.1	7.4	.3
1968.4	6.9	7.3	−0.2

between dependent and independent variables. Indeed, this is what we mean by structure. However, there is generally nothing in economic theory that leads us to expect stability in the relationships between independent variables. Yet, the arithmetic we use to calculate the coefficients of a function imposes, as a requirement for stability of the structure, that there be stability in the relationship between independent variables. This is a particularly serious matter when the correlation between the independent variables is as high as it is in this function.

Let us turn back now to ask whether there is anything in the statistics calculated for the sample period that would cause us to expect bad forecasts from this function. There were some indications. Although the signs of the coefficients were right; the standard errors of the coefficients satisfactory; $\bar{R}^2$ was high and S_e was low. The Durbin-Watson statistic was suspicious—an indication of the long runs present in the residuals. This, along with the .996 intercorrelation of the independent variables, should (employing hindsight) have raised doubts about the forecasting properties of the function.

Much of what was said about the function for consumer durables except cars applies, also, to the function for regulated and mining-industry investment. The data are shown in Tables 5 and 6. There is one major difference, however, which is that the 1965-I–1968-IV function bears very little resemblance to the 1948-III–1964-IV function. The intercorrelation matrix indicates that there were major shifts in the relationships between the dependent and independent variables, as well as high, and changing, intercorrelation between the independent variables. As in the case of the other function, the low Durbin-Watson statistic reflects the presence of runs, and the intercorrelation matrix contains a suggestion of future forecast difficulties.

Where does this kind of examination take us? I have concluded that we have to be as careful as we possibly can in our examination of the statistics calculated for the sample period—with a particular concern for runs in the residuals and multicollinearity—but that this in itself is not enough. Estimation by minimizing sums of squares is a very powerful device for fitting data: *The assumptions that we make when using the fits for forecasting—particularly zero mean and constant variance—must be tested empirically. This can be done by suc-*

TABLE 5

Regulated and Mining-Industry Investment

(1948-III–1964-IV)

	Mean	Standard Deviation	Correlation Matrix $\frac{Z_{-1}+Z_{-2}}{2}$	$\frac{K_{r-1}+K_{r-2}}{2}$	$\Sigma A_i Z_{-i-3}$	$\Sigma A_i(i_L)_{-i-3}$	I_{pr}
$\frac{Z_{-1}+Z_{-2}}{2}$	349.09	52.88	1.0				
$\frac{K_{r-1}+K_{r-2}}{2}$	240.50	114.41	0.972	1.0			
$\Sigma A_i Z_{-i-3}$	338.93	45.03	0.966	0.946	1.0		
$\Sigma A_i(i_L)_{-i-3}$	3.68	0.70	0.904	0.930	0.922	1.0	
I_{pr}	11.95	1.28	0.787	0.723	0.764	0.535	1.0

$$I_{pr} = \underset{(1.399)}{4.814} + \underset{(0.007)}{0.0154}\frac{Z_{-1}+Z_{-2}}{2} - \underset{(0.003)}{0.0045}\frac{K_{r-1}+K_{r-2}}{2} + \underset{(0.006)}{0.0288}\sum_{i=0}^{7} A_i Z_{-i-3} - \underset{(0.284)}{2.4646}\sum_{i=0}^{7} A_i(i)_{L-i-3}$$

$\bar{R}^2$	SE	d
.833	0.52	0.71

(continued)

TABLE 5 (*concluded*)

(1965-I–1968-IV)

	Mean	Standard Deviation	Correlation Matrix				
			$\frac{Z_{-1}+Z_{-2}}{2}$	$\frac{K_{r-1}+K_{r-2}}{2}$	$\sum_{i=0}^{7} A_i Z_{-i-3}$	$\sum_{i=0}^{7} A_i (i_L)_{-i-3}$	I_{pr}
$\frac{Z_{-1}+Z_{-2}}{2}$	514.76	24.17	1.0				
$\frac{K_{r-1}+K_{r-2}}{2}$	477.26	39.90	0.963	1.0			
$\Sigma A_i Z_{-i-3}$	488.09	29.68	0.967	0.982	1.0		
$\Sigma A_i (i_L)_{-i-3}$	4.90	0.43	0.857	0.948	0.876	1.0	
I_{pr}	19.17	1.97	0.954	0.935	0.954	0.830	1.0

$$I_{pr} = \underset{(17.532)}{54.630} + \underset{(0.036)}{0.1006}\,\frac{Z_{-1}+Z_{-2}}{2} - \underset{(0.109)}{0.2374}\,\frac{K_{r-1}+K_{r-2}}{2} + \underset{(0.076)}{0.1962}\sum_{i=0}^{7} A_i Z_{-i-3} + \underset{(3.847)}{8.0610}\sum_{i=0}^{7} A_i (i_L)_{-i-3}$$

$\bar{R}^2$	SE	d
.930	0.52	2.48

cessive ex post forecasts beyond the period of fit. The statistical properties of the forecast could then be calculated from the ex post forecasts. The span of the ex post forecasts should be the span we need for ex ante forecasting.

At this point, we can begin to discuss intelligent interaction between the econometrician and the model. The authors report on elaborate experiments with constant adjustments for the sample period and for ex post forecasts, and conclude that they get an improvement in both cases for the first two quarters; and thereafter, deterioration. The experiment with constant adjustments over the *sample* period suggests to me that they have missed the main point. The single-equation results given in Table 1 indicate that the need for constant adjustment arises from the necessity of correcting forecasts from functions which have an expected mean error of the forecast that is not zero. Over the sample period, the constant adjustment is a crude adjustment for autocorre-

TABLE 6

Regulated and Mining-Industry Investment
(Constant Prices)
(billion dollars)

	Forecast	Residuals
1965.1	.2	.2
1965.2	.1	0
1965.3	.3	−.3
1965.4	.8	−.2
1966.1	1.5	.1
1966.2	1.7	.2
1966.3	1.1	−.1
1966.4	1.5	.4
1967.1	1.0	−.2
1967.2	1.7	.2
1967.3	2.0	−.5
1967.4	3.0	−.2
1968.1	4.4	1.1
1968.2	3.0	−.5
1968.3	3.1	−.7
1968.4	4.9	.5

lation in a set of residuals whose mean error is zero. In these circumstances, there is little point in constant adjustment over the sample period. Moreover, if the real problem in forecasting with econometric models is change in the structure, for one reason or another, an autoregressive function of residuals from the sample period will then provide only marginal help in improving the accuracy of the forecast. *The adjustment to the single-equation forecast errors should, I believe, be made from the properties of the successive ex post forecasts referred to above.*

The authors report an improvement in ex post forecasts one quarter ahead for current and constant-dollar *GNP*, through the use of ROS. They point out that their results come from a partial application of the ROS procedure, and express the opinion that ROS holds promise for further improvement. The application of ROS was partial, because they did not use model-solution values for lagged dependent variables. The authors propose a method for doing this, following Lawrence Klein.[1] The reasoning used to justify ROS suggests the following extension on the method that they and Klein propose. If we assume that the model solution is carried ahead a maximum of four quarters, the following four sets of regressions could be carried out for each element of Y_t. Each set would be used to create a model appropriate to the span of the forecast.

(1) $\hat{Y}_{t+1},\ Y_t,\ \ Y_{t-1},\ Y_{t-2}$, and X

(2) $\hat{Y}_{t+2},\ \hat{Y}^*_{t+1},\ Y_t,\ \ Y_{t-1}$, and X

(3) $\hat{Y}_{t+3},\ \hat{Y}^*_{t+2},\ \hat{Y}^*_{t+1},\ Y_t$, and X

(4) $\hat{Y}_{t+4},\ \hat{Y}^*_{t+3},\ \hat{Y}^*_{t+2},\ \hat{Y}^*_{t+1}$, and X

Where the Y's are endogenous current and lagged variables, and the X's are exogenous variables.

$\hat{Y}_{t+1}$ is the solution value for each element of Y_t one quarter ahead from the model, estimated by TSLQ; and $\hat{Y}^*_{t+1}$ is the solution value for each element of Y_t one quarter ahead from the model, estimated by ROS. $\hat{Y}_{t+2}$ is solution value for each element of Y_t two quarters

[1] Lawrence R. Klein, *An Essay on the Theory of Economic Prediction*. Helsinki, The Academic Book Store, 1968, pp. 69–70.

ahead, using the same model; and $\hat{Y}^*_{t+2}$ is obtained from solution of the model developed from equation (3). If the processes of iterative estimation and model solution converge, then $\hat{Y}_{t+1} \simeq \hat{Y}^*_{t+1}$.

The authors suspect that this procedure will not converge and also point out that the method would lead to lower measures of goodness-of-fit and t-ratios. As a matter of fact, it is reasonable to suppose that if ROS were extended to the lagged endogenous variables, the regressions might, in some cases, explain very little. It is my guess that a major effort to improve the simulations of the Wharton Model should be undertaken prior to engaging in ROS experiments. It is reasonable to suppose that better simulations would also enhance the probability of getting convergence in the ROS iterative process.

In conclusion, the authors have provided us with ample evidence that econometric models need substantial improvement. The simulation errors reported are not satisfactory, and we cannot expect a model to forecast more accurately than it simulates. Moreover, the authors report that model forecast errors are substantially worse than simulation errors.

They suggest ROS as an avenue for improvement, but it seems likely that improved simulation properties will be required before substantial benefits will result from ROS. I have suggested that the critical problem is the need to contain the model forecast errors within the boundaries suggested by the simulations. To accomplish this, it will, I believe, be necessary to pay more attention to single-equation ex post forecast errors over the span we intend to forecast. In particular, we should attempt to specify functions that have satisfactory ex post forecast-error properties. When we are not successful in accomplishing this, we should use the characteristics of the single-equation ex post forecast errors to adjust the single-equation ex ante forecasts.

LIST OF VARIABLES

C_{na} Purchases of consumer durables except automobiles and parts, billions of 1958 dollars

C_a Purchases of automobiles and parts, billions of 1958 dollars

I_{pm}	Manufacturing investment in plant and equipment, billions of 1958 dollars
I_{pr}	Regulated and mining investment in plant and equipment, billions of 1958 dollars
I_{pc}	Plant and equipment investment in commercial and other industries, billions of 1958 dollars
I_h	Investment in nonfarm residential construction, billions of 1958 dollars
ΔI_{im}	Investment in manufacturing inventories, billions of 1958 dollars, arbitrary origin
Y	Personal disposable income, billions of 1958 dollars
K_{na}	Stock of consumer durables except automobiles, billions of 1958 dollars
Z	Final sales in the private sector, billions of 1958 dollars
K_r	Stock of regulated and mining-industry investment, billions of 1958 dollars
A_i	Distributed lag weights
i_L	Moody's average yield on bonds