15 Summary and Conclusions

The purpose of this study was to develop an econometric model of the United States economy that was designed primarily for forecasting purposes. In designing the model an attempt was made to make maximum use of various expectational variables that are available; and an effort was made to avoid, whenever possible, the use of exogenous variables that are hard to forecast. The model was also kept relatively small, so that it can be easily updated and reestimated each quarter and so that the various properties of the model can be analyzed in detail. Aside from its size, the model differs from large-scale structural models in two main ways. One is its avoidance of the use of hard-to-forecast exogenous variables and the other is its treatment of the expectational variables as exogenous. The model is still structural, however, in the sense that theoretical considerations have been used in the specification of the equations.

The econometric techniques that have been used to estimate the model in general differ from those used to estimate previous models. Almost all of the equations have been estimated under the assumption of first order serial correlation of the error terms; and in the money GNP sector, account has also been taken of possible simultaneous equation bias. The monthly housing starts equations have been estimated under the assumption that the housing and mortgage market is not always in equilibrium, and the technique that was used to estimate the equations is designed to take account of coefficient restrictions across equations. It should be pointed out that the use of more sophisticated econometric techniques in this study is not necessarily inconsistent with the desire to keep the model as simple as possible. Once a technique has been programmed for computer use, it is generally as easy to use as any other technique; and with present-day computers, the fact that the technique may use a few more seconds (or microseconds) of computer time is not likely to be much of a restriction.

Some of the conclusions that emerged from estimating the individual equations of the model are the following. With respect to the consumption equations, the Michigan Survey Research Center index of consumer sentiment was significant in explaining short-run consumer behavior. The Bureau of the Census index of expected new car purchases was also significant when considered separately, but it did not appear to contain information not already contained in the consumer sentiment index. GNP rather than dispos-

able personal income was used as the income variable in the consumption equations. No loss of explanatory power in the durable consumption and service consumption equations resulted from doing this, and only slight loss of explanatory power occurred in the nondurable consumption equation. It was conjectured that GNP may in part be acting as a proxy for consumer confidence and that this is the reason why its use in the durable consumption equation did not result in any loss of explanatory power.

With respect to the plant and equipment investment equation, the OBE–SEC investment expectation variable was highly significant in explaining actual investment. The current GNP variable was also significant in explaining actual investment, which suggested that firms do have some flexibility in changing their expected investment expenditures in light of unexpected changes in current economic activity.

For the housing sector the central problem was explaining housing starts, since housing investment proved to be rather easy to explain given housing starts. Housing starts, unfortunately, were not particularly easy to explain, and a relatively complicated model had to be developed. The housing market was treated as a disequilibrium market, and under a particular assumption about how prices are determined, two equations explaining housing starts—one demand equations and one supply equation—were estimated. Aside from the mortgage rate, trend factors and the number of houses in existence appeared to be significant in determining the demand for housing starts, and deposit flows into Savings and Loan Associations and Mutual Savings Banks appeared to be significant in determining the supply of housing starts.

With respect to the inventory investment equation, four approaches aimed at modifying the basic stock adjustment model were tried. The attempt to account for the effect of sales expectations on inventory investment did meet with some success, but the other three aproaches did not. The attempt at disaggregation failed; no evidence of a more complicated adjustment process was found; and none of the various inventory expectational variables that were tried proved to be significant. The sales variable that was used in the inventory equation was the sum of durable and nondurable consumption, and the one-quarter-lagged value of this variable had a large positive coefficient and the current value of the variable a small negative coefficient in the equation. This result was consistent with a simple assumption about how sales expectations are formed.

The price equation was based on the simple theory that current price changes are determined by current and past demand pressures. A potential real GNP series was constructed, and the demand pressure variable was taken to be the potential real change in GNP less the actual money change. An eight quarter moving average of this variable was then used as the measure

of current and past demand pressures. The approach taken in this study avoided the need to develop a complete wage–price sector in order to explain prices, and the equation that was finally chosen for the model appeared to provide an adequate explanation of price changes.

The employment equation was based on the idea that the number of hours paid for per worker does not always equal the number of hours actually worked per worker and that during any one time there is either a positive or negative amount of excess labor on hand. A simple short-run production function was specified and estimated, and from this function a series on man-hour requirements was derived. The man-hour requirements series was then used to construct a measure of the amount of excess labor on hand. The amount of excess labor on hand proved to be significant, along with the current and the one-quarter-lagged value of the change in output, in explaining the change in employment.

With respect to the labor force equations, the labor force participation of primary workers did not appear to be sensitive to labor market conditions and was merely taken to be a function of time. The labor force participation of secondary workers did appear to be sensitive to labor market conditions, and the participation rate of secondary workers was taken to be a function of the employment–population ratio. The equation did not appear to be capable of accounting for the rapid growth of the secondary labor force in the last half of the 1960s, however, and this growth was left largely unexplained in the model.

A relatively small model such as the present one has the advantage that it can be rather easily analyzed. In this study, various versions of the model were simulated and analyzed before the final version was chosen; the stability of the estimated relationships over time was examined and the outside-sample forecasting results were compared with the within-sample results; and the sensitivity of the forecasting results of the model to likely errors made in forecasting the exogenous variables was examined. The general conclusions that emerged from this exercise were the following. It appeared to be important in the money GNP sector to test each equation within the context of the overall model. Certainly with respect to the inventory investment equation and perhaps with respect to the nondurable consumption equation, different choices would have been made had the equations not been tested within the overall model. This was not true for all equations, but it was true for enough to indicate that in a simultaneous-equation model, the equations should not be chosen merely by looking at the properties of the estimated equations.

With respect to the stability of the estimated relationships, all but about five of the equations were fairly stable over the 653–694 period. The demand equation explaining housing starts was not very stable over this period, nor

was the equation explaining the labor force participation of secondary workers. The supply equation explaining housing starts, the price equation, and the inventory investment equation were also somewhat unstable, but to a lesser extent than the other two. When all of these equation estimates were used to generate outside-sample forecasts for the 654-694 period, the results were in general fairly close to the within–sample results. For the mean absolute errors in terms of levels, the within–sample results were better, but for the errors in terms of changes, the two sets of results were quite close. Also, for the 1968–1969 period the errors in terms of both levels and changes were close for the two sets of forecasts.

The forecasting results were a little more sensitive to the use of extrapolated values of the exogenous variables rather than the actual values. Again, however, the errors in terms of changes were much closer for the two sets of forecasts than were the errors in terms of levels. For the three-, four-, and five-quarter-ahead forecasts, the GNP mean absolute errors in terms of changes differed by about 1.5 billion dollars for the two sets of forecasts (see Table 13–5). For the one- and two-quarter-ahead forecasts, the results were much closer.

For the within-sample forecasts there was little evidence of error compounding as the forecast horizon lengthened. For the outside-sample forecasts based on actual values of the exogenous variables, error compounding occurred for the errors in terms of levels, but not in general for the errors in terms of changes. For the outside-sample forecasts based on extrapolated values of the exogenous variables, error compounding occurred for both error measures, but much less for the errors in terms of changes.

A comparison of results achieved in this study with the results achieved by the Wharton and OBE models indicated that the present model is an improvement over both of these models. The comparison also indicated that the forecasts generated by the present model are likely to be an improvement over the forecasts generated by the econometricians associated with the Wharton and OBE models. In particular, no fine tuning devices appeared to be necessary in this study in order to generate accurate forecasts.

There are a number of possible reasons why the present model gave better results than the Wharton and OBE models. One possible reason is that closer attention was paid in the study to the question of how the model performs as a unit. In line with this, an attempt was also made to design the model in such a way as to minimize potential simulation errors. This was especially true in the specification of the price sector, where the entire wage–price nexus was avoided. Another possible reason why the present model performed better relates to the estimation techniques used. Estimating each equation under the assumption of first order serial correlation of the error

terms and then using the estimates of the serial correlation coefficients in the generation of the forecasts appears to be quite helpful. The fits of the equations were generally much worse if account was not taken of the serial correlation of the error terms (see Appendix B). Finally, the fact that account was also taken in this study of possible simultaneous equation bias may have improved the forecasting results.

Although the model was designed primarily for forecasting purposes, it is not completely useless as a policy tool. Fiscal policy actions affect the model in two main ways. First, the level of government spending (purchases of goods and service) affects the forecasts of GNP and related variables directly through the exogenous G_t variable. As was seen in Chapter 11, the short-run government spending multiplier is 1.232 for GNP. Secondly, tax law changes affect the forecasts of GNP and related variables indirectly through the effects they have on consumer sentiment and plant and equipment investment expectations. Since tax laws are generally debated and discussed considerably ahead of their actual enactment, these debates and discussions may affect the consumer sentiment and investment expectations variables far enough ahead so that these effects are reflected in the forecasts of the model. Personal tax law changes in the quarter in which they are enacted do not appear to have any systematic effect on personal consumption expenditures, and the argument given here for why this is so is that consumers to some extent have already discounted these changes. In other words, it is argued here that in explaining or forecasting short-run changes in consumption, it is more important to explain or forecast consumer sentiment than it is to account for the direct effects of tax rate changes on disposable personal income.

Monetary policy actions also affect the model in two main ways. First, the mortgage rate enters the housing starts equations; and thus, to the extent that monetary policy affects the mortgage rate, this has an affect on housing starts. Secondly, monetary policy actions may be reflected in the consumer sentiment and investment expectation variables. As discussed in Chapter 4, for example, no evidence could be found that short-term credit conditions affect the relationship between actual and expected investment expenditures, but that evidence was found that long-term interest rates affect expected investment expenditures. For short-run forecasting purposes, however, it did not appear to be necessary to include the equation explaining expected investment expenditures in the model. For policy purposes, of course, one would want to include such an equation in the model (as well as including a monetary sector), and even for present purposes, the exogenous forecasts of the investment expectation variable that have to be made after the available data or proxies for the variable run out should be guided in part by current and expected future monetary policy.

The final policy issue that should be mentioned here relates to the monthly housing starts sector. The advances of the Federal Home Loan Bank to Savings and Loan Associations were quite significant in explaining the supply of housing starts, but no evidence could be found that the activity of the Federal National Mortgage Association had an effect on the supply of housing starts. Even the Federal Home Loan Bank will, however, have an effect on actual housing starts only to the extent that supply and not demand is the constraint in the housing market.

The primary weakness of the model is probably its inability to account for large quarterly changes in inventory investment, such as those that occurred in 664, 671, 681, and 682 (see Tables 11–4, 12–18, and 13–7). To some extent, errors in forecasting the change in inventory investment are offset by errors in the opposite direction in forecasting consumption expenditures. But for some quarters, such as 671, there is no error offsetting. After a large change in inventory investment in one quarter, there tends to be a large change in the opposite direction in the next quarter (witness 664–671 and 681–682), and aside from the one-quarter-ahead forecast for the second quarter, for which the actual investment of the first quarter is known, the model is not capable of forecasting the changes for either quarter.

Another weak point of the model is its inability to account for the large growth of the secondary labor force during the last half of the 1960s. Whether the model will continue to perform poorly in this area in the future is perhaps still uncertain, but the past performance is not particularly encouraging. Other questions that remain are whether the housing starts equations will be more stable in the future than they were in the past and whether the nonlinear version of the price equation will be stable.

The art or science of building econometric models is still in its infancy, and it is probably much too early to tell how useful econometric models will be for forecasting and policy purposes. The results in this study run contrary to the results reported by Evans, Haitovsky, and Treyz [14] for the Wharton and OBE models and indicate that econometric models can be built that do not need to be extensively (and subjectively) fine tuned in order to produce reasonable forecasts. The results also indicate that the present model is more capable of producing accurate forecasts than are noneconometric forecasting techniques. All of these results are, of course, preliminary. Just how useful the model will be in the future and whether large-scale structural models will be able to produce even better results are open questions.