Interindustry and Macroeconomic Effects of Monetary Policy: A Long Term, Modeling Perspective

Ralph Michael Monaco

APPROVAL SHEET

Title of Thesis: Interindustry and Macroeconomic Effects of Monetary Policy: A Long Term, Modeling Perspective

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ABSTRACT

Title of Dissertation: Interindustry and Macroeconomic Effects of Monetary Policy: A Long Term, Modeling Perspective

Ralph Michael Monaco, Doctor of Philosophy, 1984.

Dissertation directed by: Clopper Almon, Jr., Professor of Economics

The effects and effectiveness of monetary policy changes are almost always evaluated within the context of the quarterly macroeconometric model. Such a model is not usually simulated very far into the future, say two to three years at most. Thus, implications drawn from these simulations do not reflect long term considerations of a continued policy regime. Further, macroeconometric models are silent on the differing effects of policy among industries. The purpose of the present study is to examine the long term, macroeconomic as well as interindustry differences among possible Federal Reserve policy schemes.

The monetary policy model used to simulate these possible Federal Reserve policy schemes is an annual, six-equation model predicting the quantity of M2 balances held in the economy and five interest rates of varying maturity. The exogenous policy variables are the non-borrowed reserves of the banking system and the required reserves of the banking system. The monetary policy model was designed to be inserted into a 78 sector input-output model with econometrically estimated equations for the various final demand types. The input-output model includes a

price-income side which calculates prices from the various components of value added such as profits, labor compensation and indirect business taxes. As part of the thesis, several of the sets of equations were re-estimated and changes were made to the structure of the model to allow a greater influence of interest rates. The construction of an economically "reasonable" forecast pointed out further deficiencies which were addressed and dealt with in the thesis. A forecast to 1995 is presented as a base from which various simulations are run.

Finally, the entire model is simulated from 1982 to 1991 under various assumptions about the paths of monetary policy variables. These results are then compared with the results of similar simulations done with models developed by three commercial forecasting houses. It is found that the model developed in the thesis compares very favorably with the models of the commercial forecasters. Along with the macroeconomic comparisons with the three other models, the interindustry implications of these monetary policy regimes are developed to determine which industries experience the most significant changes in output and employment in the face of the policy changes.

Preface

Over the past six years it has been my privilege to be associated with the Interindustry Forecasting Project at the University of Maryland (INFORUM) research group, first as a graduate research assistant, later as a dissertation fellow. The INFORUM model is a large interindustry model of the United States economy which can be linked to smaller models of several foreign countries. In the course of my work with INFORUM, I became interested in the subject of modelling in general, and, more specifically, with model building, operation, and the forecasting properties of large scale models. When the time arrived to choose a dissertation topic, I saw the chance to combine an interest in models of the monetary sector with the interest in large scale models in general by building a small monetary sector model and incorporating it into the then-existing INFORUM model. The properties and forecasting reasonableness of the newly revised model were to form the basis of the thesis.

At approximately the same time as the dissertation decision, INFORUM was "completing" the building of a new domestic model for Chase Econometrics. With the departure of the coordinator of the new model, it fell to me to finish putting the new model together. Such a task would enable me to become familiar with the new model and allow me to use this new model as part of the proposed thesis. The projected completion time for the task was one month.

Eleven months later the new model produced its first sensible forecast. In the intervening time, much was learned and changed about the economic structure, the estimated equations and the programming that

comprised the new model.

The interindustry model that finally emerged was far more complicated and less manageable than the interindustry model originally intended to be used with this thesis. This decrease in manageability stems primarily from the endogenization of real disposable income, a variable which was exogenous in the earlier version of this model. Programming complexity was enhanced by the simultaneous solution of industry output and prices and by the requirement that the three individual pieces of the model be capable of operating reasonably without the other two. The Fortran code for preparing data for the model to use and for the model itself consists of approximately 10,000 lines. A complete printout of all of the variables used in the model for a typical forecast horizon of 15 years runs to well over 400 pages.

It must be hastily added that this model is very much a group effort, with every member of the INFORUM staff contributing a great deal to the workings and results of the model. Most of these efforts went to the important task of estimating the equations which fundamentally comprise the model. The work of putting these equations together into a model and writing the model software fell first to Patrick Henaff, who brought the model to near completion, and later to myself. Matthew Hyle was responsible for the programming and equations of the price-income side of the model. The original set of programs around which the model was designed was the effort of Clopper Almon and Douglas Nyhus.

There are many people to thank for helping me, both with bringing the model to some sense of completion and in helping with my thesis, two very intertwined tasks. I owe much to Matthew Hyle, who shared many a long evening with me in our mutual quest to finish the model and our

theses. I owe an even greater debt to Margaret Buckler, who managed always to be there at the right moment with advice or a friendly ear. She has also made an art of writing display routines, without which the model results could not be seen. Many ears were made available to me by kindly souls. Among the best were those of David Robison, Stephen Pollock, Anthony Barbera, and Lorraine Sullivan. Daisy Foster lent her fingers to the enterprise by helping with the typing.

A large debt of gratitude is owed to my thesis advisor and sometimes sparring partner, Clopper Almon, who provided me with one of the greatest opportunities an economic modeler can be given -- the chance to participate in an important way in the construction of a new kind of model.

INTERINDUSTRY AND MACROECONOMIC EFFECTS OF MONETARY POLICY: A LONG TERM, MODELING PERSPECTIVE

by

Ralph Michael Monaco

Dissertation submitted to the Faculty of the Graduate School
of the University of Maryland in partial fulfillment
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Chapter 1. Introduction and Summary

The recent experience with high inflation rates, high interest rates and a slumping economy has brought the questions of the effects and effectiveness of monetary policy to center stage of the economic policy debate. The tool used almost exclusively to determine the effects of monetary policy changes is the quarterly macroeconometric model. While this tool is appropriate and useful for many purposes, it is inappropriate to examine long term consequences of a policy action, largely because the focus when building these models is on the short run. An equation which fits the historical data well will extrapolate the recent past quite adequately into the near future and is the logical choice for inclusion in a short-run forecasting model. Consider the problem of forecasting consumption expenditures on durable goods. To arrive at a relatively accurate forecast of expenditures a year or two into the future, it is probably not necessary to account for the slowly changing age composition of the population. To forecast consumption expenditures on durables by 1995, however, the age composition of the population becomes a critical factor, since some age groups tend to make more durable goods purchases than do other age groups. Modeling considerations would probably favor the equation without demographic influences, since very little short-run explanatory power is added by the demographic variables and the cost of using and maintaining a model complicated by the introduction of demographic variables is higher than the cost of using and maintaining a less complicated model. The policy implications of a model including demographic variables probably differ from a model without them, if only because the sensitivities to other

variables are different in the two models. Thus, using a model designed for short term forecasting is generally inappropriate for long term forecasting.

A second feature lacking in many macroeconometric models is detail about various industries in the economy. This is a particularly important feature for monetary policy. One, if not the, major monetary policy transmission mechanism is interest rates. Certain industries are more sensitive to interest rate levels and changes than others. A model which discriminates only among manufacturing, non-manufacturing and service industries provides less information about the more specific effects of a policy change than does a model which sub-divides each of the three industries. Information about the effects of monetary policy on the three aggregate sectors may be useful to the lumber industry, for example, but not as useful as a model which includes a separate Lumber industry as part of the model.

The purpose of this dissertation is to provide a framework for analyzing the long term, interindustry effects of monetary policy. This is accomplished by incorporating a simple monetary policy model into an interindustry model designed for long term forecasting. The combined models then provide a simulation tool for analyzing the two issues discussed above. Conceptually, the dissertation consists of three parts: developing the monetary model, revising and completing the interindustry model, and simulating the model under various monetary policy changes. This three part process is presented in chapters 2 through 6.

In chapter 2, two competing approaches to interest rate modeling are discussed. A variant of one of the approaches is selected as an appropriate modeling approach in this particular environment. A six-equation monetary model is then developed, estimated and simulated independently of the larger, interindustry model.

In chapter 3, the large interindustry model is introduced. Interest rate sensitivities of various final demand equations are presented. Two sets of regression equations are re-estimated to enhance the interest rate sensitivity of the model. Changes in the structure of the model calculation of foreign prices are presented. The solution process and structure of the model is briefly outlined and discussed.

Chapter 4 consists of reporting the attempts to produce an economically reasonable base forecast from which alternatives can be run. In the course of these attempts, changes are made to major macroeconomic equations in the model and several exogenous fixes are developed. Several partial runs of the model are presented and a base forecast is shown and discussed.

Chapter 5 compares the results of the base run with alternatives produced when the monetary policy variables are changed. Two alternatives investigate the efffects of changing the growth rate of the non-borrowed monetary base, the principal exogenous monetary policy variable. Another scenario investigates the effect of differing reserve requirements on the long term forecast. Finally, a single scenario is run which allows comparison of the base with a model that contains a

higher level of interest rates. In all of these cases, long term average growth rates are emphasized and are the subject of the comparison. To keep the analysis to a manageable level, only the macroeconomic results and the industry output results are the subject of discussion.

In chapter 6, more long term average growth rate comparisons are presented. This chapter focusses on the macroeconomic results of three other long term models run under similar monetary policy assumptions. These scenarios are compared with the model developed in the earlier chapters run under the same policy assumptions. Weaknesses in all of the models are revealed. More detailed results are presented for the model developed in this thesis, which tends to reveal more clearly some problems and results from the previous chapter.

Finally, a conclusion outlines some possible extensions of the model. General comments about the viability and characteristics of the model are presented.

Chapter 2. Monetary Sector

The purpose of this chapter is to discuss the problem of monetary modelling and various approaches to dealing with the problem. A small, six-equation model is developed, the purpose of which is to provide a framework incorporating movements in the fundamental factors in the economy into interest rate determination. The model is designed to become a part of a large, interindustry forecasting model and is estimated using annual data from 1960 to 1981. Simulations over subsets of that data set are presented.

A model of the monetary sector should be able to meet two requirements. First, the model should start from quantitites over which the Federal Reserve has complete or nearly complete control and translate movements in these variables to other variables in the system. Second, the model should be able to produce an array of interest rates, both long and short term. While the size of the model that meets these two requirements can vary quite substantially, these two tasks must be met. Two major types of models have been advanced as models of the monetary sector. These are flow-of-funds models and bank-reserves models. The bank-reserves type of model is by far the most prevalent approach to monetary modelling, and we turn to examine these models first.

Approaches to Monetary Modelling

The bank-reserves approach to monetary modelling begins with the assumption that the market for bank reserves controls the short term

interest rate and that longer term interest rates can be modelled using the short term rate via term-structure equations. To be more specific, the model of short-term interest rate determination begins with the definition of free reserves

$$(1)\quad FR = NBR - RR$$

where

FR = free reserves of the banking system
NBR = non-borrowed reserves
RR = required reserves.

By realizing that required reserves can be written as some specified fraction of total deposits and taking non-borrowed reserves as exogenous, we can use equation (1) as the equivalent of the usual market clearing condition in a three-equation model of the short term interest rate:

$$(2)\quad NBR = FR + qD$$

$$(3)\quad FR = FR(Z,r)$$

$$(4)\quad D = D(X, r)$$

where

q = reserve requirement ratio
D = total deposits
Z = exogenous variables which determine free reserves
X = exogenous variables which determine demand for deposits
r = short term interest rate.

The usual approach to monetary modelling has been to estimate equations (3) and (4) and to solve the estimated money demand equations for the interest rate when using exogenous non-borrowed reserve assumptions.

While this three-equation system meets the first requirement of a monetary model, namely. allowing the modeler to begin from a variable that the Fed can control, it does not meet the second requirement of having the capacity to generate long-term interest rates. This deficiency is met by using a term-structure relation like (5) in which the long term rate is determined by the short term rate and other variables, usually the inflation rate.

$$(5)\quad r_L = r_L(r, p)$$

where

r_L = long term interest rate
p = inflation rate.

The four equation model ((2) through (5)) is now a complete monetary sector model and is a prototype of the monetary sector used in most forecasting models of the U.S. economy. Naturally, particular models vary greatly in terms of the number of equations, the type of data used and the procedure used to estimate the equations.

A bank reserves model that is nearly as simple as the prototype presented here is developed by Scadding for the Hickman-Coen medium-range forecasting model.[1] The monetary model is an eight equation model which predicts the quantity of M2 balances (old M2), the 90-day Treasury bill rate, and the rate paid on time deposits by banks. Separate equations are estimated for excess reserves and borrowed reserves, which are the components of free reserves. The model is estimated using annual data from 1924-1940, 1946-1966. Although the Scadding version meets only the first requirement of monetary sector models, the second requirement was met by the addition of a single term

structure equation estimated especially for the Hickman-Coen model. This equation translates the Treasury bill rate into the AAA bond rate. Cooper presents a quarterly version of the simple prototype and other versions can be found in DeLeeuw and Hendershott.[2]

The Federal Reserve Board's quarterly macroeconomic model is a much larger version of the prototype presented here. The complication in this model arises from the division of total deposits into several types. An equation is developed for demand deposits, overnight repurchase agreements, Eurodollar accounts, money market mutual fund accounts, and several other types of deposits. Since many of these equations require different sets of exogenous variables, the size of the overall model is increased by considerably more than just the number of deposit equations.

In the determination of interest rates, an alternative to a bank reserve model is a flow-of-funds model. In the flow-of-funds approach, the demand and supply of each type of security for each of several market participants is explicitly modelled. The interest rates are regarded as the prices which equilibrate the demand and supply of each security type. Two of the recent examples of this approach are found in Hendershott and Backus et. al. .[3] Such models are generally regarded as more complete and consistent than bank reserves models for several reasons. First, because the flow-of-funds models generally disaggregate agents into more categories than the three of the bank reserves model, (the Fed, the non-bank public and banks) potentially important differences in behavior glossed over by the aggregate model can be modelled with the flow-of-funds approach. Second, since flow-of-funds models try to present a complete balance sheet for each agent in the

model, certain theoretical balance sheet restrictions can easily be imposed on the model which cannot be imposed on the more aggregate model. The best example of these restrictions is the restriction that permits changes in rates of return to affect only the composition and not the size of the portfolio. Finally, the examination of separate security markets allows portfolio-adjustment effects among various securities of differing maturity, which is in stark constrast to the term-structure approach. The choice of which type of model to use to forecast interest rates, whether a flow-of-funds or aggregate bank reserves model, becomes a queston of whether to use a large, disaggregated, complex model or a small, highly aggregated model. The key issue is whether the added size and complexity of the flow-of-funds model adds enough to the accuracy of the forecasts of the various interest rates to justify the extra effort necessary to build, maintain, and use the model.[4] This issue has been addressed by Hendershott and Orlando who estimated each type of model using quarterly data from no later than 1966.1 to no later than 1971.4.[5] The bank reserve model contains 13 equations and forecasts three interest rates, the commercial paper rate, the AAA bond rate and a mortgage rate. The flow-of-funds model consists of 39 equations with seven agents and three assets. Simulation of each model over the period 1972.1 to 1972.4 yielded the following results for the three rates.

Table 2.1

Root Mean Square Errors 1972.1-1972.4

Rate on Asset	Bank Reserves		Flow of Funds	
	Levels	Changes	Levels	Changes
Commercial paper	.44	.41	.96	.50
Corporate Bond Rate	.55	.33	.11	.09
Mortgage Rate	.23	.11	.54	.23

The comparison is presented using the root mean squared error of the forecasted levels and the forecasted changes. The immediate conclusion one can draw from this table is that neither method of forecasting interest rates is substantially better than the other. While the bank reserves model was better able to forecast the commercial paper rate and mortgage rate, it was decidedly inferior in forecasting the corporate bond rate. The absence of a clearly superior method for forecasting interest rates leaves the conclusion that these two models are roughly equivalent in their capacity for interest rate forecasting. In view of this evidence, and the comparative ease of building, using, and maintaining a smaller model, the aggregative approach to interest rate forecasting was adopted.

Problems of Implementation of the Bank Reserve Models

The hallmark of the recent financial history of the United States has been rapid innovation. While the causes of the innovative behavior seem to be clear, namely, the technical progress in fund transferring and the response of the financial system to high rates of inflation and usury ceilings, the effect on the job of the monetary modeller has been

to increase immensely the difficulty of forecasting. The innovations in the monetary sector show up as instabilities in the coefficients of the estimated equations and make the use of these equations suspect for forecasting .[6] This problem of instability has manifested itself in the two key equations of the bank reserves models, the money demand equation and the free reserves equation.

The money demand equation is perhaps the most frequently estimated relation in all of empirical economics. The usual approach to modelling money demand is the Baumol-Tobin approach, which views the demand for transactions balances as an inventory problem. With a given level of transactions and an opportunity cost to holding funds, the optimal size of the inventory of transactions balances can be determined. This line of analysis leads to the specification that the logarithm of real transactions balances is linearly related to the logarithm of some measure of income (permanent or current) and a short term interest rate. Although this type of equation fit the data well and provided reasonable forecasts out-of-sample simulations prior to 1973, the standard equation began to fail on post-1973 data. Judd and Scadding provide a summary of the stability problems associated with conventional money demand equations and the steps taken to deal with this problem.[7]

Many of the attempts to "stabilize" the equation involve the extension of the definition of real money balances to include the new interest bearing transactions accounts. This inclusion has, however, changed the nature of the money demand curve, since the short term interest rate is now not solely a measure of the opportunity cost of holding funds as was previously the case. To the extent that measures of money balances include assets which bear market interest rates, the

sign on the short-term interest rate in the money demand equation should be positive. not negative. This problem is especially acute for M2 demand curves, since by 1982, 64% of the non-M1 components of M2 bore market related interest rates.[8] Presumably, the introduction of the entire term structure of interest rates would be a soluton to this problem; however, since this redefinition is a relatively new phenomenon, it would be impossible to estimate a relationship in which the short term rate is positively related to real money balances and the long term rate is negatively related to real money balances. The newest type of accounts, "super NOW" and money market deposit accounts, will, over the horizon we are interested in, virtually eliminate the dichotomy between transactions and savings accounts and probably change the M2 type demand equation into one in which the short-term rates have positive signs while the long-term rates have negative signs.[9]

While the demand side of bank reserves models has received considerable attention, the supply side, as embodied in the free reserves equation, has received comparatively little attention. Unfortunately for monetary modelers, innovation in bank behavior has affected the free reserves equation in a manner similar to the money demand equation. The conventional wisdom on the free reserves equation relates the amount of free reserves to the discount rate, the short-term interest rate, changes in reserve requirements and the volume of commercial loans.[10] The discount rate measures the cost of borrowing funds from the Fed, while the short-term interest rate measures the cost of holding excess reserves. Thus, the discount rate is expected to have a positive coefficient in a regression while the short term rate should enter with a negative sign. In quarterly equations, consideration is

taken of the change in reserve requirements having a negative effect on the level of reserves (decreasing reserve requirements increasing free reserves initially) and the effect of commercial loans on free reserves. Commercial loans are included because banks are presumed to sacrifice their excess reserves position or borrow from the discount window to accommodate the demand for loans in order to maintain a continuing relationship with their debtors. This term, then, emphasizes the residual nature of free reserves.

In a recent article, Lombra and Kaufman point out that the simple analytics behind this type of equation no longer obtain.[11] Instead, in a world of liability management, excess reserves and borrowed reserves lose their pre-eminent role as the paths by which banks alter their portfolios. The increasing importance of the federal funds market and of certificates of deposit has enabled banks to make loans without changing their holding of excess reserves or borrowing from the discount window. Lombra and Kaufman provide some evidence that the standard excess reserve equation has changed considerably by presenting the results of a monthly regression equation estimated over two separate periods, 1960.1 to 1968.6 and 1969.1 to 1976.12. The fit of the equation using the later sample period was substantially worse than the fit of the equation over the earlier period and the coefficients on the short term interest rate and discount rate switched signs between the earlier and later periods. Thus, there is some evidence that the key relation on the supply of money side is unstable and some further evidence that suggests that free-reserves demand is no longer the key relation on the supply side.

The point of the preceding discussion is that although the bank

reserves models forecast interest rates roughly as well as larger, more complicated models, recent financial innovations on the demand and supply side make the use of the bank reserves structural equations suspect as forecasting tools. An alternative to the use of structural models whose stability properties are suspect or whose properties under a new environment are unknown is to estimate a reduced form equation on the variable of interest directly. In this case, rather than estimating the demand and supply of money, an equation is estimated to predict interest rates directly. Although this approach does not diminish the structural instabilities except in the unlikely event that such instabilities cancel out from the demand and supply side, the analysis is made more convenient by allowing all of the instabilities to be put into a single equation which can be modified easily at the will of the forecaster. As a practical matter, the forecaster often has a better idea about the course of interest rates than about the structural parameters of the demand and supply equations.

In the small model developed here for inclusion into the larger, interindustry model, there are six equations summarizing the monetary sector. An equation is developed which translates the non-borrowed monetary base into M2. This equation satisfies the first requirement of a monetary model. The second requirement is met by the addition of five interest rate equations. Each one of the equations will be dealt with separately.

Estimating the model

To meet the requirement that the model should start from some quantity over which the Fed has control, the non-borrowed monetary base is taken as the exogenous variable and a single regression equation is used to translate the base measure into the broader, M2 aggregate. This equation explains the movement in the money multiplier, a concept which contains elements of the demand and supply of money. The textbook version of the M2 multiplier can be written as the solution to a six-equation system:

(1) $NB = dD + sS - FR + C$

(2) $FR = a_1 M2$

(3) $C = a_2 M2$

(4) $D = a_3 M2$

(5) $S = a_4 M2$

(6) $M2 = C + D + S$

where

NB = non-borrowed reserve base
FR = free reserves
D = transactions deposits
S = savings and time deposits
C = currency
d = required reserve ratio on transactions deposits
s = required reserve ratio on time and savings deposits

The solution for the M2 multiplier is:

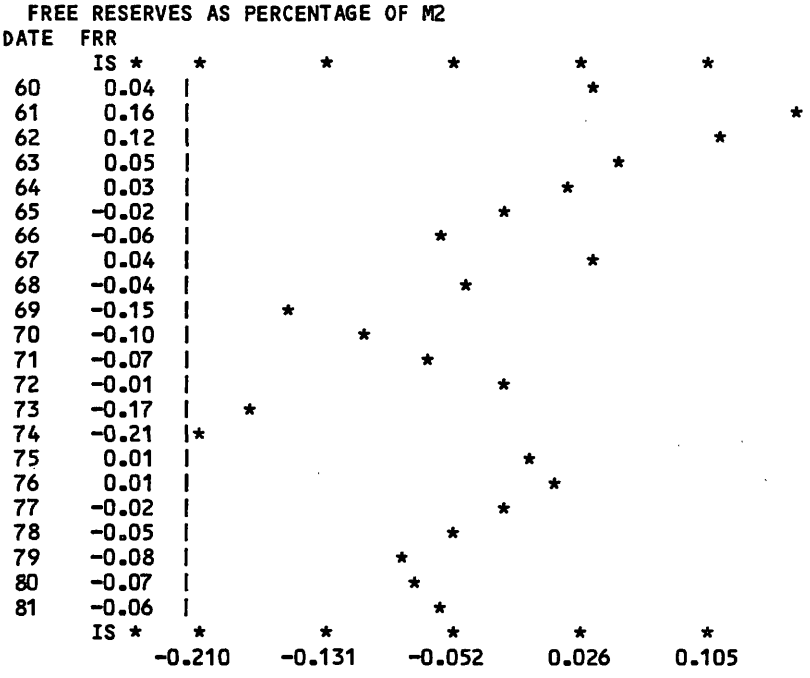
$$M2/NB = (da_3 + sa_4 - a_1 + a_2)^{-1} .$$

While in the textbook case a_1 through a_4 are fixed parameters, it is clear that they are really functions of other variables such as interest rates, income , and policy instruments of the Fed. Equation 2, for example, could be replaced by the usual free reserves type of equation

and its parameters estimated prior to substitution into the money multiplier equation. Alternatively, the a_i can be viewed as possibly very complicated non-linear functions of interest rates, income and other exogenous variables, and an equation estimated which is intended to approximate the more complicated function. This latter course was taken. In order to understand better the factors which influence the multiplier, it is important to know how the components moved in the past. Figures 2.1 and 2.2 present plots of the historical a_i values from 1960 to 1981. As these pictures show, rather steady declines in the currency and demand deposit ratios are somewhat offset by increases in the time and savings deposit ratio.[12] Given the lower reserve requirement ratio on time and savings deposits, the effect of the movements of the a_i has been to increase the multiplier. The free reserve ratio, (a_1), is by far the smallest component, and shows no consistent trend. Given its size, the free reserve ratio exerts a much smaller influence on the multiplier than the other components.

An examination of the plots suggests that to describe the long term movements in the multiplier, asset substitution between currency, demand deposits and interest-bearing money accounts must be modeled. As a generalization, the use of cash management techniques is positively related to the losses sustained when the techniques are not adopted. The major part of these losses is the result of high rates of inflation and interest. Cash management, or procedures and habits which tend to minimize holdings of non-interest bearing assets, has an element of learning to it. Thus, once procedures are adopted, they are seldom discontinued when inflation and interest rates fall to lower levels. Threshhold or ratchet type variables constructed from previous peaks of

FIGURE 2.1


FREE RESERVES AS PERCENTAGE OF M2
DATE FRR
IS 0.04
60 0.04
61 0.16
62 0.12
63 0.05
64 0.03
65 -0.02
66 -0.06
67 0.04
68 -0.04
69 -0.15
70 -0.10
71 -0.07
72 -0.01
73 -0.17
74 -0.21
75 0.01
76 0.01
77 -0.02
78 -0.05
79 -0.08
80 -0.07
81 -0.06
IS 0.04
-0.210
-0.131
-0.052
0.026
0.105

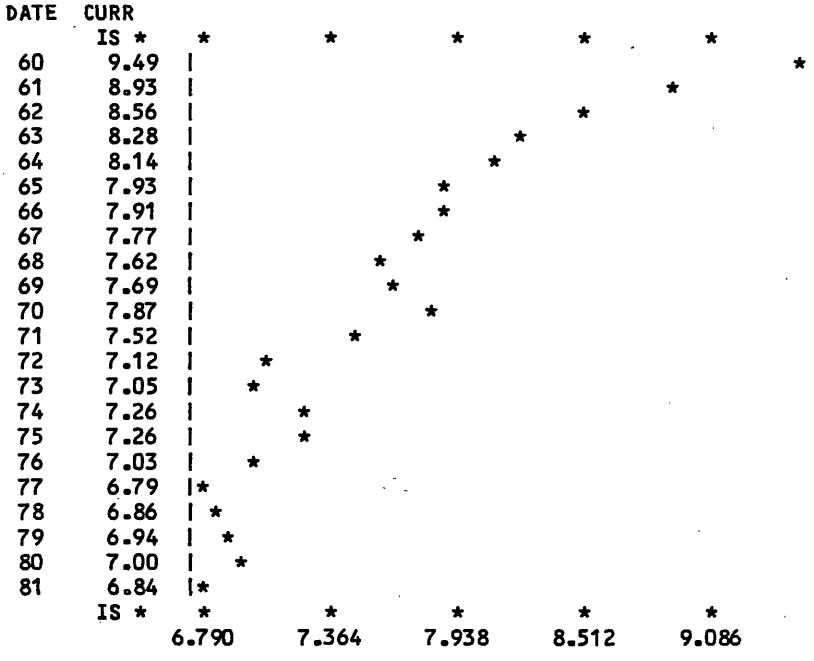
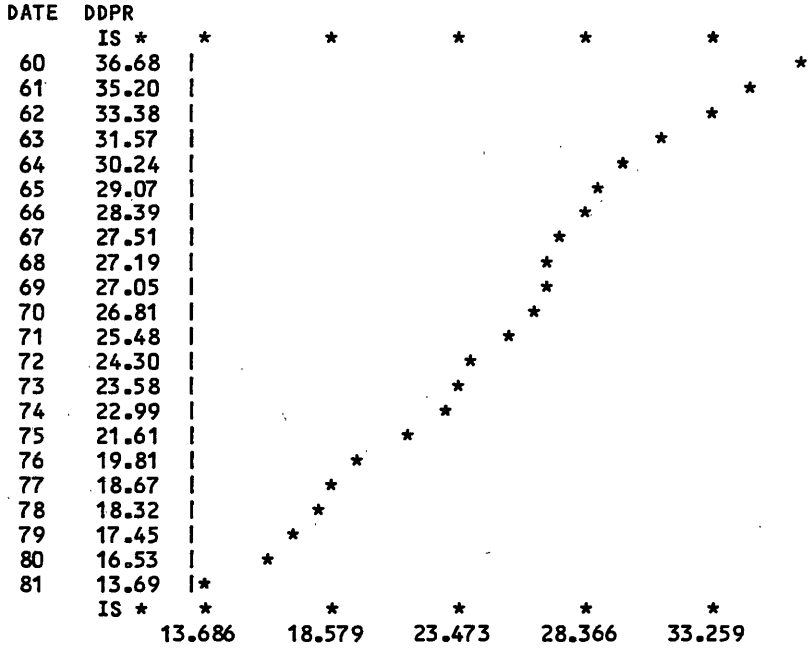
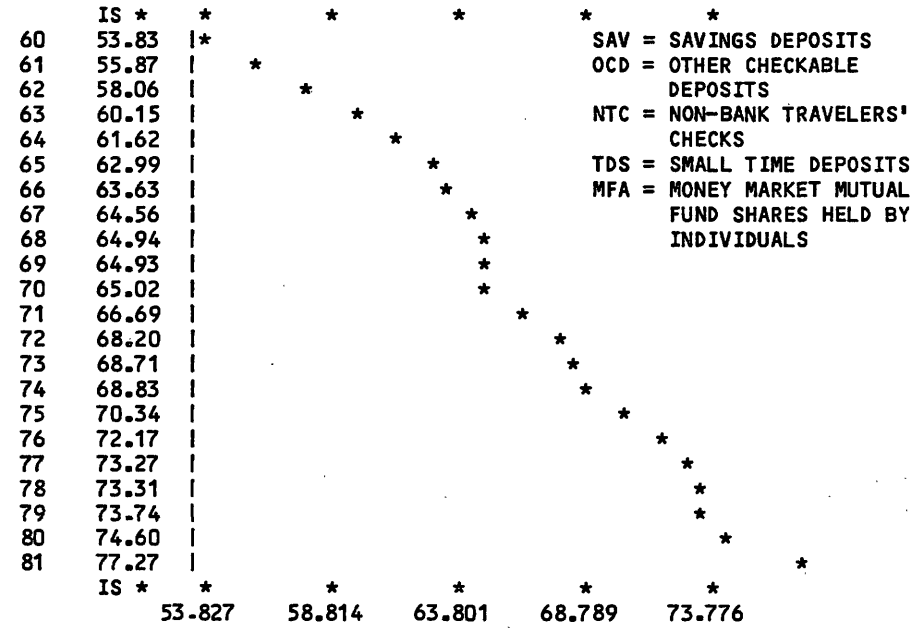

CURRENCY AS A PERCENTAGE OF M2
DATE CURR
IS 9.49
60 9.49
61 8.93
62 8.56
63 8.28
64 8.14
65 7.93
66 7.91
67 7.77
68 7.62
69 7.69
70 7.87
71 7.52
72 7.12
73 7.05
74 7.26
75 7.26
76 7.03
77 6.79
78 6.86
79 6.94
80 7.00
81 6.84
IS 9.49
6.790
7.364
7.938
8.512
9.086

FIGURE 2.2

DEMAND DEPOSITS AS A PERCENTAGE OF M2



SAV + OCD + NTC + TDS + MFA AS A PERCENTAGE OF M2



SAV = SAVINGS DEPOSITS
OCD = OTHER CHECKABLE DEPOSITS
NTC = NON-BANK TRAVELERS' CHECKS
TDS = SMALL TIME DEPOSITS
MFA = MONEY MARKET MUTUAL FUND SHARES HELD BY INDIVIDUALS

inflation or interest rates and used in the multiplier regression would seem to follow the intuition described above. Other candidates for inclusion in the money multiplier relation are a measure of required reserves (which should be inversely related to the multiplier), a measure of income growth, and perhaps a time trend.

Several equations were estimated in an attempt to embody these relationships. While other specifications included lags of various lengths on the independent variables and a log-linear transformation, the specification which dominates all others in terms of goodness-of-fit and out-of-sample predictive power is a simple OLS regression on annual data from 1960 to 1981 using the following variables:

90 day Treasury bill rate
Percentage change in real GNP
Previous peak inflation rate or current rate, whichever is greater (over the period 1960 to 1981)
Total required reserves divided by M1 money supply

The results of the estimation are presented in Figure 2.3. The coefficients are all of the proper sign, with previous peak inflation, the Treasury bill rate and income growth forcing the multiplier up and higher levels of the required reserve ratio pushing the multiplier down. The fit is extremely good and the residuals exhibit no sign of serial correlation.

One test of the suitability of a regression for forecasting purposes is its ability to simulate well out of the sample period. To this end, the same specification for the money multiplier was estimated from 1960 to 1975 and simulated from 1976 to 1981. The results from this exercise are presented in Figure 2.4. Generally, the results are quite good, indicating that the specification is fairly stable. The average absolute percentage error (AAPE) for the simulation period is

FIGURE 2.3

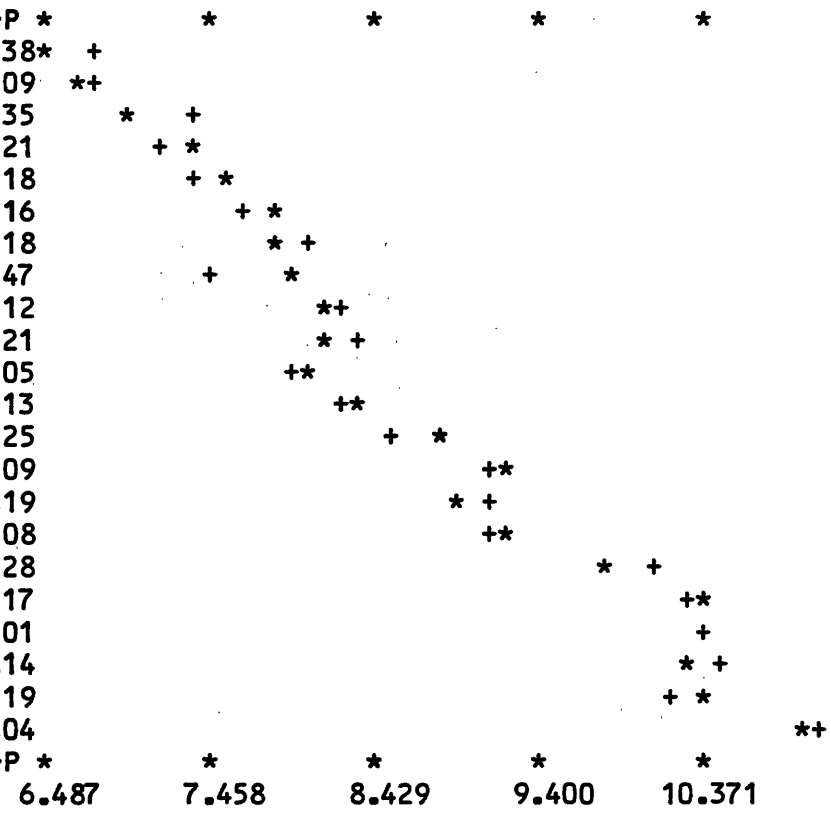
MONEY MULTIPLIER EQUATION ESTIMATED THROUGH 1981

4 SEE = 0.2168 RSQR = 0.9727 RBARSQ = 0.9663
RHO = -0.0992 DW = 2.198 AAPE = 2.21

VARIABLE	REGRES-COEF	T-VALUE	ELASTICITY	MEXPLAVAL	MEAN
INTERCEPT	7.660589	7.02	0.883	97.39	1.0000
PPINFL	0.310161	11.29	0.198	191.40	5.5418
RTB	0.120063	3.84	0.081	36.64	5.8540
PCRG	0.147334	5.48	0.058	66.29	3.4383
REQRES	-0.015463	-2.14	-0.221	12.68	123.7882
MMULT	DEPENDENT VARIABLE - - - - - -				8.67467

MONEY MULTIPLIER

DATE	ACTUAL IS *	PREDIC IS +	MISS IS A-P *
60	6.49	6.87	-0.38
61	6.75	6.84	-0.09
62	7.05	7.39	-0.35
63	7.45	7.23	0.21
64	7.63	7.46	0.18
65	7.86	7.70	0.16
66	7.94	8.12	-0.18
67	8.01	7.54	0.47
68	8.16	8.28	-0.12
69	8.20	8.41	-0.21
70	8.05	8.01	0.05
71	8.40	8.27	0.13
72	8.82	8.57	0.25
73	9.25	9.16	0.09
74	8.99	9.18	-0.19
75	9.23	9.15	0.08
76	9.88	10.15	-0.28
77	10.45	10.28	0.17
78	10.43	10.41	0.01
79	10.36	10.50	-0.14
80	10.44	10.25	0.19
81	11.01	11.05	-0.04
	IS *	IS +	IS A-P *



MMULT = M2 / (NONBORROWED RESERVES + CURRENCY)
REQRES = REQUIRED RESERVES / M1
PPINFL = PREVIOUS PEAK INFLATION RATE
PCRG = PERCENTAGE CHANGE IN REAL GNP
RTB = 90 DAY TREASURY BILL RATE

FIGURE 2.4

MONEY MULTIPLIER EQUATION ESTIMATED THROUGH 1975

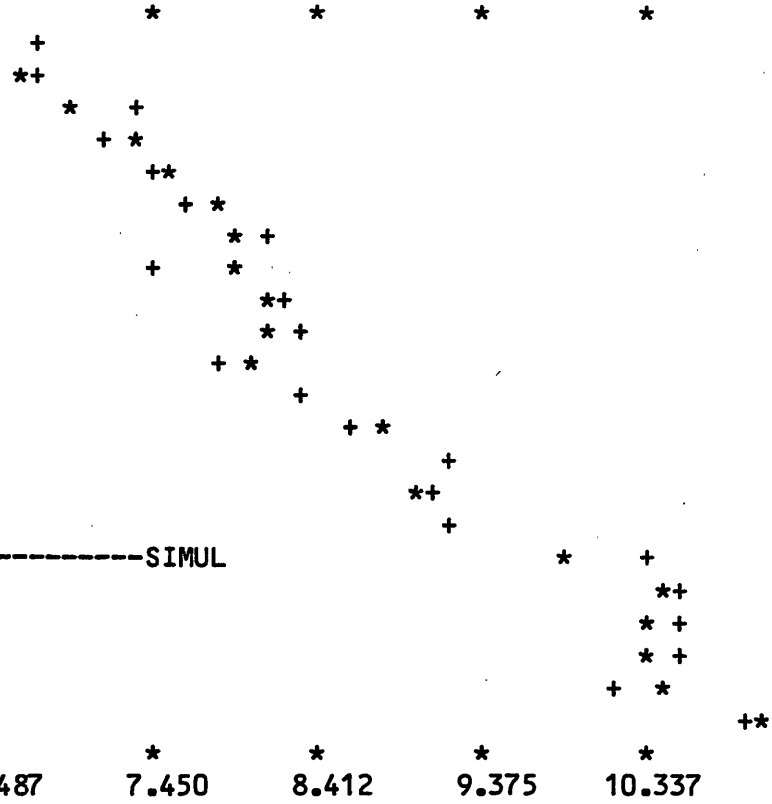
4 SEE = 0.2274 RSQR = 0.9239 RBARSQ = 0.8962
RHO = -0.1233 DW = 2.247 AAPE = 2.35

VARIABLE	REGRES-COEF	T-VALUE	ELASTICITY	MEXPLAVAL	MEAN
INTERCEPT	7.876002	2.85	0.982	31.77	1.0000
PPINFL	0.351301	6.23	0.183	112.71	4.1722
RTB	0.079398	1.05	0.047	4.91	4.7232
PCRG	0.169629	4.70	0.073	73.42	3.4353
REQRES	-0.017503	-0.80	-0.285	2.89	130.3626
MMULT	DEPENDENT VARIABLE - - - - - -				8.01766

AAPE IN TEST PERIOD = 2.28

MONEY MULTIPLIER

DATE	ACTUAL IS *	PREDIC IS +	MISS IS A-P
60	6.49	6.82	-0.34
61	6.75	6.82	-0.07
62	7.05	7.43	-0.39
63	7.45	7.23	0.22
64	7.63	7.46	0.17
65	7.86	7.72	0.15
66	7.94	8.13	-0.20
67	8.01	7.51	0.51
68	8.16	8.29	-0.13
69	8.20	8.36	-0.16
70	8.05	7.91	0.15
71	8.40	8.33	0.07
72	8.82	8.69	0.12
73	9.25	9.19	0.06
74	8.99	9.15	-0.16
75	9.23	9.23	0.00
76	9.88	10.43	-0.56
77	10.45	10.56	-0.12
78	10.43	10.60	-0.17
79	10.36	10.54	-0.18
80	10.44	10.15	0.29
81	11.01	10.93	0.09
	IS *	IS +	IS A-P



lower than the same statistic computed over the regression sample period. In both estimations, the primary explanatory variables are the previous peak inflation rate and the percentage change in real GNP.

Having established a relation between the non-borrowed monetary base and a more comprehensive monetary aggregate, we turn to the task of developing equations to forecast interest rates. The starting point for the development of these equations is the liquidity preference model and the modelling itself follows closely the work done by Feldstein and Eckstein [13]. The Feldstein and Eckstein work was directed toward assessing the fundamental determinants of the long-term interest rate, rather than the short term rate. Such an approach is in direct contrast to bank reserves models in which the short rate is modeled more "structurally" than the long rate and in which the long rate is modeled via term structure equations. The Feldstein and Eckstein approach was chosen for many reasons.

First, there is a large body of empirical evidence suggesting that the interest rate which enters the decision to invest in plant or equipment is the long-term rate. The use of the long-term rate in the behavioral equations used to forecast investment and structures is also a feature of the interindustry model for which this monetary sub-model is designed. Given the pre-eminent role of the long rate to the "real", (as opposed to nominal), economy, it would seem more appropriate to make the long rate respond to fundamental changes in the economy directly, rather than having the long rate respond indirectly through movements in the short rate. It is a well established empirical fact that short rates are more volatile than long rates. Given that both long and short rates are responding to the same economy, the relative volatility of

short rates is evidence that short rates respond to transitory events more strongly than do long rates. Since the primary emphasis of the large interindustry model is to produce long-term forecasts with less emphasis on accurately tracking short-run, cyclical phenomena, the conventional term-structure approach to long-term interest rate determination was eschewed.

Perhaps more important than the above reasons for modelling the long rates directly is the changing nature of the money demand curve. The standard liquidity preference approach defines an inverse relationship between the quantity of money held (where money has no explicit yield) and the rate of return on short-term, liquid assets. As more interest-bearing asset accounts become part of the generally accepted definition of money, and as these accounts begin to bear market-related interest rates, the inverse relation between the short term interest rate and the quantity of money becomes more tenuous. Forecasting movements in long-term rates via short rates, themselves determined by an equation which is certainly changing, is surely an unsatisfactory procedure. For this study, therefore, an equation is developed which defines the major money substitute as long term government securities. Thus the rate of return on long term government securities is seen as the opportunity cost of holding money-type accounts.

The above analysis suggests that if the term structure relation is to be used at all, it should be used in a way opposite to the way it is used in the current literature. In general, term structure theories suggest only that long and short rates are related. They do not suggest that the short rate "causes" or "determines" long rates, although the

conventional approach uses short rates to determine long rates. It would seem that a relation could be developed which makes the short rate a function of the long rate. Equations using this "reverse" term structure relation were estimated using annual data over the 1959-81 period varying the specifications slightly. The result of this effort was that all of the "reverse" term structure equations provided forecasts of the short rate that were implausibly volatile for reasonable forecasts of the long rate. Such a result is hardly surprising, since conventional term structure relations have been criticized on the grounds that the forecasts that they produce of long rates are implausibly smooth.[14] The result obtained from the reverse term structure equations is another view of the same phenomenon. Since an equation which produces reasonable short rates from a set of reasonable long rates could not be found, the attempt to make use of the term structure to aid in forecasting either long or short term rates was abandoned. Instead, the short term interest rate equation uses the same set of independent variables as the long rate, with the structural differences between the long and short rates indicated by the relative importance of the independent variables.

Having discussed the approach to modelling interest rates, we can now turn to a more detailed discussion of their specifications. The equation used to predict the 10 year Treasury bond rate, the long term, riskless asset considered in the model, is fairly simple. The specification is the result of an attempt to incorporate influences from the monetary sector, from real aggregate demand, and from inflation. Many equations were tried, varying the monetary policy variable, the indicator of aggregate demand and the length of the lag on inflation.

For the monetary policy variable, the percentage change in the monetary base, the percentage change in non-borrowed reserves and the percentage change in M2 balances were among the variables tried. The variable chosen to represent monetary forces is the ratio of M2 to nominal GNP. The sign on this variable in an interest rate equation should be negative, reflecting the idea that greater quantities of M2 holdings are associated with lower long term bond rates, for a given level of nominal income. For the aggregate demand indicator two main variables were tried: the overall unemployment rate and the rate of growth in real GNP. Each of these were tried in several transformations including the logarithm of real output and the inverse of the unemployment rate. The percentage change in real GNP was selected as the aggregate demand indicator. A lag of one year was found to be useful in explaining interest rate movements.

The rate of inflation is the third major influence on rates and it is by far the factor to which the most attention has been paid in the recent literature. The rate of inflation, in various lag distributions, enters interest rate equations as a proxy for the expected rate of growth of the price level. Although many early economic writers realized and discussed the relationship between expected inflation and interest rates, Irving Fisher is generally credited with inventing the proposition that the nominal rate of interest can be decomposed into a real rate of interest and the expected rate of growth in the price level.[15] Armed with this simple idea, and proposing the idea that with perfect foresight movements in nominal interest rates would be dominated by movements in the inflation rate, Fisher conducted some empirical tests of his theory. His conclusions were that perfect foresight had to

be rejected because inflation was not passed completely through to nominal rates. Fisher's later empirical work showed that the highest simple correlations between inflation and interest rates could be obtained when the inflation effect was distributed over time, with the periods extending 20 to 30 years. Fisher's interpretation of this correlation was that price level changes resulted in changes in real economic activity, which took much time for the economy to work through.

As is the case with many simple and useful ideas, the Fisher decompostion of nominal rates was reinterpreted to mean something that was not originally intended: that real interest rates could be adequately described by the constant term in a regression and that the expected rate of growth in the price level could be adequately represented by a distributed lag on past inflation rates. As the importance of expectations of all types to economic behavior has become more recognized, the Fisher relation has become the battleground in the war between the rational expectations school and the more traditional macroeconomic theorists. Skirmishes have been fought over the proper econometric technique to use to estimate the model, whether survey data for inflation expectations is adequate for use in the model and whether the size of the coefficient on the inflation term should be unity. The conclusions most recently drawn about the model are very much like the conclusions drawn by Fisher himself, namely that the expected real rate diverges from the realized real rate systematically with the inflation rate. This conclusion suggests that there is considerable money illusion in securities markets. This illusion should have an effect on real economic activity, in the manner proposed by Fisher.[16]

A very useful result of the Fisher relation resurgence is the

recognition that because nominal interest income is taxed, the maintenance of after-tax real returns implies a more than directly proportional relationship bewteen inflation and interest rates. For example, with a 50% marginal tax rate, the preservation of a 2% real rate of return after a fully expected rate of price increase of 8% requires the nominal interest rate to rise by 16 percentage points. Summers places the approximate value of the coefficient on expected inflation at 1.3 when the distortions of the tax system are considered.[17]

Having observed that the rate of inflation is particularly important for interest rate equations, a three-year moving average of the rate of growth in the GNP deflator is included in the interest rate equations developed for the present model. The fact that annual data are used precluded more sophisticated analysis of the lag distribution on inflation. Thus the point should be made clear that the three-year moving average is not intended to be the definitive description of the expectations-generating mechanism. Rather, the three-year moving average is best viewed as an adequate device to relate inflation and interest rates.

Figure 2.5 reports the results of estimating an equation of the discussed form using OLS and annual data from 1960 to 1981. The inflation variable is by far the most important variable in the equation and since its coefficient is much less than 1.3, the equation suggests that there is considerable money illusion in the 10 year bond market. While all of the coefficients are of the proper sign and the equation fits relatively well, the low Durbin-Watson statistic suggests that some systematic influence is not represented by the independent variables.

FIGURE 2.5

10 YEAR TREASURY BOND RATE ESTIMATED THROUGH 1981

4 SEE = 0.7488 RSQR = 0.9149 RBARSQ = 0.8949
RHO = 0.5078 DW = 0.984 AAPE = 9.10

VARIABLE	REGRES-COEF	T-VALUE	ELASTICITY	MEXPLAVAL	MEAN
INTERCEPT	40.476070	4.21	6.054	42.83	1.0000
CAMK	-62.254456	-3.98	-5.839	39.01	0.6270
PCRG	0.173474	1.65	0.089	7.69	3.4383
PCRG(T-1)	0.070394	0.81	0.038	1.92	3.6192
LINFL	0.951267	10.94	0.657	183.58	4.6199
RTB10Y	DEPENDENT VARIABLE - - - - - -				6.68591

LONG TERM INTEREST RATE EQUATION

DATE	ACTUAL IS *	PREDIC IS +	MISS IS A-P *
60	4.12	5.55	-1.43
61	3.88	3.95	-0.07
62	3.95	4.33	-0.38
63	4.00	3.17	0.83
64	4.19	3.09	1.10
65	4.28	3.52	0.76
66	4.92	5.14	-0.22
67	5.07	4.59	0.48
68	5.65	5.70	-0.05
69	6.67	6.82	-0.15
70	7.35	7.39	-0.04
71	6.16	6.72	-0.56
72	6.21	6.18	0.03
73	6.84	7.11	-0.27
74	7.56	7.92	-0.36
75	7.99	8.47	-0.48
76	7.61	8.63	-1.02
77	7.42	7.70	-0.28
78	8.41	8.27	0.14
79	9.44	10.20	-0.76
80	11.46	10.67	0.79
81	13.91	11.98	1.93
	IS *	IS +	IS A-P *

3.092 5.394 7.695 9.997 12.299

RTB10Y = RATE ON 10 YEAR TREASURY BONDS
CAMK = M2 / NOMINAL GNP
PCRG = PERCENTAGE CHANGE IN REAL GNP
LINFL = THREE PERIOD MOVING AVERAGE OF PERCENTAGE CHANGE IN GNP DEFLATOR
DUM79 = DUMMY VARIABLE : .25 IN 1979, 1.0 IN 1980
1.00 IN 1981, 0 ELSEWHERE

FIGURE 2.6

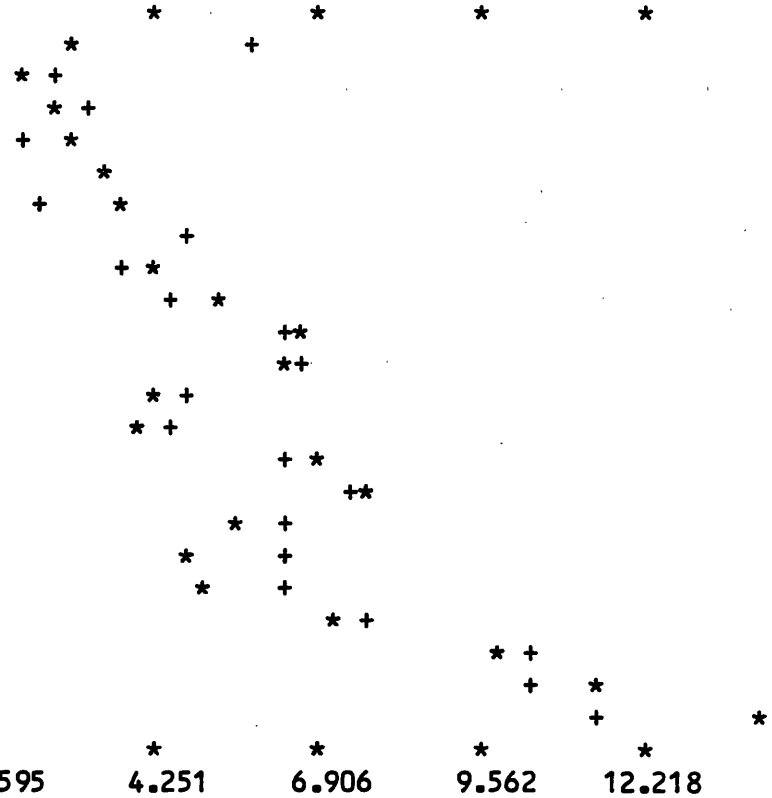
90 DAY TREASURY BILL EQUATION ESTIMATED THROUGH 1981

4 SEE = 1.2133 RSQR = 0.8311 RBARSQ = 0.7913
RHO = 0.6581 DW = 0.684 AAPE = 20.22

VARIABLE	REGRES-COEF	T-VALUE	ELASTICITY	MEXPLAVAL	MEAN
INTERCEPT	63.096112	4.05	10.778	40.10	1.0000
CAMK	-101.697713	-4.01	-10.893	39.56	0.6270
PCRG	0.236224	1.38	0.139	5.49	3.4383
PCRG(T-1)	0.289573	2.06	0.179	11.79	3.6192
LINFL	1.010061	7.17	0.797	100.60	4.6199
RTB	DEPENDENT VARIABLE - - - - - -				5.85401

TREASURY BILL EQUATION

DATE	ACTUAL IS *	PREDIC IS +	MISS IS A-P *
60	2.95	5.94	-3.00
61	2.38	2.78	-0.41
62	2.78	3.44	-0.66
63	3.16	2.20	0.96
64	3.55	1.59	1.96
65	3.95	2.42	1.53
66	4.88	4.88	-0.00
67	4.33	3.86	0.47
68	5.34	4.62	0.72
69	6.69	6.51	0.18
70	6.44	6.83	-0.39
71	4.34	4.95	-0.61
72	4.07	4.77	-0.70
73	7.02	6.62	0.41
74	7.87	7.59	0.28
75	5.82	6.47	-0.65
76	5.00	6.41	-1.41
77	5.27	6.56	-1.29
78	7.22	7.89	-0.67
79	10.04	10.39	-0.35
80	11.62	10.48	1.13
81	14.08	11.58	2.50
	IS *	IS +	IS A-P *



RTB = RATE ON TREASURY BILLS, NEW ISSUES, 90 DAYS
CAMK = M2 / NOMINAL GNP
PCRG = PERCENTAGE CHANGE IN REAL GNP
LINFL = THREE PERIOD MOVING AVERAGE OF PERCENTAGE CHANGE IN GNP DEFLATOR
DUM79 = DUMMY VARIABLE : .25 IN 1979, 1.0 IN 1980
1.00 IN 1981, 0 ELSEWHERE

(The same pattern is exhibited by the short term rate equation. See Figure 2.6.) By examining the columns labelled MISS, it can be seen that the worst over-prediction occurs in 1974 and the worst under-predictions are in 1980 and 1981. The 1981 miss is fully 13% of the observed 10 year bond rate while the miss in the short rate equation is 18% of the actual short rate in 1981. These large misses by the equation in the last few years may be reflecting the rather tumultuous recent financial history. At least three major causes may be offered to explain the run-up of interest rates over the period 1979-81. These are: the change in announced operating procedure of the Fed, the imposition and removal of credit restrictions in 1980, and the furor over the size of the Federal government deficit. The effect on interest rate of each of these factors will be briefly discussed.

The change in October 1979 by the Federal Reserve to an operating procedure that placed much greater emphasis on maintaining targetted rates of growth of monetary aggregates greatly influenced interest rates. The immediate effect on interest rates was an increase in their volatility. According to Johnson, the standard deviation of weekly data on the three month Treasury bill rate increased from 1.57 percentage points over the period from January 1968 to September 1979, to 2.39 percentage points over the period from October 1979 to September 1980.[18] Similar increases were found for Treasury bills and bonds across the maturity spectrum. Johnson concludes that

> Much of this increase in variability reflects, of course, the unusually sharp cyclical swings experienced this past year (1980): but even apart from those swings, Treasury rates have shown considerably more nonsystematic variability since October 1979.[19]

The question of whether this increased variability of rates by itself has led to higher average rates is a difficult one to answer empirically, primarily because the "sharp cyclical swings" to which Johnson refers make it difficult to distinguish procedure-change effects from the usual economic effects. It can be argued, however, that the increase in variability and levels of rates are responses to another factor, namely, uncertainty over the course of monetary policy and the workability of the new procedure. This uncertainty may have forced lenders to demand some premium for parting with their money over some period, as market participants assimilated the new environment.

The imposition of credit controls and the announcement of a 3% discount rate surcharge in March of 1980 gave interest rates of all maturities an upward push. Although the credit controls and the surcharge were removed in May of that same year, a 2% surcharge was re-established in November and was continued into 1981. The effect of these surcharges was to increase the levels of all rates, either through increasing the cost of funds to banks or via "announcement" effects. The imposition and removal may have heightened the level of uncertainty about policy and further increased the uncertainty premuim.

Finally, the furor over the size of the Federal government deficit added another kind of uncertainty or fear premium to interest rates. According to Brunner, the explosion in interest rates in 1981 was due to

the addition of a ". . . substantial risk premium which hardly ever entered in the past history of our financial markets."[20] He asserts that risk premium was brought on by the uncertainty imposed by U. S. policy-makers. Market participants tell a similar story. Irwin L. Kellner, of Manufacturer's Hanover Trust Company, attributes the level of interest rates in the second half of 1981 to a "fear premium" brought on by the uncertainty about the course of the Federal budget deficits.[21] Market participants may expect the long term inflation rate to be higher with higher deficits, thereby pushing up longer rates. Uncertainty about the extent of the effective budget cuts that were part of the Reagan economic program may have contributed to the rise in interest rates by making it nearly impossible to figure out the extent of the government's borrowing needs.

From the preceding paragraphs it is evident that the post-1979 period is unusually turbulent and atypical of the rest of the post-WWII period. The econometric response to a few data points which are different in some way from other points in the series is to use a dummy variable. In this case, a dummy variable of the following form was constructed:

Value	Period
0.00	1960-78
0.25	1979
1.00	1980
1.00	1981

The .25 in 1979 reflects the one quarter of the new Fed operating procedure, while the ones in the other periods reflect all three reasons.

Re-estimating the two interest rate equations after adding the dummy variables to each resulted in the estimates presented in Figures

FIGURE 2.7

10 YEAR TREASURY BOND EQUATION WITH DUMMY VARIABLE, THROUGH 1981

5 SEE = 0.4476 RSQR = 0.9696 RBARSQ = 0.9601
RHO = 0.0919 DW = 1.816 AAPE = 5.12

VARIABLE	REGRES-COEF	T-VALUE	ELASTICITY	MEXPLAVAL	MEAN
INTERCEPT	19.121382	2.68	2.860	20.33	1.0000
CAMK	-27.044515	-2.32	-2.536	15.60	0.6270
PCRG	0.095947	1.44	0.049	6.31	3.4383
PCRG(T-1)	0.083189	1.55	0.045	7.29	3.6192
LINFL	0.776210	12.37	0.536	225.13	4.6199
DUM79	2.987819	5.36	0.046	67.29	0.1023
RTB10Y	DEPENDENT VARIABLE - - - - - -				6.68591

LONG TERM INTEREST RATE EQUATION

DATE	ACTUAL IS *	PREDIC IS +	MISS IS A-P *
60	4.12	5.00	-0.88
61	3.88	4.02	-0.14
62	3.95	4.21	-0.26
63	4.00	3.82	0.18
64	4.19	3.79	0.40
65	4.28	4.10	0.18
66	4.92	5.05	-0.13
67	5.07	4.92	0.15
68	5.65	5.54	0.11
69	6.67	6.32	0.35
70	7.35	6.70	0.65
71	6.16	6.39	-0.23
72	6.21	6.27	-0.06
73	6.84	6.84	0.00
74	7.56	7.53	0.03
75	7.99	8.03	-0.04
76	7.61	8.15	-0.54
77	7.42	7.73	-0.31
78	8.41	7.74	0.67
79	9.44	9.65	-0.21
80	11.46	12.32	-0.86
81	13.91	12.99	0.92
	IS *	IS +	IS A-P *

3.793 5.945 8.098 10.251 12.403

RTB10Y = RATE ON 10 YEAR TREASURY BONDS
CAMK = M2 / NOMINAL GNP
PCRG = PERCENTAGE CHANGE IN REAL GNP
LINFL = THREE PERIOD MOVING AVERAGE OF PERCENTAGE CHANGE IN GNP DEFLATOR
DUM79 = DUMMY VARIABLE : .25 IN 1979, 1.0 IN 1980
1.00 IN 1981, 0 ELSEWHERE

2.7 and 2.8. The fit of both equations has been enhanced considerably and the residuals now display no evidence of serial correlation. For the 10 year bond rate, the coefficient on the three year moving average inflation term has declined from .95 to .77 while the elasticity on the liquidity term has been cut in half. Examining the coefficient on the dummy suggests that the three factors discussed above added approximately 3 percentage points to the long rate.

Turning to the short rate, the same pattern of a reduced coefficient on the inflation term and the M2 term is found. The coefficient of the dummy in the short rate equation suggests that the short rate was pushed up by nearly 4 percentage points because of the above-mentioned factors.

In order to examine the suitability of these equations for forecasting purposes, these equations were estimated from 1960 to 1975 and simulated over the 1976-81 period. Since the period 1979-81 has already been established as an unusual period, we should not expect the equations estimated from 1960-75 to simulate well over the 1979-81 period. It was decided that the values for the dummy from the estimation done over the 1960-81 would be applied during the relevant period during the simulation. The results of the estimations and simulations are reported in Figures 2.9 and 2.10. The results indicate a dimimution in the fit of both the long and short rate equations and a deterioration in the Durbin-Watson statistic in the long rate equation. The AAPE of the simulation for the long rate equation is nearly twice that of the same statistic computed over the sample period. The AAPE of the short rate simulation is much worse than the long rate with an average miss of nearly 18%. This figure is heavily influenced by severe

FIGURE 2.8

90 DAY TREASURY BILL EQUATION WITH DUMMY VARIABLE, THROUGH 1981

5 SEE = 0.8747 RSQR = 0.9122 RBARSQ = 0.8847
RHO = 0.3600 DW = 1.280 AAPE = 14.26

VARIABLE	REGRES-COEF	T-VALUE	ELASTICITY	MEXPLAVAL	MEAN
INTERCEPT	33.186765	2.38	5.669	16.33	1.0000
CAMK	-52.382718	-2.30	-5.611	15.34	0.6270
PCRG	0.127639	0.98	0.075	2.97	3.4383
PCRG(T-1)	0.307495	2.94	0.190	24.12	3.6192
LINFL	0.764876	6.24	0.604	85.29	4.6199
DUM79	4.184736	3.84	0.073	38.70	0.1023
RTB	DEPENDENT VARIABLE - - - - - -				5.85401

TREASURY BILL EQUATION

DATE	ACTUAL IS *	PREDIC IS +	MISS IS A-P *
60	2.95	5.17	-2.23
61	2.38	2.88	-0.50
62	2.78	3.27	-0.49
63	3.16	3.11	0.05
64	3.55	2.58	0.98
65	3.95	3.23	0.72
66	4.88	4.76	0.12
67	4.33	4.32	0.01
68	5.34	4.39	0.96
69	6.69	5.81	0.87
70	6.44	5.86	0.58
71	4.34	4.49	-0.15
72	4.07	4.89	-0.83
73	7.02	6.24	0.79
74	7.87	7.03	0.84
75	5.82	5.86	-0.03
76	5.00	5.73	-0.74
77	5.27	6.60	-1.34
78	7.22	7.15	0.08
79	10.04	9.62	0.42
80	11.62	12.80	-1.18
81	14.08	13.00	1.08
	IS *	IS +	IS A-P *

2.376 4.865 7.355 9.844 12.334

RTB = RATE ON TREASURY BILLS, NEW ISSUES, 90 DAYS
CAMK = M2 / NOMINAL GNP
PCRG = PERCENTAGE CHANGE IN REAL GNP
LINFL = THREE PERIOD MOVING AVERAGE OF PERCENTAGE CHANGE IN GNP DEFLATOR
DUM79 = DUMMY VARIABLE : .25 IN 1979, 1.0 IN 1980
1.00 IN 1981, 0 ELSEWHERE

FIGURE 2.9

10 YEAR TREASURY BOND EQUATION ESTIMATED THROUGH 1975
WITH DUMMY IN SIMULATION

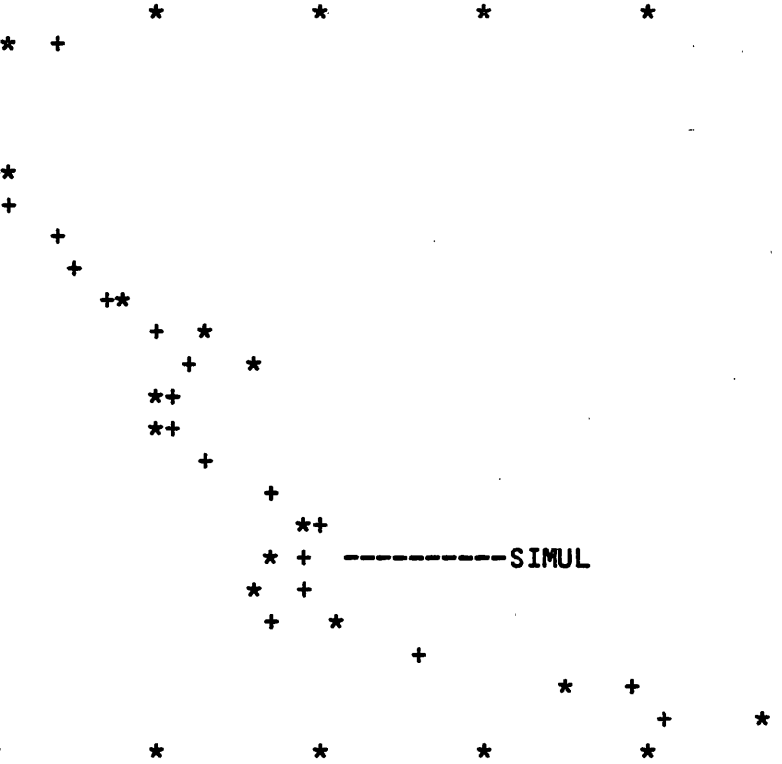
4 SEE = 0.3041 RSQR = 0.9551 RBARSQ = 0.9387
RHO = 0.4443 DW = 1.111 AAPE = 3.59

VARIABLE	REGRES-COEF	T-VALUE	ELASTICITY	MEXPLAVAL	MEAN
INTERCEPT	9.803469	1.66	1.766	11.77	1.0000
CAMK	-11.956919	-1.23	-1.353	6.68	0.6282
PCRG	0.039534	0.66	0.024	1.97	3.4353
PCRG(T-1)	0.100545	2.12	0.070	18.66	3.8799
LINFL	0.772435	11.73	0.493	267.40	3.5405
RTB10Y	DEPENDENT VARIABLE - - - - - -				5.55250

AAPE IN TEST PERIOD = 13.38
AAPE IN TEST PERIOD WITH DUMMY VARIABLE (DUM79) = 4.93

LONG TERM INTEREST RATE EQUATION

DATE	ACTUAL IS *	PREDIC IS +	MISS IS A-P *
60	4.12	4.75	-0.63
61	3.88	3.96	-0.08
62	3.95	3.99	-0.04
63	4.00	4.00	-0.00
64	4.19	3.97	0.22
65	4.28	4.23	0.05
66	4.92	4.94	-0.02
67	5.07	5.10	-0.03
68	5.65	5.48	0.17
69	6.67	6.23	0.44
70	7.35	6.62	0.73
71	6.16	6.37	-0.21
72	6.21	6.39	-0.18
73	6.84	6.84	0.00
74	7.56	7.71	-0.15
75	7.99	8.25	-0.26
76	7.61	8.07	-0.46
77	7.42	7.94	-0.52
78	8.41	7.71	0.70
79	9.44	9.41	0.03
80	11.46	12.21	-0.78
81	13.91	12.57	1.34



RTB10Y = RATE ON 10 YEAR TREASURY BONDS
CAMK = M2 / NOMINAL GNP
PCRG = PERCENTAGE CHANGE IN REAL GNP
LINFL = THREE PERIOD MOVING AVERAGE OF PERCENTAGE CHANGE IN GNP DEFLATOR
DUM79 = DUMMY VARIABLE : .25 IN 1979, 1.0 IN 1980
1.00 IN 1981, 0 ELSEWHERE

FIGURE 2.10

90 DAY TREASURY BILL EQUATION ESTIMATED THROUGH 1975
WITH DUMMY FOR SIMULATION

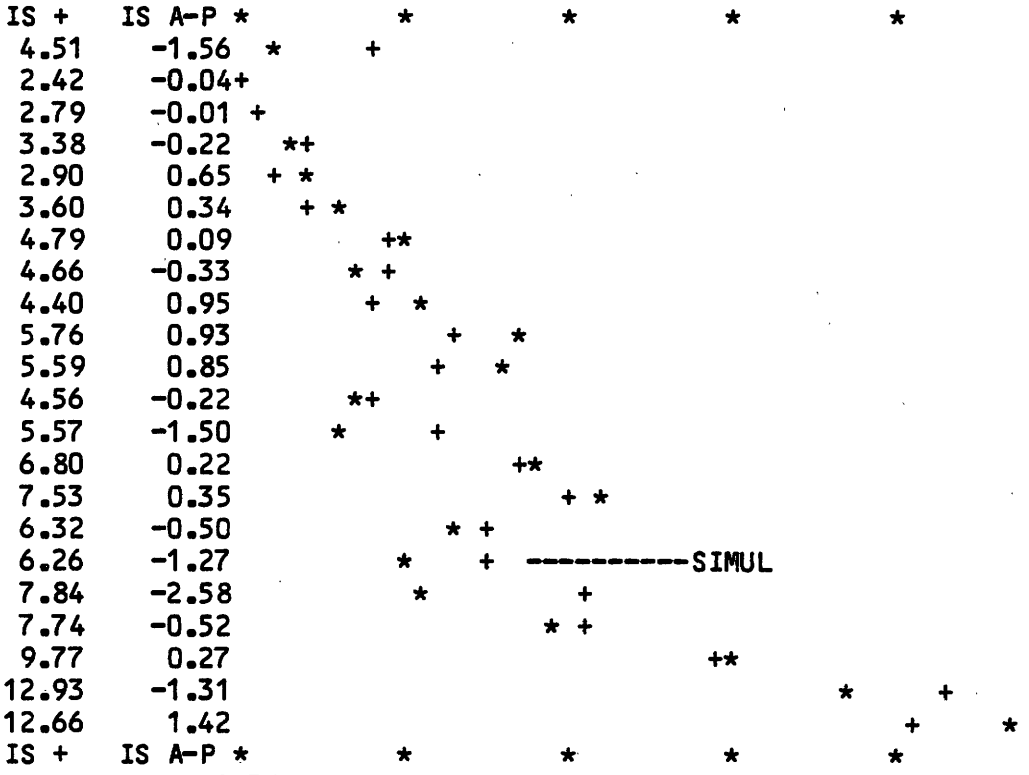
4 SEE = 0.7465 RSQR = 0.7972 RBARSQ = 0.7235
RHO = 0.3069 DW = 1.386 AAPE = 12.62

VARIABLE	REGRES-COEF	T-VALUE	ELASTICITY	MEXPLAVAL	MEAN
INTERCEPT	14.241332	0.98	3.015	4.27	1.0000
CAMK	-23.202499	-0.97	-3.086	4.22	0.6282
PCRG	0.114671	0.78	0.083	2.74	3.4353
PCRG(T-1)	0.385403	3.31	0.317	41.23	3.8799
LINFL	0.895106	5.53	0.671	94.54	3.5405
RTB	DEPENDENT VARIABLE - - - - - -				4.72319

AAPE IN TEST PERIOD = 26.53
AAPE IN TEST PERIOD WITH DUMMY VARIABLE (DUM79) = 17.61

TREASURY BILL EQUATION

DATE	ACTUAL IS *	PREDIC IS +	MISS IS A-P *
60	2.95	4.51	-1.56
61	2.38	2.42	-0.04
62	2.78	2.79	-0.01
63	3.16	3.38	-0.22
64	3.55	2.90	0.65
65	3.95	3.60	0.34
66	4.88	4.79	0.09
67	4.33	4.66	-0.33
68	5.34	4.40	0.95
69	6.69	5.76	0.93
70	6.44	5.59	0.85
71	4.34	4.56	-0.22
72	4.07	5.57	-1.50
73	7.02	6.80	0.22
74	7.87	7.53	0.35
75	5.82	6.32	-0.50
76	5.00	6.26	-1.27
77	5.27	7.84	-2.58
78	7.22	7.74	-0.52
79	10.04	9.77	0.27
80	11.62	12.93	-1.31
81	14.08	12.66	1.42
	IS *	IS +	IS A-P *



RTB = RATE ON TREASURY BILLS, NEW ISSUES, 90 DAYS
CAMK = M2 / NOMINAL GNP
PCRG = PERCENTAGE CHANGE IN REAL GNP
LINFL = THREE PERIOD MOVING AVERAGE OF PERCENTAGE CHANGE IN GNP DEFLATOR
DUM79 = DUMMY VARIABLE : .25 IN 1979, 1.0 IN 1980
1.00 IN 1981, 0 ELSEWHERE

over-predictions in the 1976-77 period. It should be noted that the AAPE for 1960-75 estimation is over 12%, suggesting that the simple model does not fit as well for the short rate as it does for the long rate.

Given an equation to calculate the rate on longer-term government securities, it is possible to calculate the rates on private securities using the goverment security rate as a prime determinant. The equation to predict the rate on Moody's AAA rated securities uses the current and lagged value of the 10-year Treasury bond rate, the current rate of inflation and the ratio of the sum of corporate profits and capital consumption allowances to nominal GNP. If the term to maturity of the two types of securities were identical, the equation would serve to explain the movement of default risk over time. Since, however, the average maturity on AAA rated bonds is approximately twice that of the 10-year Treasury security, there are aspects of the term structure as well as default risk differences to be explained. Thus, the two government security variables provide a type of term structure "base" while the other variables are intended to catch movements in the risk premium and term premium. The expected sign on inflation can either be positive or negative. This is because an inflation effect is already incorporated into the ten year Treasury bond rate.

The coefficient on inflation, then, represents the differential effect of inflation on the two security types. The expected sign on the internal funds proxy, (corporate profits plus corporate capital consumption allowance divided by nominal GNP) is negative. There are two mechanisms that would explain this sign. First, large values of this ratio would be an indication that firms were doing well and might

lead to a diminution of the risk of default. Second, the variable may be an indicator of a series of portfolio adjustments. A rise in profits or depreciation allowances might cause a reduction in the demand for external funds, which, given lenders who have definite lending preferences, would lead to a fall in the interest rates on corporate bonds. The results of estimating this equation using annual data from 1960 to 1981 are reported in Figure 2.11. The equation fits extremely well, and the prime independent variable is by far the contemporaneous value for the 10-year Treasury bond rate. The rate of inflation enters positively and the proxy for internal funds enters negatively, as expected. Figure 2.12 reports the results of estimating the same equation from 1960 to 1975 and simulating over the 1976-81 period. While the AAPE in the test period is rather small, about 4.5%, all of the errors are over-predictions. The coefficients on the inflation rate and the internal funds proxy have changed considerably between these two periods, which may signal some instability in the equation. The effect of inflation doubles and the effect of the internal funds proxy triples when the longer period is used. Since most of the explanatory power from both equations is coming from the 10-year bond rates, and since this coefficient is fairly stable, this equation is still probably suitable for use in a forecasting context.

The last equation which is driven by the long-term government security rate is the mortgage rate, which is a rate used in the equations for purchases of structures in the large, interindustry model. Figure 2.13 reports the results of estimating very simple equation using only the level of the 10-year Treasury bond rate and the change in that rate to explain the mortgage rate. The results are extremely good, both

FIGURE 2.11

AAA BOND RATE EQUATION ESTIMATED THROUGH 1981

4 SEE = 0.1326 RSQR = 0.9974 RBARSQ = 0.9968
RHO = -0.1447 DW = 2.289 AAPE = 1.36

VARIABLE	REGRES-COEF	T-VALUE	ELASTICITY	MEXPLAVAL	MEAN
INTERCEPT	2.726795	4.25	0.379	43.54	1.0000
RTB10Y	0.702071	13.08	0.652	232.57	6.6859
RTB10Y(T-1)	0.269406	4.03	0.234	39.87	6.2505
INFL	0.097706	3.73	0.067	34.83	4.9372
FUNDS	-15.691477	-4.04	-0.331	39.96	0.1519
RAAA	DEPENDENT VARIABLE - - - - - -				7.20348

SIMPLE AAA EQUATION

DATE	ACTUAL IS *	PREDIC IS +	MISS IS A-P *	*	*	*	*
60	4.41	4.62	-0.21*+				
61	4.35	4.36	-0.01+				
62	4.32	4.35	-0.03+				
63	4.26	4.33	-0.07+				
64	4.40	4.41	-0.00+				
65	4.49	4.47	0.02 +				
66	5.13	5.08	0.05 **				
67	5.51	5.47	0.03 +				
68	6.17	6.04	0.14 **				
69	7.03	7.12	-0.09 +				
70	8.04	8.12	-0.08 *+				
71	7.39	7.37	0.01 +				
72	7.21	6.92	0.29 **				
73	7.44	7.40	0.04 **				
74	8.57	8.35	0.22 **				
75	8.83	9.03	-0.20 *+				
76	8.43	8.34	0.10 +				
77	8.02	8.06	-0.04 +				
78	8.72	8.77	-0.04 +				
79	9.63	9.88	-0.25 *+				
80	11.94	11.77	0.17 **				
81	14.17	14.22	-0.05				*+
	IS *	IS +	IS A-P *	*	*	*	*
			4.259	6.379	8.498	10.617	12.737

RAAA = RATE ON AAA CORPORATE BONDS
RTB10Y = RATE ON TREASURY BONDS, 10 YEARS
INFL = PERCENTAGE CHANGE IN GNP DEFLATOR
FUNDS = (CORPORATE PROFITS + DEPRECIATION) / GNP

FIGURE 2.12

AAA BOND RATE EQUATION ESTIMATED THROUGH 1975

4 SEE = 0.1185 RSQR = 0.9950 RBARSQ = 0.9932
RHO = -0.1906 DW = 2.381 AAPE = 1.44

VARIABLE	REGRES-COEF	T-VALUE	ELASTICITY	MEXPLAVAL	MEAN
INTERCEPT	0.339847	0.22	0.056	0.22	1.0000
RTB10Y	0.761602	7.04	0.694	134.75	5.5525
RTB10Y(T-1)	0.374638	3.57	0.327	46.85	5.3237
INFL	0.038145	0.61	0.025	1.69	3.9715
FUNDS	-4.110243	-0.55	-0.101	1.35	0.1502
RAAA	DEPENDENT VARIABLE - - - - - -				6.09719

AAPE IN TEST PERIOD = 4.86

SIMPLE AAA EQUATION

DATE	ACTUAL IS *	PREDIC IS +	MISS IS A-P *
60	4.41	4.55	-0.14*+
61	4.35	4.27	0.08+
62	4.32	4.25	0.07+
63	4.26	4.29	-0.03+
64	4.40	4.44	-0.03+
65	4.49	4.57	-0.08 +
66	5.13	5.14	-0.01 +
67	5.51	5.52	-0.02 +
68	6.17	6.07	0.11 **
69	7.03	7.13	-0.10 +
70	8.04	8.09	-0.05 +
71	7.39	7.41	-0.03 +
72	7.21	6.95	0.26 +*
73	7.44	7.48	-0.03 *+
74	8.57	8.37	0.20 +
75	8.83	9.02	-0.19 +
76	8.43	8.74	-0.30 *+ -------SIMUL
77	8.02	8.40	-0.38 * +
78	8.72	9.13	-0.40 * +
79	9.63	10.33	-0.70 * +
80	11.94	12.31	-0.37 * +
81	14.17	14.99	-0.82 * +
	IS *	IS +	IS A-P *

4.250 6.535 8.819 11.103 13.388

FIGURE 2.13

MORTGAGE RATE EQUATION ESTIMATED THROUGH 1981

2 SEE = 0.1422 RSQR = 0.9958 RBARSQ = 0.9953
RHO = 0.0302 DW = 1.940 AAPE = 1.35

VARIABLE	REGRES-COEF	T-VALUE	ELASTICITY	MEXPLAVAL	MEAN
INTERCEPT	1.711926	12.30	0.204	232.91	1.0000
RTB10Y	0.925477	42.68	0.805	1006.47	7.2856
DRTB10Y	-0.139427	-2.17	-0.009	14.61	0.5506
RMOR1	DEPENDENT VARIABLE - - - - - -				8.37778

SIMPLE MORTGAGE RATE EQUATION

DATE	ACTUAL IS *	PREDIC IS +	MISS IS A-P *
64	5.78	5.56	0.22+*
65	5.74	5.66	0.08+
66	6.14	6.18	-0.04 +
67	6.33	6.38	-0.05 +
68	6.83	6.86	-0.03 *+
69	7.66	7.74	-0.08 +
70	8.27	8.42	-0.15 *+
71	7.59	7.58	0.01 +
72	7.45	7.45	-0.00 +
73	7.78	7.95	-0.17 +
74	8.72	8.61	0.11 +*
75	8.75	9.05	-0.30 *+
76	8.76	8.81	-0.05 +
77	8.80	8.61	0.19 +*
78	9.30	9.36	-0.06 +
79	10.48	10.30	0.18 +
80	12.25	12.04	0.21 +
81	14.17	14.24	-0.07 *+
	IS *	IS +	IS A-P *

5.563 7.410 9.257 11.104 12.951

RMOR1 = RATE ON CONVENTIONAL FIRST MORTGAGES ON NEW HOMES
RTB10Y = RATE ON TREASURY BONDS, 10 YEARS
DRTB10Y = FIRST DIFFERENCE IN RTB10Y

in terms of the fit of the equation and stability of the parameters. This second point was shown when the equation was run from 1964 to 1975 and simulated through 1981. The results of this exercise are reported in Figure 2.14. The coefficients changed very little between the two regressions on different sample periods, and the fit hardly changed. Although several other specifications were tried, none fit or was as stable as the simple equation reported here. The simulation over the 1976 to 1981 period is characterized by an AAPE of about 3% although all of the errors are under-predictions.

The final rate that is calculated by this simple model is the rate on four-six month prime commercial paper. The equation used to calculate this rate looks very much like the equation used to translate the Treasury bond rate into the corporate bond rate. The specification uses the current and one-year lagged Treasury bill rate, the current rate of inflation and the internal funds proxy, for reasons stated above. Figures 2.15 and 2.16 report the results of estimating the equation first from 1960 to 1981 and then from 1960 to 1975 with a simulation over the 1976 to 1981 period. Both equations fit very well and show no sign of serial correlation. The pattern of the swings and relative sizes of the coefficients are similar in both equations except for the rate of inflation, which is negative and insignificant in the shorter sample and positive and significant in the longer sample. The simulated path of the commercial paper rate is quite close to the actual path of the commercial paper rate for the 1976-1979 period but diverges by progressively larger amounts in 1980 and 1981. Leaving out the 1980 and 1981 misses and recalculating the AAPE results in an average error of 4.83% rather than the nearly 9% error for the whole period.

Model simulations

Together these six equations comprise a very small model of the monetary sector which meets the two requirements stated at the beginning of this chapter. Figure 2.17 summarizes how the equations are linked together. In an attempt to ascertain how well this small model can forecast interest rates, two types of simulations were run. The two simulations differ in the use of different time horizons used to estimate the parameters of the equations. In the first case, the parameters are from the estimation done through 1981, while in the second case the parameters are from estimations done through 1975. In both cases all variables except M2 and the interest rates are taken to to have their actual values. The AAPEs from these simulations are reported in Tables 2.2 and 2.3. In Table 2.2, the AAPE from the estimation through 1981 is presented along with the AAPE for the simulation using the estimated parameters. In Table 2.3 four AAPEs are presented. These are: the AAPE from estimating the equations through 1975, the AAPE from the single equation out-of-sample simulation from 1976-81, the AAPE from the full-model simulation using estimated parameters from the estimations done through 1975 and the AAPE from the full model simulation for the 1976-81 period. It should be noted that for all of the simulations listed in Table 2.3 the values of the dummy variable included in the 10 year bond and 90 day bill equation from the estimation done through 1981 were added to those two interest rate series. To deal with the simultaneity of the bill rate and the money multiplier, the equations used to predict them were solved iteratively until convergence was reached. It was discovered that after the second

FIGURE 2.14

MORTGAGE RATE EQUATION ESTIMATED THROUGH 1975

```
 2  SEE =     0.1042    RSQR =  0.9906 RBARSQ =  0.9886
      RHO =   -0.2830     DW  =   2.566  AAPE  =    0.97
VARIABLE          REGRES-COEF T-VALUE ELASTICITY MEXPLAVAL     MEAN
INTERCEPT            2.085572    12.19    0.288   318.40        1.0000
RTB10Y               0.859711    30.32    0.720   915.51        6.0742
DRTB10Y             -0.163213    -2.56   -0.007    31.41        0.3325
RMOR1                     DEPENDENT VARIABLE  - - - - - -        7.25333
AAPE IN TEST PERIOD =    3.12
```

SIMPLE MORTGAGE RATE EQUATION

```
DATE  ACTUAL    PREDIC    MISS
       IS *      IS +   IS A-P *          *          *          *          *
 64     5.78      5.66     0.12+
 65     5.74      5.75    -0.01+
 66     6.14      6.21    -0.07  *+
 67     6.33      6.42    -0.09   *+
 68     6.83      6.85    -0.02      +
 69     7.66      7.65     0.01           +
 70     8.27      8.29    -0.02              +
 71     7.59      7.58     0.01          +
 72     7.45      7.42     0.03         +
 73     7.78      7.86    -0.08           *+
 74     8.72      8.47     0.25               **
 75     8.75      8.88    -0.13                 +
 76     8.76      8.73     0.03                 **  ----------SIMUL
 77     8.80      8.48     0.32                 + *
 78     9.30      9.16     0.14                    +*
 79    10.48     10.03     0.45                        + *
 80    12.25     11.61     0.64                                +   *
 81    14.17     13.64     0.53                                                + *
       IS *      IS +   IS A-P *          *          *          *          *
                                  5.657      7.468      9.279     11.091     12.902
      RMOR1   = RATE ON CONVENTIONAL FIRST MORTGAGES ON NEW HOMES
      RTB10Y  = RATE ON TREASURY BONDS, 10 YEARS
      DRTB10Y = FIRST DIFFERENCE IN RTB10Y
```

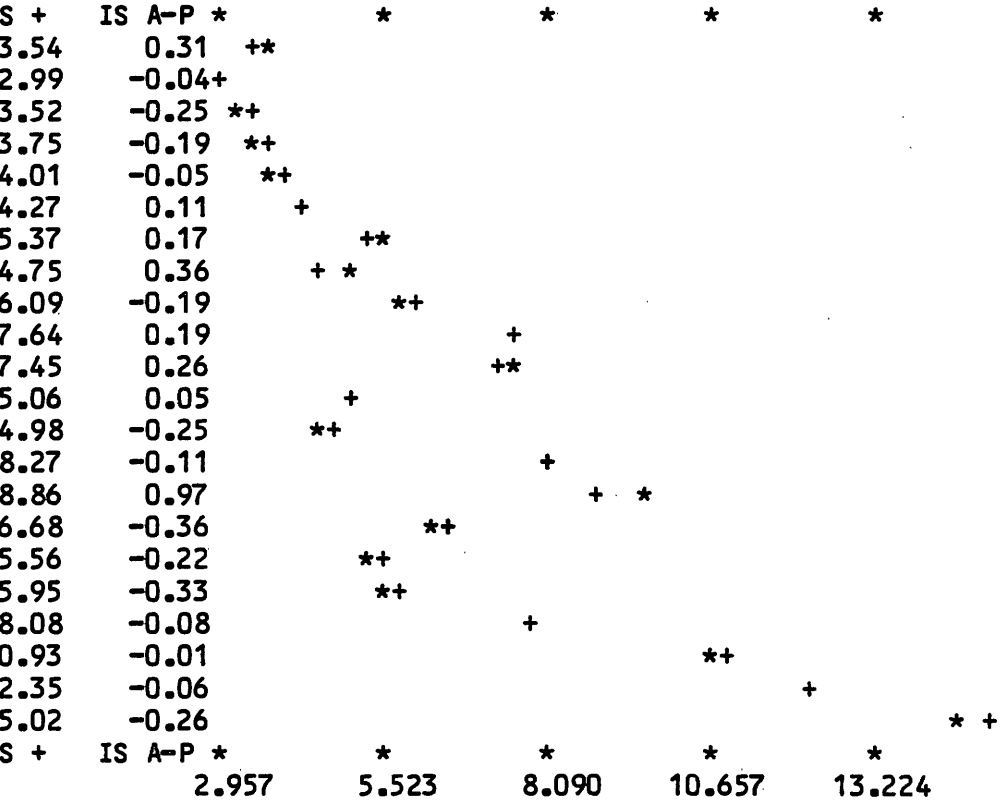
FIGURE 2.15

COMMERCIAL PAPER EQUATION ESTIMATED THROUGH 1981

4 SEE =	0.3019	RSQR =	0.9904	RBARSQ =	0.9882	
RHO =	-0.0379	DW =	2.076	AAPE =	3.75	
VARIABLE	REGRES-COEF	T-VALUE	ELASTICITY	MEXPLAVAL		MEAN
INTERCEPT	4.212018	2.56	0.639	17.73		1.0000
RTB	1.105438	16.60	0.981	314.80		5.8540
RTB(T-1)	-0.202299	-2.09	-0.165	12.07		5.3693
INFL	0.097717	1.69	0.073	8.11		4.9372
FUNDS	-22.931391	-2.22	-0.528	13.57		0.1519
RCP	DEPENDENT VARIABLE - - - - - -					6.59613

SIMPLE COMMERCIAL PAPER EQUATION

DATE	ACTUAL IS *	PREDIC IS +	MISS IS A-P *
60	3.85	3.54	0.31
61	2.96	2.99	-0.04
62	3.26	3.52	-0.25
63	3.56	3.75	-0.19
64	3.96	4.01	-0.05
65	4.38	4.27	0.11
66	5.55	5.37	0.17
67	5.11	4.75	0.36
68	5.90	6.09	-0.19
69	7.83	7.64	0.19
70	7.71	7.45	0.26
71	5.11	5.06	0.05
72	4.73	4.98	-0.25
73	8.15	8.27	-0.11
74	9.84	8.86	0.97
75	6.32	6.68	-0.36
76	5.34	5.56	-0.22
77	5.61	5.95	-0.33
78	7.99	8.08	-0.08
79	10.91	10.93	-0.01
80	12.29	12.35	-0.06
81	14.76	15.02	-0.26
	IS *	IS +	IS A-P *



RCP = RATE ON PRIME COMMERCIAL PAPER, 4-6 MONTHS
RTB = RATE ON TREASURY BILLS, 90 DAYS, NEW ISSUES
INFL = PERCENTAGE CHANGE IN GNP DEFLATOR
FUNDS = (CORPORATE PROFITS + DEPRECIATION) / GNP

FIGURE 2.16

COMMERCIAL PAPER EQUATION ESTIMATED THROUGH 1975

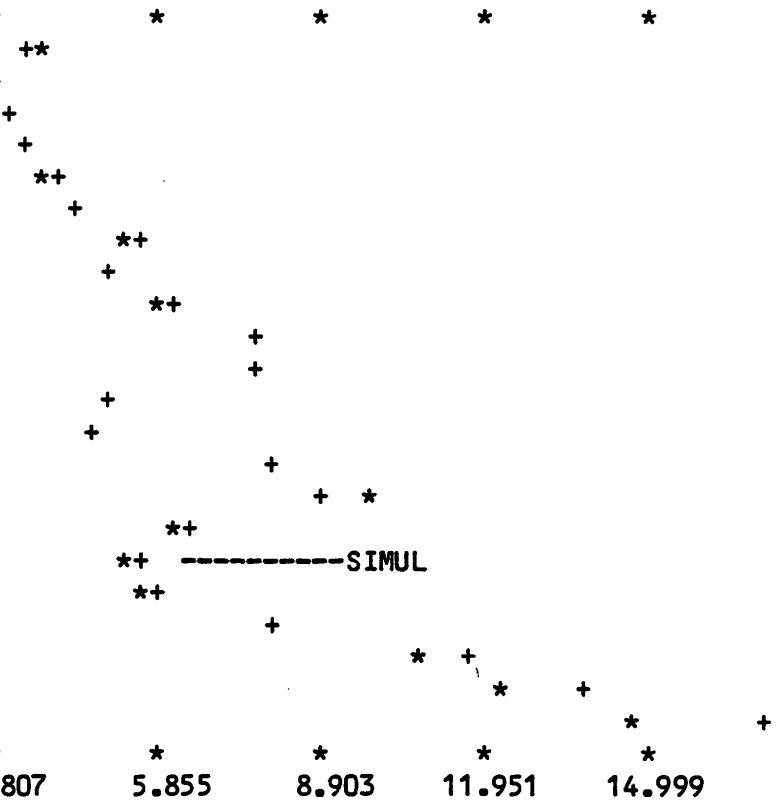
4 SEE = 0.2509 RSQR = 0.9841 RBARSQ = 0.9783
RHO = -0.0630 DW = 2.126 AAPE = 3.21

VARIABLE	REGRES-COEF	T-VALUE	ELASTICITY	MEXPLAVAL	MEAN
INTERCEPT	1.581310	0.90	0.287	3.65	1.0000
RTB	1.267754	13.75	1.086	326.47	4.7232
RTB(T-1)	0.012439	0.11	0.010	0.05	4.5725
INFL	-0.076176	-0.82	-0.055	3.02	3.9715
FUNDS	-12.053867	-1.14	-0.328	5.70	0.1502
RCP	DEPENDENT VARIABLE - - - - - -				5.51281

AAPE IN TEST PERIOD = 9.08

SIMPLE COMMERCIAL PAPER EQUATION

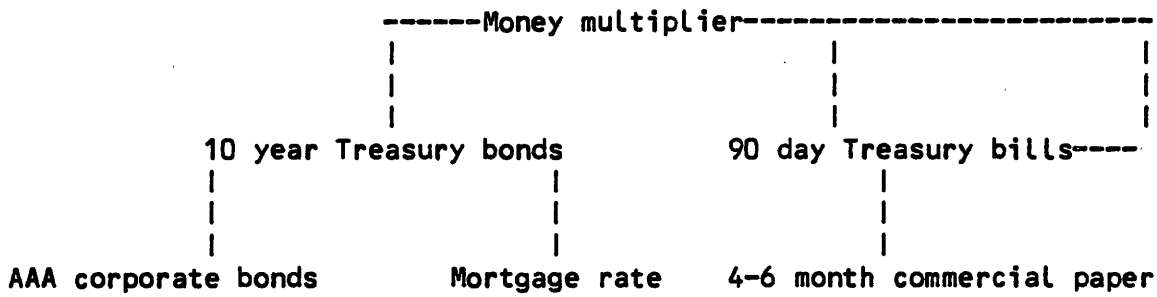
DATE	ACTUAL IS *	PREDIC IS +	MISS IS A-P *
60	3.85	3.45	0.40
61	2.96	2.81	0.15
62	3.26	3.17	0.09
63	3.56	3.64	-0.09
64	3.96	4.10	-0.13
65	4.38	4.47	-0.08
66	5.55	5.60	-0.06
67	5.11	5.04	0.07
68	5.90	6.19	-0.29
69	7.83	7.95	-0.12
70	7.71	7.82	-0.10
71	5.11	5.13	-0.02
72	4.73	4.77	-0.04
73	8.15	8.29	-0.14
74	9.84	9.15	0.69
75	6.32	6.64	-0.32
76	5.34	5.77	-0.42
77	5.61	5.96	-0.35
78	7.99	8.27	-0.27
79	10.91	11.78	-0.87
80	12.29	13.88	-1.59
81	14.76	17.13	-2.38
	IS *	IS +	IS A-P *



RCP = RATE ON PRIME COMMERCIAL PAPER, 4-6 MONTHS
RTB = RATE ON TREASURY BILLS, 90 DAYS, NEW ISSUES
INFL = PERCENTAGE CHANGE IN GNP DEFLATOR
FUNDS = (CORPORATE PROFITS + DEPRECIATION) / GNP

FIGURE 2.17

Hierarchy of equations in the monetary sub-model



iteration, there was
no appreciable change in the solution values. Thus for these simulations as well as in the forecasts presented later, the iterative procedure loops through the equations twice.

These simulations perform at least three useful diagnostic purposes. First, since the bill rate depends on the money multiplier and vice-versa, it is possible that the two equations working in concert could produce some unreasonable results. Note that the signs of the coefficients on these two endogenous variables preclude the possibility of either equation exploding to some nonsensical solution. Consider, for example, what happens when there is an unusually large, positive simulation miss in the 90 day bill equation. The effect on the money multiplier equation is to increase the multiplier, which for a fixed non-borrowed base leads to an increase in M2. This leads, for an exogenous level of nominal GNP, to an increase in the M2 to GNP ratio and causes a decrease in the simulated bill rate, offsetting some of the original simulation miss. While the tendencies of the equations seem reasonable, whether the equation produces results that are economically sensible depends on the particular parameter estimates.

The second and third useful diagnostic purpose served by these simulations are intertwined. A model which consistently under-predicts or over-predicts is probably not a good forecasting tool. Neither is a model which tends to accumulate errors as the forecast lengthens. Since none of the single equations exhibit a large amount of serial correlation, it is not likely that the model will generate serially correlated misses. Further, since the model has very little "memory"

for endogenous variables, the likelihood of accumulating errors is also small. The simulations investigate these possibilities.

The results in Table 2.2 are generally quite appealing. The simulation AAPE for the money multiplier equation is lower than the estimation AAPE, a pattern which is repeated in the 90 day bill rate equation. This reduction is due to the substitution of the model-generated values for M2 into the bill rate equation and the model-generated bill rate into the money multiplier equation. The increases in AAPEs for the other series are very moderate except for the commercial paper series. The increase in AAPE for this series reflects the variability of the 90 day bill rate. None of the simulations display either consistent over or under-predictions.

Much the same results are displayed in Table 2.3 as Table 2.2. The substitution of model-generated values into the equations tends to increase the AAPEs only slightly. For the multiplier and bill rate equations, the AAPEs of the simulation were lower that the AAPEs from the estimation. Columns two and four are particularly interesting. Column two shows the out-of-sample simulation with predetermined values of the endogenous variables substituted in the right-hand-side over the 1976-81 period. Column four shows the results of substituting model-generated values for the endogenous variables. Small increases are shown in all equations but one: the commercial paper equation. The large increase for this equation reflects the highly variable 90 day bill rate. In general, the percentage errors in the equations are in the six percent range, except for the 90 day bill rate and the commercial paper rate. This result tends to lend support to the specifications developed earlier in this chapter. None of the equations

TABLE 2.2

Average Absolute Percentage Errors, Estimation and Simulation through 1981 using estimates from 1960-81

	Estimation	Simulation
Money Multiplier	2.21	2.01
10 year Treasury bonds	5.12	6.49
90 day Treasury bills	14.26	11.31
AAA corporate bonds	1.36	3.87
Commercial paper	3.75	12.17
Mortgages	1.35	3.53

TABLE 2.3

Average Absolute Percentage Errors: Estimations, Single equation, and Full model simulations using parameters from estimations 1960-75

	Estimation 1960-75	Single equation 1976-81	Model 1960-75	Model 1976-81
Money Multiplier	2.35	2.28	2.09	2.73
10 year Treas. bonds	3.59	4.93	4.25	5.52
90 day Treas. bills	12.62	17.61	9.88	17.95
AAA corporate bonds	1.44	4.86	3.35	4.94
Commercial paper	3.97	9.08	11.12	25.03
Mortgages	.97	3.12	2.70	3.64

display consistent forecast errors in either direction.

Before concluding this chapter, it is useful to summarize the response of the model to changes in the policy variables. These responses are reported in Table 2.4, which shows the impact elasticities of interest rates and the money multiplier to changes in reserve requirements and the non-borrowed reserve base. These effects are simply calculated from the elasticities shown in the various equation listings.

TABLE 2.4

Effect on endogenous variables of 10% changes in Fed policy variables

	10% decrease in reserve requirements	10% increase in nonborrowed base
Money multiplier	2.21%	-
10 year Treas. bonds	- 5.61%	-25.36%
90 day Treas. bills	-12.40%	-56.11%
Commercial paper	-12.15%	-55.04%
AAA corporate bonds	-3.66%	-24.88%
Mortgages	-4.52%	-20.41%

Conclusion

The purpose of this chapter has been to present the problem of monetary policy modelling, to briefly discuss approaches taken previously to the problem and to develop a small monetary model which will be incorporated into a larger forecasting model. The parameters of the model, some of its simulation properties, and the response of the

model to policy changes are presented. The next chapter briefly outlines the larger model and discusses modifications made to incorporate the monetary sub-model.

ENDNOTES

1. See Scadding {15}.

2. See Cooper {3}, DeLeeuw {4}, and Hendershott {6}.

3. See Hendershott {6} and Backus et. al., {1}.

4. This is the key issue for someone interested in forecasting interest rates. For someone interested in the effects of a particular policy on the volume of a particular instrument, say of GNMA instruments on mortgage credit, the flow-of-funds model is the clear choice.

5. See Hendershott and Orlando {7}.

6. Of course this problem is not confined to bank reserves models. Flow-of-funds models may be more subject to parameter instability due to the detail at which these models are estimated.

7. See Judd and Scadding {10}.

8. Larkins {13}, p. 43.

9. For a brief yet comprehensive account of these financial innovations, see Larkins {13}.

10. Samples of these equations can be found in Hendershott {6}, DeLeeuw {4}, Cooper {5}, and Lombra and Kaufman {13}.

11. Lombra and Kaufman {13}.

12. Data are from the Federal Reserve Board. "Revised Money Stock Data", March 1982 and June 1982. Also "Reserves of Depository Institutions", revised March 1982.

13. Feldstein and Eckstein {5}.

14. Shiller {16}.

15. This section draws heavily from Humphrey {8} and Rutledge {14}.

16. See Summers {17}.

17. Summers {17}, p. 209.

18. Johnson {9}, p. 22.

19. Johnson {9}, p. 2.

20. Brunner, quoted in {18}, p. 217.

21. Kellner {12}, p. 2.

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APPENDIX

In the equation listings presented as part of chapter 2, a statistic is presented for each independent variable in the equation that may be unfamiliar to most economists. The statistic is named MEXPLAVAL for Marginal Explanatory Value and it measures the percentage change in the standard error of the estimate that would occur if the value of the coefficient of the variable in question were restricted to 0 (left out of the regression equation). Like standardized regression coefficients (beta coefficients), MEXPLAVAL allows for ranking the independent variables in terms of their contribution to explaining movements in the dependent variable. MEXPLAVAL, however, has the additional advantage of relating the relative importance of the independent variables directly to a measure of the goodness-of-fit of the regression. Note that there are no assumptions about the distribution of the error term in the regression necessary for the calculation and interpretation of MEXPLAVAL. The purpose of this appendix is to show that MEXPLAVAL is closely related to a statistic that most economists are familiar with, the F statistic.

If the regression model is $Y = XB + u$, then MEXPLAVAL, denoted M, can be written as

$$(1)\quad M = ((1.0 + B_i^2/(X_i'X_i)^{-1}ESS_u)^{.5} - 1.0)100.$$

where

B_i = estimated coefficient of the ith variable

$(X_i'X_i)^{-1}$ = ith element on the principal diagonal of the $(X'X)^{-1}$ matrix

ESS_u = error sum of squares from the regression model with B_i not restricted to 0.

MEXPLAVAL is closely related to the statistic used to test linear restrictions on a regression model. If the regression model is

(2) $Y = XB + u$ subject to $RB = r$

the variable

$$(3) \quad F = \frac{(r - RB)'(R(X'X)^{-1}R')^{-1}(r - RB) / m}{ESS_u / T - k}$$

where

m = number of restrictions

k = number of estimated parameters

T = number of observations

B = estimated parameters

is generally used. The statistic is distributed $F_{m,t-k}$.

To test a restriction on the ith parameter only, r = 0, R is a row vector of length k consisting of all zeros except for a 1 as the ith element. This reduces the statistic in (3) to

$$(4) \quad F = \frac{B_i^2/(X_i'X_i)^{-1}}{ESS_u / T - k}$$

It is possible to view the above statistic in a slightly different way. From Proposition 16 in Schmidt, page 28.

$$(5) \qquad F = \frac{ESS_r - ESS_u}{ESS_u / T - k}$$

which implies that

$$(6) \qquad B_i^2/(X_i'X_i)^{-1} = ESS_r - ESS_u$$

Now (5) looks very much like a percentage difference of the restricted model error sum of squares from the error sum of squares of the unrestricted model. Eliminating the division by T - k in (5) turns it into a percentage difference.

$$(7) \qquad (ESS_r - ESS_u) / ESS_u$$

To transform (7) into a percentage change of the standard errors rather than the sum of squares, add 1.0 to (7) to get (8).

$$(8) \qquad \frac{ESS_r - ESS_u}{ESS_u} + \frac{ESS_u}{ESS_u}$$

which leaves (9).

$$(9) \qquad \frac{ESS_r}{ESS_u}$$

At this point, we need only take the square root of (9), subtract 1 from (9), and multiply the result by 100 to put the formula into percentage change terms. Thus, MEXPLAVAL has been shown to be equivalent to the percentage change in the standard error of the regression when a variable is left out.

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Chapter 3. The LIFT Model

The purpose of this chapter is to describe the LIFT model, which will play host to the monetary policy sub-model developed in the previous chapter. In this chapter a general overview of the model is given, which includes a discussion of the structure of the model, the content of the behavioral equations, and emphasizes the existing and newly created transmission channels of monetary policy.

Overview of LIFT

The Long term Interindustry Forecasting Tool (LIFT) is the latest and most complete version of a series of input-output models built by the INFORUM research group under the direction of Clopper Almon Jr. These models are used to provide long term forecasts, 10 to 15 years into the future, to firms and government agencies who subscribe to and thus support the forecasting group.[1] The philosophy behind this model is somewhat different from other models that provide information such as the volume of industry output at some fairly detailed level. In most other models, the industry specific results are "driven" by a macroeconomic model. In other words, most industry models have macroeconomic models to calculate totals and simple functions to distribute the totals to various industries. The behavioral modeling is done at the macroeconomic level. In contrast, the LIFT model behavioral equations are estimated a a very detailed sectoral level, mostly at the specific industry or product level. There are at least two advantages to such an approach. First, there is the obvious advantage that the

parameters in the behavioral equations can differ between sectors. To cite an example, this approach allows the response of investment activity to the introduction of an investment tax credit to be different in the steel industry and the automobile industry. Second, and perhaps more important, this structure mimics the structure of the actual economy more closely than the structure of a model that begins with totals and distributes them. The LIFT model, like the economy, works from the detail to the aggregate, rather than from the aggregate to the detail, which is the way most other models work. The model, for example, can examine the effects on the whole economy of, say, a change in profits in any industry, follow this change to the prices of various products, the investment and employment behavior of various industries and trace the path to the changing output mix of the economy. This structure is not only intuitively appealing, but it allows for a much richer simulation environment which can focus on particular industries.

With this concept firmly in mind, we can turn to a more detailed look at the way the LIFT model works. It is convenient to divide the model into three distinct but inter-related pieces : the real side, the price-income side, and the Accountant. Each piece will be described separately.

The Real Side

The real side of the model is that part of the model which calculates constant-dollar industry outputs from a given total-requirements matrix and the vector of final demands in constant dollars. This calculation uses the well-known input-output equation:

$$(1) \qquad q = (I-A)^{-1} f$$

where

q = vector of industry outputs, in constant dollars

$(I-A)^{-1}$ = total requirements matrix, where each coefficient a_{ij} represents the total amount of good i needed to produce on unit of good j

f = vector of final demands, in constant dollars.

In LIFT, the coefficients of the A matrix, (the direct requirements matrix) do not respond to economic factors, so the thrust of the modeling effort is directed to producing forecasts of the vector of final demand.[2] This vector of final demand is forecasted in six components, each of which is forecasted by using regression equations estimated on disaggregated data. A seventh component of final demand, government expenditures by product, is determined exogenously. The seven components of the final demand vector and the number of sectors for each component are:

Personal Consumption Expenditures	(78 goods)
Equipment Investment	(55 industries)
Construction Activity	(31 types of structures)
Inventory Investment	(78 products)
Exports	(78 products)
Imports	(78 products)
Government Expenditures	(78 products)

Before turning to examine each of the six endogenous components individually, it is useful to consider the problem of how to deal with different levels of aggregation of the final demand components. LIFT produces an output vector with 78 sectors, and it is clear that some method must be used to translate, say, the forecasts of purchases of structures by 31 structure types into these 78 sectors. This is done via "bridge" matrices, which provide a bridge between one sector ordering and another. These matrices are required for the personal consumption expenditure (PCE) vector, the equipment expenditure vector and the construction expenditure vector. The matrices, labelled the PCE bridge, the B, and C, matrices respectively, have different interpretations for each final demand component. The B matrix, for example, shows the product composition of industry investment for each of the 55 investment industries, while the C matrix shows the product composition of each of the 31 types of structures. The PCE bridge matrix shows the input-output level product composition of each of the 78 types of consumption goods. Only the coefficients in the B matrix respond to economic factors. The coefficients of the C matrix and the PCE bridge are determined by time trends and are not affected by other items in the forecast.[3] The final demand vector can be written the following way to account for this complication:

$$(2) \quad f = i + e + v + C's + B'd + PCE'c + g$$

where

f	= final demand vector	(78 by 1)
i	= import vector	(78 by 1)
e	= export vector	(78 by 1)
s	= structures vector	(31 by 1)
C	= C matrix	(31 by 78)
d	= equipment vector	(55 by 1)
B	= B matrix	(55 by 78)
c	= consumption vector	(78 by 1)
PCE	= PCE bridge	(78 by 78)
g	= government vector	(78 by 1)

v = inventories

Now we turn to examine each one of these six components forecasted via equations briefly, emphasizing the channels by which monetary variables affect each component. Table 3.1 provides a summary listing of the components and influences on those components of the real side.

Personal Consumption Expenditures[4]

The equations used to forecast the 78 consumption commodities are the result of estimations done using cross-section and time series data. The cross-section data, from the 1972 Bureau of Labor Statistics Consumer Expenditure Survey, are used to isolate the effect of the distribution of income, age structure of the population and other demographic variables (like educational attainment, household size, and number of wage earners per household). The time series estimations on the consumption of different commodities are then done to capture the effect of changing relative prices. These time series estimations use variables derived from the cross-section as independent variables.

Table 3.1

Components and Influences of Real Side

Component	Number of Sectors	Influences
Personal Consumption	78	Age structure of population Disposable income Relative prices Other demographic data Commercial paper rate
Equipment investment	55	Industry outputs Cost of capital Wage rates Energy prices Stocks of equipment
Construction	31	Industry outputs Interest rates Stocks of structures Demographic data
Inventory investment	78	Industry outputs Interest rates Inflation rate Stocks of inventories
Imports	78	Industry outputs Relative foreign to domestic prices Time trends Exchange rates
Exports	78	Foreign demand indexes Relative foreign to domestic prices Time trends Exchange rates
Labor productivity	55	Industry outputs Time trends

Specifically, for any commodity i, we have two equations:

$$(3)\quad C^* = a + \sum_{j=1}^{K} b_j Y_j + \sum_{j=1}^{H} d_j D_j$$

$$(4)\quad C = (a + bC^* + c\Delta C^* + dT) * \prod (p_i/p_j)^{s_j \lambda_{IJ}}$$

where

Y_j = amount of income per adult equivalent falling within jth income category for k different categories

D_j = 0,1 dummy for particular demographic variables these are:
- region of country
- family size
- educational level
- working or non-working spouse

C^* = expenditures per adult equivalent on the ith consumption good (cross section)

C = expenditures per adult equivalent on the ith consumption good (time series)

T = simple time trend

p_i = price of ith good

p_j = average price of goods in group j

s_j = share of total consumption of group j of M total groups

λ_{IJ}, d, c, b are all parameters to be estimated

Several points should be noted about these two equations. First, the measure of income used in the cross section is not really income, but total expenditures, which differs from disposable income by the amount of savings, interest payments by consumers to business, and personal transfer payments to foreigners. Second, using the ideas developed by Almon[5], the time series estimations are done as a system, with the number of estimated cross price elasticities reduced by introducing the concept of economically relevant groups. These groups then act as substitutes or complements with the ith good. Slutsky symmetry is satisfied by imposing the constraint that λ_{IJ} (for group I and group J) be equal to λ_{JI} for all I and J. Third, an effort was made to develop commodity-specific populations to allow the changing age

composition of total population to have an effect on the types of consumer goods purchased. This effort was implemented by creating age-weighted populations for each commodity, assigning a weight of unity to persons aged 31-40 and estimating commodity specific adult equivalency weights for other age groups. Thus, C and C^* are not really per-capita consumption expenditures but commodity specific per-capita consumption expenditures. Because each commodity is divided by a different population, it is not possible to insure, by proper choice of parameters, that the sum of the expenditures on individual items will equal the required total. That requirement is met by a small, mechanical adjustment.

The procedure for estimating the consumption equations is fairly straight-forward. The first step is to estimate equation (3) to obtain parameter estimates for a,b, and d for each commodity. Then, using the just-derived estimates and a time series of observations for the independent variables of the cross-section equations, a time series of predictions of consumption for each good is calculated. Finally, these calculated values are used in (4) to produce predictions of consumption of commodity i over time. Equations estimated with this approach are now a standard part of the LIFT model.

One influence on consumption that is not accounted for in the above framework is the influence of financial conditions, especially interest rates. While the omission of this influence is probably inconsequential for many of the consumer expenditure commodities, it is a serious omission for the durable goods part of PCE, especially for purchases of

automobiles. Within the framework developed above, the simplest route to take when incorporating interest rates, or any other time series variables thought to be important for a particular consumption good, is to add the extra variable inside the first parenthetical expression in equation (4). In the original estimation of the consumption model, this approach was used for a few sectors, most notably for Funeral expenses, which uses the death rate.

As an alternative to just adding the interest rate to the first parenthetical expression in (4), it is possible to drop the time trend and add the interest rate term to (4). This alternative is motivated by the high degree of collinearity between an annual average interest rate series ,the time trend, and the predictions of consumption from the cross section. The simple correlation between a time trend and the 90 day Treasury bill rate over the period 1955 to 1981 is .836. Entering these variables in a regression equation would probably result in very imprecise estimates for the coefficients. Substituting the interest rate for the time trend is a way to reduce the collinearity problem.

The search for interest-rate effects in PCE has two dimensions. First, there is the question of which sectors should have interest rates included in their time series estimations. The second question is whether to drop the time trend and add the interest rate or just to add the interest rate to the equation. To address these possibilities, the equations were estimated several times, varying which equations contained interest rates and where these interest rates were put in the equations. Sectoral definitions for this final demand component appear

in an appendix to this chapter. It is more useful to report only summary results here. In all cases the interest rate used is the 4-6 month commercial paper rate, as a proxy for the various complicated financing rates and schedules used for consumer purchases. No attempt was made to develop alternative measures of credit or to use "real" interest rates in the equations. The search for interest rate effects was confined to two large groups of PCE sectors: Household durables, which include rugs, washing machines and like appliances, and Transportation, which includes new cars and trucks, net purchases of used cars, fuel, other supplies and public transportation.[6] The a-priori supposition for all of the sectors in these two groups is that a rise in the interest rate will cause a decline in expenditures on these good types. When this supposition was not fulfilled, i.e. when the sign on the interest rate term was found to be positive for a sector, interest rates were deleted from that sector and the system re-estimated without interest rates in that sector.

Using the above principle as a selection criteria, the interest rate was found not to be appropriate for any of the sectors in the Household durables group. The interest rate, whether substituted for the time trend or added to the equation, consistently produced a positive sign. In no case did the positively-signed interest rate term make a noticeable reduction in the size of the sum-of-squared-errors for any of the Household durables commodities. In the Transportation group, however, interest rates had the proper sign and so were retained for use in the forecasting model.

Given that interest rate effects of the proper sign could be found only in the Transportation group, the question of the magnitude of the effect was investigated. Table 3.2 reports the relevant elasticities for the two major sectors of that group, New cars and trucks, (accounting for 3.6% of total consumer expenditures in 1980) and Net purchases of used cars (.84% of total consumer expenditures in 1980). It should be noted first that the elasticities are calculated with respect to 1979 data and secondly that the income elasticities are really income elasticities and not C^* elasticities.

The results shown in Table 3.2 are somewhat disturbing. Table 3.2 shows that the estimates of the own price and interest rate elasticities are highly specification dependent. Dropping the time trend from the equation had the effect of multiplying the interest rate elasticity for New cars and trucks by a factor of ten and doubling the interest rate elasticity for Net purchases of used cars. Although the income elasticities do not change very much, the own price elasticities become significantly less negative and, in the case of New cars and trucks, becomes positive. This imprecision of the elasticity estimates stems from the severe collinearity among the interest rate, C^*, and the time trend. One way to deal with this problem is to "add information" to the equation by the way of constraints on the values the parameters can take. The interest rate elasticities for purchases of New cars and trucks shown in Table 3.2 represent wide extremes of possible values. Informally, we would expect the true elasticity to lie in the range represented in the table, but perhaps to be closer to the low end than to the high. To examine the results of estimating the entire PCE system

Table 3.2

Elasticities for estimations with and without time trends

Sector	With time trend			Without time trend		
	own price	inc.	interest	own price	inc.	interest
New cars & trucks	-.241	3.275	-.0466	.089	2.875	-.352
Used cars	-.612	1.298	-.0898	-.196	1.207	-.170

Table 3.3

Elastcities for Constrained estimation

Sector	own price	income	interest	consumption share
New cars and trucks	-.069	3.090	-.146	3.60
Used cars (net)	-.286	1.343	-.045	0.84
Tires & tubes	-.204	0.821	-.154	0.92
Accessories & parts	-.221	0.701	-.060	0.34
Boats, RV's & aircraft	-1.70	2.383	-.027	0.18
sum				5.88

when this loose prior is attached to the system, a final estimation was done "softly" constraining the interest rate elasicity to be between -.1 and -.2.[7] This constraint was applied only to the elasticity in the New cars and trucks equation. The results from this estimation are presented in Table 3.3, which presents elasticities for the five sectors using interest rates and the shares of total expenditures accounted for by these goods in 1979.

The sectoral results displayed in Table 3.3 are quite appealing. By virtue of the search procedure and selection criteria, all of the own price elasticities are negative and none of the income elasticities appear unreasonable. The income elasticity for New cars and trucks remains somewhat high but this result is robust with respect to the specification changes discussed here. The interest rate elasticities are relatively small, with the exception of Tires and tubes, whose elasticity is greater than the corresponding elasticity for New cars and trucks. The result of this work has been to make nearly 6% of total consumer expenditures respond to movements in interest rates.[8]

Investment Expenditures[9]

The equations used to forecast the equipment investment behavior of 55 industries are based on the assumption of cost minimization subject to a production function. A cost function is postulated and the factor demand equations for capital are derived which relate capital to relative factor prices, technological change and industry specific outputs. While the details of this work are interesting, for the present purpose it is necessary only to know how the investment equation derived from the capital factor demand equation responds to financial variables. The effects of financial conditions are represented by interest rates and interest rates appear in the price of capital for each industry.

We can write the price of capital for each industry as:

$$(5)\quad p_k = p_{eq}(r+d(l))(1-tz-c)/(1-t)$$

where

p_k = price of capital
p_{eq} = equipment deflator for industry i
r = discount rate for stream of future earnings
$d(l)$ = physical depreciation rate, a function of average equipment lives
t = marginal corporate tax rate
c = investment tax credit
z = present value of tax depreciation given by the formula

$$z = (2/iL)(1-(1/iL)(1-e^{-iL}))$$

where
i = nominal interest rate
L = average service life of equipment in each industry

This formula for the price of capital has two possible channels through which interest rates can have an effect. First, the rate which is used to discount the stream of future earnings generated by the equipment, r, is conceptually a real, not a nominal rate. It would be possible to relate this rate to market interest rates, but it was found that the equations fit best when it was assumed that r was fixed at a constant rate, namely 2.5%. The second channel is by way of the nominal interest rate, which appears directly in the formula for the calculation of the present value of depreciation. In the estimation of these equations, the AAA bond rate was substituted for i. The magnitude of the effect of interest rates on the demand for capital thus depends on two factors: the long run own price elasticity of capital and the elasticity of the price of capital with respect to the AAA bond rate. These two effects are reported in Table 3.4 for those sectors with substantial own price elasticities. Only four sectors exhibit elasticities greater than .5. These are Aerospace, Gas, water and

sanitation, Agricultural fertilizers, and Other chemicals.

Table 3.4

Long run price elasticity of capital and elasticity of price of capital with respect to AAA bond rate

Sector	Capital elasticity own price	Capital price interest elasticity
1 Agriculture	-.421	.0736
2 Crude Oil & Gas	-.407	.0796
3 Mining	-.240	.0736
4 Construction	-.217	.0494
5 Food & tobacco	-.037	.0789
11 Agricultural fertilizers	-.712	.0748
12 Other chemicals	-.590	.0748
13 Petroleum refining	-.263	.0812
37 Aerospace	-.972	.0696
38 Ships & boats	-.245	.0767
47 Gas, water, sanitation	-.734	.0699
48 Wholesale & retail trade	-.155	.0736
50 Real estate	-.127	.0744
51 Hotels & repair (not auto)	-.107	.0744
54 Movies & amusements	-.440	.0744
55 Medical & Educational	-.364	.0744

The numbers in Table 3.4 answer the question of the effect of the cost of capital on the amount of capital purchased by each industry. To examine the effects of changes in the interest rate on the volume of industry investment, the set of equations was solved for 1978 investment twice, once with the observed 1978 AAA rate and once with the bond rate 1% (not percentage point) higher than the 1978 observed value. The difference between the two solutions, as a percentage of the 1978 investment figures are reported in Table 3.5. Thus, Table 3.5 is presenting interest rate elasticities of investment with the elasticities computed at the 1978 values. The table lists only those sectors with relatively large values for the elasticities. It should be noted that the elasticities are usually called impact elasticities, meaning that the table shows the immediate response of investment to a change in the bond rate. From the point of view of the LIFT model, the impact elasticities are more meaningful than long run elasticities. This is because investment changes will change sectoral outputs, which will in turn feed back on investment. When the model is forecasting, the long run elastcities will never be observed directly, because of the corresponding changes in other parts of the model brought about by investment changes. These impact elasticities give some idea of the direct effect of interest rate movements on investment behavior.

Table 3.5

Impact multipliers of bond rate on investment

	Sector	Elasticity
1	Agriculture	-.054
2	Crude oil & gas	-.166
3	Mining	-.037
4	Construction	-.007
5	Food & tobacco	-.025
11	Agricultural fertilizers	-.246
12	Other chemicals	-.046
13	Petroleum refining	-.094
37	Aerospace	-.143
47	Gas, water & sanitation	-.127
48	Wholesale & retail trade	-.027
50	Real estate	-.014
51	Hotels & repairs (not auto)	-.029
54	Movies & amusements	-.042
55	Medical & educational	-.033

Construction Expenditures

The LIFT model has 31 sectors of purchases of structures by type of structure, following the sectoral detail available in the National Income and Product Accounts (NIPA). The list of sectors appears in the appendix to this chapter. Of these 31 sectors, 20 sectors are forecasted by regression equations. The remainder, mostly government

structures, are determined exogenously. These sectors are marked in the list in the appendix.

The 20 sectoral equations were estimated with ordinary least squares, using data from 1958 to 1981. Of the 20 equations, 9 of the sectors use one or more interest rates directly. Four of the remaining 11 construction sectors use one or more of the sectors in which interest rates appear directly as explanatory variables. This makes 13 of the 20 construction equations functions of interest rates directly or indirectly. The largest construction sector, accounting for 15.7% of total new structures purchases in 1981, is Single family residential structures. Of total private residential structures, Single family residential structures and Additions and alterations (residential) account for 66.7%. The private non-residential structures total is dominated by 5 sectors, Industrial structures (15% of total non-residential structures), Offices (14%), Stores, restaurants and garages (16%), Oil and gas well drilling (15.5%) and Electric utilities (12.4%). To simplify the exposition, only the specifications for these sectors will be discussed. All of the equations sensitive to interest rates are summarized in the appendix.

The equation used to forecast Single family residential structures contains two variables which are intended to capture financial effects. These are the level of the mortgage rate and the current and one year lagged difference between the AAA bond rate and the 4 to 6 month commercial paper rate. The mortgage rate enters as a price variable, to show the cost of new homes to the families that live in them. The rate

difference variable represents the availability of credit to home builders. A low value is likely to indicate a flow of credit out of major housing lending institutions that generally occurs when short term instruments become more profitable investment opportunities relative to longer term securities. The elasticity of the per-household expenditures on new, single unit residential structures, (measured at the mean of the data series) are -.68 for the mortgage rate and .05 for the rate differential. To state the effects another way, an increase of 1 percentage point in the mortgage rate reduces real expenditures on single-unit residential structures by 13.8%, measured at the 1981 data points. Similarly, a 1 percentage point increase in the rate differential eventually leads to a 13.8% increase in single-unit residential construction expenditures. The equation used to forecast Residential additions and alterations is a function of the rate differential, the level and the first difference of the mortgage rate, all multiplied by the value of the stock of single unit residential structures. This multiplication is done to insure that the size of the pool of structures affects the response of additions and alterations to interest rate changes. While the sign on the rate differential is positive, again reflecting a credit availability phenomenon, the sign on the mortgage terms are also positive. This sign reflects a substitution effect between purchases of new structures and additions and alterations. The elasticities of these variables is .03 for the rate differential and .16 for the mortgage rate. These elasticities mean that a 1 percentage point increase in the rate differential leads to approximately a 600 million dollar (constant 1977 dollars)increase in expenditures on Residential Additions and Alterations. A 1 percentage

point increase in the mortgage rate increases expenditures on this sector by 250 million constant 1977 dollars.

For private non-residential structures, four of the five most important sectors contain interest rate terms. Only Electric utilities construction does not use interest rates, instead using only a long distributed lag on the output of product level sector 56 (Electric utilities) to determine new structures purchases. This is not really surprising since the Electric utilities industry is regulated and somewnat insulated from cost-of-credit effects. For Industrial structures, the financial variable is the product of the rate difference used in the residential structures equation and the lagged stock of industrial structures. Both the contemporaneous and one-year-lagged values are used in the equation. This variable was found to be the only interest rate type variable that exerted a reasonable and significant influence in this equation. The reason for the negative sign, which is opposite of the sign on the residential sectors, may retlect the ability of non-residential builders to command construction labor and materials more cheaply and easily when residential building is depressed. The long run elasticiy of expenditures of Industrial structures with respect to the variable is -.141. This implies that a 1 percentage point increase in the rate differential reduces expenditures on new Industrial structures by 2,250 million constant 1977 dollars. This same type of term, the long and short rate differential, appears in the equation for Offices and purchases of new Stores, restaurants and garages. For these sectors, the long run elasticities are -.049 and -.066 respectively. These elasticities translate to a 500 million constant dollar decline

and an 850 million constant dollar decline in expenditures for these two sectors when the rate differential rises by 1 percentage point.

The final major private non-residential construction sector is Oil and Gas well drilling, which includes a two-year moving average of the AAA bond rate as a primary determinant of the level of expenditures. The interest elasticity for this sector is fairly substantial at -.30.

Inventory investment[10]

There are 60 equations which are used to forecast inventory change by type of product. The general form of the equation for each sector is:

$$(6)\quad S_t - S_{t-1} = a + bI_t + c(I_t - I_{t-1}) + dS_{t-1} + eR_tI_t$$

where

S_t = stock of inventories of each product at time t
I_t = output of product less change of inventory of the product and the use of the product in its own making
R_t = 4 to 6 month commercial paper rate less the rate of growth of the price of each product

The equation relates the change in inventory stocks to the use of the product as a material input to the making of all other products, the change in this usage, the level of the stock in the previous period and a proxy for the real interest cost of holding inventories. The expected signs on the coefficients are positive for a, reflecting the probable increase in inventory holdings when the level of usage increases, either positive or negative for c, depending on whether the stocks of the good

in question move pro or counter-cyclically, negative for d, to account for the depressing effect on inventory accumulation of already high levels of inventory stock, and negative for e. Prior to estimating the equations, two criteria were established which resticted the signs on d and e to be negative. When the estimation resulted in positive signs for either of these two terms, the term was dropped and the equation re-estimated without it.

Using this procedure, 17 of the 60 equations were found to contain negative interest cost effects. The terms were found to be only moderately significant, i.e. with associated t values greater than unity, for only a few sectors. These are Farms and agricultural services, Miscellaneous manufacturing, Furniture, Crude petroleum, and Footwear. On the whole, the interest sensitivity of inventory holdings by product is very small. Recent work by DeLeeuw on inventory behavior by type of holder confirms this relative insensitivity of aggregate inventory holdings to real interest rate changes, although he is able to find a statistically significant effect. DeLeeuw finds that holdings of materials inventories are more sensitive to real interest rate changes than finished goods or goods-in-process inventories. Generally, "Orders" industries (roughly meaning durable goods manufacturing industries) are more sensitive than "Sales" industries (roughly meaning non-durable goods manufacturing). The elasticities of response range from a low value of -.025 for holdings of goods-in-process inventories in Sales industries, to -.2 for holdings of material inventories in Order industries with the average elasticity around -.08. The regressions which produced these results were estimated on annual data

from 1958 through 1981.[11] The results reported for the present work (in the appendix to this chapter) may reflect the greater data problems associated with inventory holdings by product as opposed to inventory holdings by holder.

Foreign trade equations (Exports and Imports)[12]

There are two channels by which monetary factors can exert an influence on the foreign trade part of the model. First, there are direct interest effects in the export and import equations for investment income derived from sources foreign to the investor. The import equation explains the value of investment income of foreign-owned assets in the U. S. as a simple linear function of the total value of merchandise imports and the rate on U. S. dollar denominated deposits not held in the U. S. (the Eurodollar rate). The value of U. S. investment income derived from overseas assets is a simple linear function of total merchandise exports and the Eurodollar rate. For forecasting purposes, the Eurodollar rate is a simple linear function of the 4 to 6 month commercial paper rate. The interest elasticity for imports is .319 and for exports is .962. The elasticity for exports is particularly significant because the share of total exports accounted for by this sector is quite high (22%). The corresponding share for imports is much smaller, only 5.07%. No other non-merchandise export or import equations use interest rates or any other variable directly related to monetary factors. It is important to note that the non-merchandise trade equations are not functions of relative foreign to

domestic prices while relative prices are a primary determinant of merchandise imports and exports.

The general form of the merchandise export and import equations is:

$$(7)\quad x = (a + bD)p^{c}$$

where

x = constant dollar imports or exports
D = demand variable
    foreign demand indexes for exports
    domestic output plus imports less exports for imports
p = relative price term
    foreign to domestic price ratio for imports
    domestic to foreign price ratio for exports
p -3
a,b,c = parameters to be estimated.

The second channel of effects for monetary policy is through the exchange rate and its consequent effect on the relative foreign to domestic price ratio. To understand the innovation in the present work, it is necessary to review the process used to generate foreign prices.

In the LIFT model there are nine major trading partners: Canada, Japan, Belgium, France, Germany, Italy, Netherlands, United Kingdom, and the Rest of the world. To derive the historical series on import prices, domestic prices are gathered for each country and the exchange rate is applied to derive deflators for each country that are comparable to the U.S. domestic deflators. The next step is to translate the sector ordering of the price deflators from various countries to the sector ordering used in the LIFT model which is accomplished via "bridge" matrices specific to each country. At this point in the

procedure, a set of prices for each major trading partner exists at the sector ordering used by LIFT and up to this point no distinction has been made between export and import prices. To translate the 9 price vectors into a single foreign price vector, some weighting scheme must be used. To get the price of imports vector, the weights are the share of total U.S. imports of the ith commodity accounted for by the jth trading partner. The price of competing world exports is obtained by using the same 9 vectors of price weighted by the share of total world exports of commodity i accounted for by trading partner j.

Algebraically, we can write this procedure for each time period as:

$$(8)\quad p_f = \sum_{i=1}^{9} p_i^*$$

where

p_f = price of imports or exports depending on the definition of the share matrix

$p_i^* = e_i S_i I_i p_i$

where

e_i = country specific exchange rate (scalar)
S_i = diagonal matrix of weights for each country (48 by 48)
I_i = aggregation or disaggregation matrix, specific to each country (48 by M)
p_i = vector of domestic prices for country i (M by 1)
M^i = variable representing number of sectors for each of the 9 trading partners

The prices derived in this fashion are used in the estimation of the merchandise import and export equations, of which there are 48 different commodities. To establish <u>forecasts</u> of these prices, the following regressions were run (omitting time subscripts for convenience) for import and export prices:

$$(9)\quad \ln(p'_i/p_d) = a + bT$$

where

$p'_i = I_i p_i$ as described above

p_d = U.S. domestic deflator

T = simple time trend

Note that the effects of exchange rates are omitted from these regressions.

This procedure provides relative growth rates of foreign prices with respect to a vector of variables that is forecasted elsewhere in the model, namely, domestic prices. These relative growth rates are modified by assumed paths of exchange rates for each country, then aggregated using the respective share matrices for the last year for which data is available for each country. (The procedure is that of equation (8).) Prior to the present work, this forcasting of foreign prices was done outside of the LIFT model. The procedure was to take a forecast of domestic prices and calculate vectors of import and export prices through the horizon of the forecast. Then the <u>levels</u> of foreign prices were entered as exogenous data to the general forecasting model. The flaw with this procedure is that any scenario that results in a higher rate of inflation for the U.S. has unintended and continuing effects in the export and import markets by altering the relative foreign-to-domestic price ratio. One solution to this problem is to iterate between the forecasting model and the generation of foreign prices until some convergence in forecast results is reached. This is a cumbersome and time-consuming procedure. An alternative approach is to

endogenize exchange rates, rather than keeping them completely exogenous. One way to incorporate economic factors into exchange rates is to estimate a separate exchange rate equation for each of the 9 major trading partners. These rates could then be used in the calculation of the p^* vector for each country. This approach was not taken for two reasons. First, annual estimations would have to be done on a very small data set, since exchange rates have been floating only from 1973. Second, estimating each exchange rate would carry implications about all of the non-U.S. exchange rates as well as for the direct exchange rates between the U.S. and any individual trading partner. These implied changes in the non-U.S. rates would naturally imply changes in the trade patterns that could not be accounted for in this model.

Instead of estimating all 9 exchange rates, a single function is applied to the single vector of export and import prices (the results of equation (8)). Given a set of exogenous exchange rate forecasts, this function will, in essence, allow the value of the dollar to appreciate or depreciate relative to all currencies, while not affecting the rates of exchange between foreign currencies. The function, which is posited, not estimated, and which operates only in the forecast period, relates the movements in this exchange rate scaler to the differential between the calculated current dollar balance-of-trade and some target level of the current dollar balance-of-trade.

Basically, the function to change the exchange rate scaler is of the following form:

for ($BT < BT^*$) EXSCL = .95

for ($BT > BT^*$) EXSCL = 1.05

where

EXSCL = exchange rate scaler
BT = actual current dollar balance of trade, Exports less imports
BT^* = target level of the current dollar balance of trade.

This function provides a device to make the exchange rate scaler move so that BT is brought closer to BT^*. When the U. S. is running a larger trade deficit than the target in a year, the function makes the U. S. dollar less expensive to foreigners, thereby increasing exports and decreasing imports. There are at least two major problems with such a simple function. First, it is not necessary to drive BT to BT^* exactly, so that the funtion should become active only outside some band around BT^*, say, 10% in either direction. Second, the factor of adjustment is independent of the distance between BT and BT^*. These two difficulties are corrected in the following function.

For ($BT < BT^* - .1 * BT^*$) $EXSCL = .95^N$

where

$N = (BT^* - BT) * 10 / BT^*$

and

for ($BT > BT^* + .1 * BT^*$) $EXSCL = 1.05^N$

where

$N = (BT - BT^*) * 10 / BT^*$

The major problem with this function is that it depends crucially on the values chosen for BT^*. Generally, BT^* is a variable that can be set at the user's discretion, allowing for some flexibility as an aid in making simulations. For the purpose of this work, the values of the current dollar balance-of-trade that results from the base scenario will be the BT^* values for the subsequent simulation runs in chapters 5 and 6. Thus, any movement in the exchange rate scaler in any of the simulations will reflect the effects of the simulation on the foreign trade part of the model. It should be noted that the values for the adjustment factors (.95 and 1.05) were chosen completely arbitrarily. The major innovation in this work, then, is to make the levels of foreign prices endogenous and to devise an automatic system for dealing with balance of trade considerations.

Productivity and Employment[13]

After the model has generated forecasts of the 6 types of final demand and used equation (1) to calculate the vector of industry outputs, the vector of industry outputs and time trends are used in the equations for labor productivity. The general form of the equation used to predict the amount of output per hourly adjusted employees for each industry is:

$$(11) \quad \ln E/q = a + bT1 + cT2 + d(\ln q_t - \ln q_{t-1})^+ + e(\ln q_t - \ln q_{t-1})^-$$

where

E = hourly adjusted employment in each industry
T1 = simple time trend starting in 1956
T2 = simple time trend starting in 1969
q = industry specific output

The plus and minus signs in equation (11) refer to positive and negative output changes. Two points should be noted about the equation. First, the two time trends are the result of "eyeballing" the productivity data and noting a distinct change in the trend in most industries after 1969. Second, the reason for the use of the two change-in-output terms is to allow for the possibility of an asymmetric productivity response to increases and decreases in output.

Using the vector of productivity and the output vector, hourly adjusted employment for each industry is generated. These results are then summed to establish total hourly-adjusted employment for the economy and this result is compared with the exogenous projections of the labor force (from the Bureau of Labor Statistics) to determine the unemployment rate. This rate then enters many of the behavioral functions of the model.

A cautionary note is important here. Because no account has been taken of fluctuations in average weekly hours, the unemployment rate calculated by the model may over-state or under-state the true unemployment rate. One other factor that must be considered is that people may hold more than one job. To account for this latter effect, a

variable is defined which measures the number of multiple job holders as the number of hourly adjusted employees which must be removed from total employment to attain the last known unemployment rate. (The number of multiple job holders is not a statistic collected by any agency on a continuous basis.) For this work the forecast path of the number of multiple job holders is taken from the June, 1983 INFORUM base run, with an adjustment to move the calculated unemployment rate of the model closer to the observed rate for 1981. Since no explicit attempt is made to model average hours of work per week, the implicit assumption is that average weekly hours are constant at the average for the last year for which the unemployment rate is known.

Once the calculation of employment and the unemployment rate is finished, the model moves on to the price-income side to determine industry prices and industry factor incomes, the part of the model to which we now turn our attention.

Price-income side[14]

The price-income side of the LIFT model produces forecasts of the 13 components of income in current dollars for each of 50 industries. The components are forecasted by using separate regression equations for each industry for most of the 13 components. The exceptions to this general rule are listed below. Forecasting income this way serves two purposes. First, the forecasts of income by type of income are interesting in their own right. From these forecasts, and a few additional equations, useful macroeconomic totals such as personal

income can be calculated.

The second use to which these forecasts are put is in the calculation of industry prices using the equation:

$$(12)\quad p = (I-A)^{-1}v$$

where

p = vector of industry prices

$(I-A)^{-1}$ = same as described for equation (1)

v = vector of industry value added per unit of output where value added is the sum of the 13 income components

This approach to price forecasting states that the price of any good is a weighted average of all the material input prices where the weights are the elements of the direct requirements matrix, plus a component for the amount of primary factor reward per unit of output. The primary factor rewards are payments to labor, capital and the government (through indirect business taxes). The design of the price-income side permits only the total for capital income for each industry to affect price, rather than allowing the 8 components of capital income to exert individual effects on price. This design is implemented by estimating a set of total capital income equations (one for each industry) and a set of equations for each of the eight types of capital income. The forecasts of total capital income produced by summing the eight individual types of capital income are scaled to the forecasts of the same total (by industry) produced by the total capital income equations. The effect of this procedure is to allow the equations for the 8 types of capital income to affect the distribution of capital income among the components, but not to affect the levels.

This distribution is important for the calculation of several macroeconomic totals. Proprietors' income, for example, is part of personal income while corporate profits are not. Any shift in the distribution of income by industry between these two types of income will change the level of personal income as well as Federal government receipts, since profits are taxed at a different rate from personal income.

One complication that should be briefly addressed is the problem of the translation of the income data, at the 50 industry level, to the product level of 78 sectors. The v vector in equation (12) is value-added per unit of product, so value-added must be available at the 78 product level. The translation between the 50 industries and the 78 products is done via yet another bridge matrix. The "product-to-industry" bridge shows the proportion of each industry's value-added accounted for by each product. Thus, forecasts of the total imcome of each of the 50 industries are passed through this bridge to get the v vector used in the price calculation of equation (12).

There are, then, three major types of income which exert an influence on the price of each good. These are labor compensation, return to capital, and indirect business taxes. Two other types of income exert a much lesser effect and so for most purposes can be ignored. These are subsidies, which are small relative to the other three, and rental income, which accrues only to value-added sector 33 (Real estate). The determinants of the three major components of total factor income are presented in tabular form in Table 3.6. These

determinants are discussed separately below. The determinants of the equations for the pieces of the return to capital are presented in Table 3.7 and only briefly mentioned below.

The key relationship on the price-income side of the model for the present work is found in the aggregate equations for labor compensation. In LIFT, there are two aggregate hourly labor compensation (HLC) equations, one for manufacturing industries and one for non-manufacturing industries. The sectoral equations for HLC , one for each industry, are a set of regressions where the dependent variables are indexes of HLC divided by one of aggregate indexes, depending on the type of industry. Since the prime explanatory variable in the non-manufacturing HLC equation is manufacturing HLC, this model structure permits the manufacturing HLC equation to define an average level of compensation for the entire economy while the various sectors can differ based on the relative HLC equations. Given the method for calculating prices and the fact that labor compensation comprises about 75% of national income, this equation determines the aggregate price level to a large extent. Thus the manufacturing HLC equation is extremely important to the model and even more so for the present work since it is the mechanism by which changes in the money supply are translated into aggregate price level movements. Some discussion of the specification of this equation, shown in Figure 3.1, is in order.

First, it is clear that the monetary aggregate should appear somewhere in the model in such a way as to influence prices. Without such an appearance, and in the absence of capacity constraints, the

Table 3.6

Major Components and Influences of Price-Income side

Component	Number of Sectors	Influences
Labor compensation		
Aggregates	2	Overall labor productivity M2 relative to real GNP Social security tax rate Import deflator Unemployment rate
Sectoral equations	50	Unemployment rate Inflation Sectoral productivity Share of total employment
Capital income	50	Sectoral imports Sectoral exports Sectoral output Capital-output ratios Unemployment rate
Indirect business taxes	50	Sectoral output Sectoral capital stocks
Government subsidies	50	Exogenous
Rental income	1	Housing consumption Unemployment rate

model would have the property that continual increases in the the money supply would depress interest rates (via the equations presented in Chapter 2) and generate continual increases in employment. Several solutions to this problem exist. One possibility is to model capacity, include the monetary aggregate in the final demand equations, and let the rate of growth of sectoral prices be a function of the extent to which capacity has been exceeded. Not only does this approach require the modeling of long-term industry capacity, which is a very difficult task (especially in defining exactly what capacity is) but it does not fit easily into the framework embodied in equation (12) which the model uses to forecast prices. Instead, one can affect prices by altering income per unit of output via the monetary aggregate. Since labor compensation accounts for such a large percentage of total income, letting the monetary aggregate affect labor compensation will satisfy the requirements. Given that the average level of labor compensation is determined by the HLC in manufacturing equation, having the monetary aggregate appear in this single equation will profoundly affect the results of the price-income side. In addition, the inclusion of the monetary aggregate here is consistent with at least one story that can be told about the way the economy works. In this story, an increase in the monetary aggregate stimulates aggregate demand which creates pressure in factor markets. One constraint firms would bump up against quite quickly is the availability of skilled workers, which would translate into higher wages and consequently, higher prices. The HLC equation for manufacturing embodies these relationships.

Table 3.7

Components and Influences of Capital Income

Component	Number of Sectors	Influences
Depreciation Corporate & Noncorporate	50	Equipment stocks Structures stocks Equipment tax lives Structures tax lives
Net interest payments	50	Exogenous
Business transfer payments aggregate	1	Gross domestic product Unemployment rate PCE deflator
sectoral	50	Industry output shares Unemployment rate
Corporate profits aggregate	1	Output growth Export growth Import growth Corporate income tax rate Commercial paper rate
sectoral	50	Industry output shares Industry export shares Industry import shares Inflation Unemployment Corporate income tax rate
Proprietors' income	50	Exogenous
Inventory valuation adjust. sectoral	1	Inflation Unemployment rate
sectoral	50	Growth rate of aggregate

Turning to examine the equation specifically, the monetary aggregate, M2, enters the equation in an unusual manner. The percentage change in manufacturing HLC is a function of the percentage change in the M2 to real GNP ratio according to equation (13):

$$(13)\quad y_t = z_t + x_{t-1} - .73(x_{t-1}-x_{t-2}) - .67(x_{t-2}-x_{t-3}) - .49(x_{t-3}-x_{t-4}) - .32(x_{t-4}-x_{t-5})$$

where

y = percentage change in HLC for manufacturing
z = total nonmonetary variables and coefficients determining y
x = percentage change in the M2 to real GNP ratio

The effect of this type of equation is to distribute the effect of changing the rate of growth in the M2 to real GNP ratio over a five year period. Consider the case of a constant rate of growth in the M2 to real GNP ratio which has been in effect indefinitely. The equation then translates the rate of growth in this monetary ratio into the rate of growth of wages directly, since all of the first difference terms cancel out when all of the x_ts are equal. Now suppose that the monetary ratio increases by 1 percntage point over the previously assumed constant rate. The equation translates none of the 1% increase to HLC in the same year, 27% of the 1% increase during the first year after the change, 33% of the 1% increase to HLC during the second year after the change, 51% during the third year after the change, and 68% during the

FIGURE 3.1

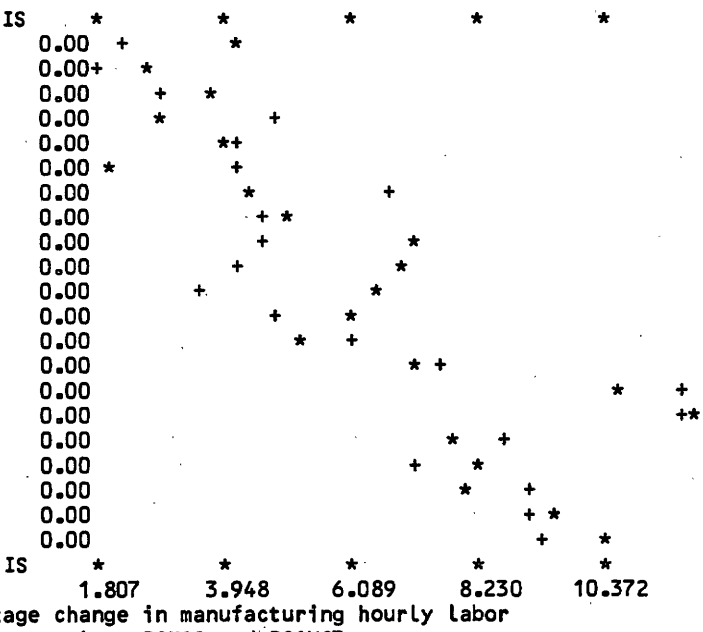
* ANNUAL MONEY WAGE EQUATION BASED ON THE RATIO OF M2 TO REAL GNP

0 6 SEE = 1.5816 RSQR = 0.6861 RBARSQ = 0.5515
RHO = 0.5175 DW = 0.965 AAPE = 197.54

VARIABLE	REGRES-COEF	T-VALUE	ELASTICITY	MEXPLAVAL	MEAN
FDPCMG(T-1)	-0.730625	-3.83	-0.095	43.14	0.0655
FDPCMG(T-2)	-0.670244	-3.27	-0.381	32.88	0.2861
FDPCMG(T-3)	-0.490979	-2.31	-0.326	17.47	0.3351
FDPCMG(T-4)	-0.320728	-1.79	-0.200	10.90	0.3136
PCSOCR	0.096238	1.54	0.868	8.10	4.5455
PCPIM	0.109080	1.74	0.393	10.23	1.8161
PCPIM(T-1)	0.107414	1.63	0.209	9.04	0.9810
PCAVG3	1.000000				
PCMOG(T-1)	1.000000				
TMANW	DEPENDENT VARIABLE - - - - - -				0.50392

ANNUAL MONEY WAGE EQUATION BASED ON THE RATIO OF M2 TO REAL GNP

DATE	ACTUAL IS *	PREDIC IS +	IS
60	4.19	2.26	0.00
61	2.86	1.81	0.00
62	3.84	3.03	0.00
63	2.93	4.95	0.00
64	4.09	4.18	0.00
65	2.08	4.33	0.00
66	4.49	6.82	0.00
67	5.02	4.71	0.00
68	7.17	4.78	0.00
69	6.99	4.29	0.00
70	6.72	3.68	0.00
71	6.12	4.86	0.00
72	5.44	6.12	0.00
73	7.22	7.72	0.00
74	10.68	11.69	0.00
75	11.87	11.68	0.00
76	7.95	8.72	0.00
77	8.37	7.37	0.00
78	8.17	9.22	0.00
79	9.66	9.22	0.00
80	10.58	9.40	0.00
	IS *	IS +	IS



TMANW = percentage change in manufacturing hourly labor compensation less PCMOG and PCAVG3

PCMOG = percentage change in M2 to real GNP ratio

PCAVG3 = three period moving average of percentage change in labor productivity, (GNP/ total jobs)

PCSOCR = percentage change in legislated Social Security tax rate

PCPIM = percentage change in merchandise import deflator less PCMOG(t-1)

FDPCMG = first difference in PCMOG

The equation was actually estimated using TMANW, which constrained the coefficients of PCAVG3 and PCMOG to unity. For plotting purposes, PCAVG3 and PCMOG(t-1) were added back to TMANW.

fourth year after the change. Full pass through of the assumed 1% increase occurs five years after the original increase. Thus there is full pass through of the excess growth in M2 over real GNP to labor compensation and prices after five years.

The percentage change in the M2 to real GNP ratio appears implicitly in another term in this equation. In this term, the rate of growth in the monetary ratio is subtracted from the average rate of growth of merchandise import prices and the resulting variable used as an independent variable in the regression. The logic behind the use of this variable is that wages probably respond to larger than usual increases in the price of imported goods, since as consumers, the wage-earners must buy goods at these prices. The definition of the usual rate of price growth for this purpose is the rate of growth of the M2 to real GNP ratio.

Aside from the effects of the monetary aggregate in the aggregate HLC equation for manufacturing, monetary variables play a limited role on the price-income side. The 4 to 6 month commercial paper rate appears in the equation which explains the behavior of the sum of corporate profits, corporate capital consumption adjustment and corporate inventory valuation adjustment. The variable plays only a minor role here, suggesting that when interest rates rise, this total falls. The elasticity of this response is quite small, at -.016.

The Accountant

The job of the Accountant is a a deceptively difficult one: to calculate various nominal aggregates usually displayed in the National Income and Product Accounts. In doing these calculations the Acountant performs its most important role for the model by taking the forecasts of the income side computing some needed macroeconomic variables such as capital consumption adjustments, and deriving personal income, taxes and disposable income. By using an econometrically estimated personal savings equation and an overall deflator calculated from the results of the real and price-income sides, the total amount of consumption expenditures in 1977 dollars can be obtained and this value fed back into the real side. The Accountant therefore closes the model in the sense that the initial assumptions about the constant-dollar disposable income and the spending rate are replaced by model-generated values.

The Accountant consists of four major parts, each corrresponding to a type of table of aggregate data in NIPA. Part 1 calculates aggregates for national income by type of income, which requires creating supplements to labor compensation such as employer contributions to social insurance, and capital consumption adjustments for several of the income types. None of these additional equations uses any monetary variables or interest rates as explanatory variables.

Part 2 relates current dollar GNP, NNP, national income and personal income, which requires equations for governmental transfer payments, personal interest income and consumer interest payments to

business. These last two pieces are functions of interest rates. Interest received by the Federal government is positively related to the AAA bond rate multiplied by the amount of Federal direct loans outstanding. Interest received by states and localities is a function of the average rate received multiplied by the interest bearing assets of states and localities. In the forecast, the average interest rate received is a simple linear function of the current and one period lagged AAA bond rate. For interest paid by the Federal government, the amount is positively related to the amount of privately held Federal government debt plus the amount of the current deficit that is held privately multiplied by the AAA bond rate. Interest paid by state and local governments is the amount of state and local debt multiplied by the average interest rate paid on that debt. In forecasting, the average rate paid is a function of the current AAA bond rate as well as one- and two-year lags on this variable.

Personal interest payments to business is a positive linear function of consumer expenditures on durables multiplied by a two-year moving average of the 4 to 6 month commercial paper rate, the level of disposable per-capita income and the change in that income. The elasticity of the consumer interest payments to business with respect to the two period moving average of the commercial paper rate is .177. This value is quite low, which suggests that when interest rates rise, alternative means of payment are used which do not require interest payments to businesses.

Parts 3 and 4 of the Accountant create the current dollar Federal government and the State and local government expenditure and receipts tables, which show the governmental surpluses or deficits. Only two additional quantities are calculated in these parts which use interest rates. These are interest receipts from social insurance trust funds for the Federal government and states and localities. In both of these cases the interest received is a function of the average rate received per unit of fund, multiplied by the size of the fund and in both cases the average rate is forecasted using an equation that consists of the AAA bond rate and the one period lagged average rate of return on social insurance funds.

Government receipts are mostly tax payments. Federal government receipts from the personal income tax are calculated using an elaborate scheme which incorporates actual tax rate schedules used by individuals from form 1040. The scheme make use of the size distribution of housholds and the differing tax treatment of the different household sizes. Other tax receipts, including those from other levels of government, are computed relative to the federal personal tax payments.[15]

Having calculated all of the desired macroeconomic aggregates, including personal income, and personal income taxes, we can turn to the final job of the Accountant which is the calculation of constant dollar disposable income and the division of constant dollar disposable income between savings and consumption. This step is extremely important in the model because this step closes the model with respect to income,

carrying the implication that the model produces a forecast of sectoral prices, sectoral outputs and sectoral income that are mutually consistent.

The key relationship which allows constant dollar disposable income to be separated into consumption and saving is the equation for per-capita constant dollar savings. This equation is reported in Figure 3.2 and relates per-capita constant dollar saving to a two-year moving average of the 4 to 6 month commercial paper rate multiplied by disposable per-capita income, the price of new cars relative to all other consumer prices, (again multiplied by the level of per-capita disposable income), disposable per-capita income and the first difference in per-capita disposable income. The results suggest that savings is only weakly positively related to interest rates, strongly negatively related to the relative price of new cars, and strongly positively related to income and its change. At first blush, it would appear that the sign on the relative new car price is incorrect, since saving and new car purchases are generally regarded as substitutes. If however, consumer expenditures on new cars are price inelastic (which they are by the estimations presented earlier, elasticity is -.3), when the price of autos rises, so does the share of autos in total income. The equation is suggesting that this increase in the share of new cars comes at the expense of savings. The income elasticity of savings for this equation is very close to 2.0, making saving behavior very income elastic.

FIGURE 3.2

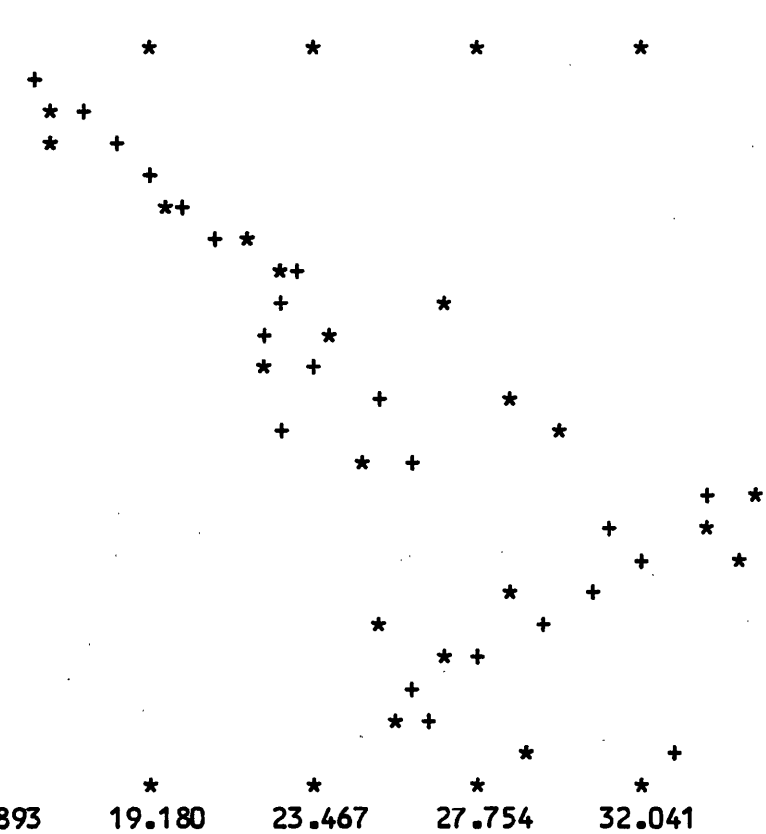
* PER CAPITA SAVINGS

0 . 4 SEE = 2.8323 RSQR = 0.7704 RBARSQ = 0.7164
RHO = 0.2997 DW = 1.401 AAPE = 8.98

VARIABLE	REGRES-COEF	T-VALUE	ELASTICITY	MEXPLAVAL	MEAN
INTERCEPT	94.424380	3.65	3.763	33.51	1.0000
INTRS	0.000809	0.67	0.079	1.32	2444.3794
RELPS	-0.327170	-3.79	-4.919	35.79	377.2672
DI72P	0.135227	4.37	1.964	45.76	364.4454
DDI72P	0.331404	2.30	0.113	14.52	8.5592
SAVP	DEPENDENT VARIABLE - - - - - -				25.09170

PER CAPITA SAVINGS

DATE	ACTUAL IS *	PREDIC IS +	MISS IS A-P *
60	14.89	16.58	-1.69*
61	16.97	17.69	-0.72
62	16.65	18.73	-2.08
63	15.25	19.35	-4.10*
64	19.98	20.14	-0.16
65	22.14	21.25	0.89
66	22.64	23.30	-0.66
67	26.95	22.89	4.05
68	24.29	22.26	2.03
69	22.28	23.70	-1.42
70	28.98	25.31	3.67
71	29.91	22.68	7.23
72	24.80	26.32	-1.52
73	35.04	34.18	0.87
74	33.98	31.19	2.78
75	34.64	32.37	2.27
76	28.70	30.92	-2.22
77	25.42	29.54	-4.13
78	26.92	27.81	-0.89
79	26.43	26.06	0.38
80	26.03	26.76	-0.73
81	29.12	32.99	-3.87
	IS *	IS +	IS A-P *



SAVP = real per-capita savings in 1972 dollars
DI72P = real per-capita disposable income in 1972 dollars
DDI72P = first difference in DI72P
RELPS = implicit deflator for new autos relative to overall consumption deflator multiplied by DI72P
INTRS = two period moving average of 4-6 month commercial rate multiplied by DI72P

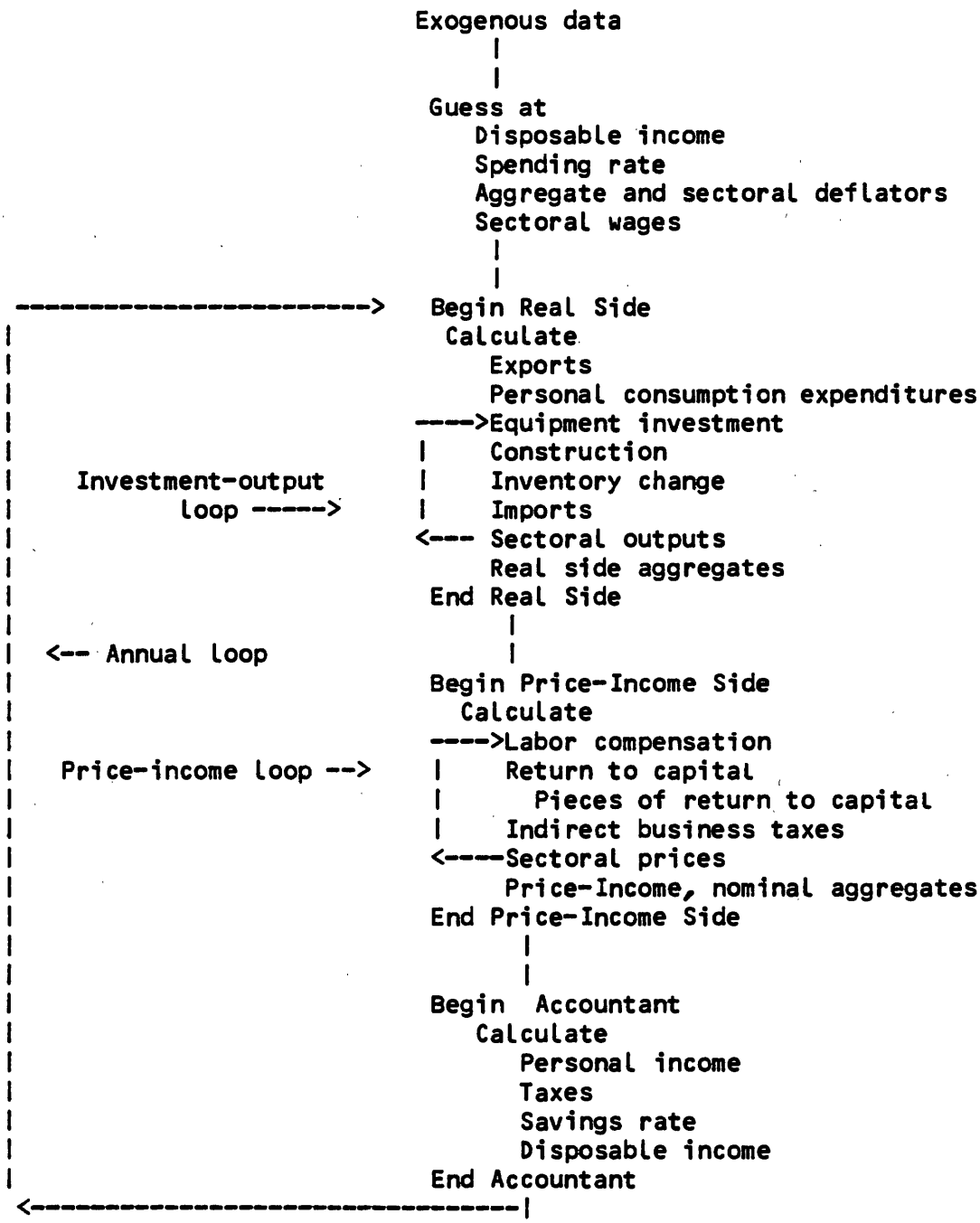
The Solution Process and Exogenous Data

Having outlined how the various parts of the model are determined separately, it is necessary to relate how the parts come together to form the whole model. The conceptual order of the solution process is outlined in Figure 3.3. Once the model has received the values for the exogenous data for the current forecasting period, the model iterates around the three components (real, price-income and Accountant) until a convergent solution is reached. The convergence criteria for this "annual" loop is that no product output in constant dollars should change by more than one percent from one iteration to the next. A maximum of six iterations is specified to prevent the model from spinning around an inordinate number of times in the same year.

Two other iterative loops are part of the solution process of the model. First, because some final demand components, (namely, investment, construction, inventories, and imports) depend on the current values of product output, while current output obviously depends on the forecasts of these components, the model must iterate through the "investment-output" loop. In this loop, the calculation of investment, construction, inventories , imports and outputs (via equation 1) is repeated until each product output in constant dollars changes by less than one percent form one iteration to the next. Although a maximum number of 6 iterations is set on this loop, experience has shown that unless something is very wrong with an equation or set of equations, only 4 or 5 iterations are necessary.

FIGURE 3.3

Schematic solution for LIFT model



The second loop built within the annual loop is a loop on the price-income side. Since some of the components of value-added depend on inflation or some aggregate deflator, and since product prices and aggregate price measures are derived from these value-added forecasts, it was decided to loop through the entire price-income side twice. Experimentation with more iterations on this loop indicated no appreciable change in the price or income forecasts after the second iteration.

The LIFT model, like most other models, requires a fair amount of exogenous data before it can begin to forecast. Generally, the exogenous data falls into one of five major types.

All demographic data in LIFT is exogenous. It uses population by eight age categories, the number of households, percentage of households with two or more wage-earners, percentage of households headed by persons aged 25-35, and the civilian labor force.

Second, indexes of foreign demand by product for the merchandise export commodities are exogenous to the model. These indexes are obtained from the domestic output vectors produced by several operating foreign country models and from trends for those trading partners without LIFT-type models. These separate output vectors are weighted by the share of total U. S. exports of good j accounted for by country i and turned into indexes which are entered exogenously and are not affected by the LIFT forecasts.

Third, domestic government expenditure on goods and services in constant dollars are exogenous. In LIFT, there are four categories of government expenditures. These are: Federal defense, Federal non-defense, State and local education, and State and local other. For each of these types, two expenditure variables are used, one for purchases of goods and services and one for compensation of employees. The expenditures on goods and services are divided into purchases of specific products via a matrix which shows the product composition of expenditures for the base year of the model, 1977. This matrix is then held constant over the forecast horizon, although the capability for altering it is built into the model. To determine real compensation of government employees, real compensation per-employee is held constant at the 1977 level. Total compensation thus reflects the movement in government employment by type of government.

Fourth, prices of crude oil, both domestic and foreign, are exogenous. It was felt that these prices could not be forecast in the usual manner because of the large degree of arbitrariness that enters into their determination. Specifying a domestic price exogenously does not destroy the relation embodied in equation (12) however. Since some part of income for an industry must be increased if its price is increased, when a domestic price is set exogenously, the product level total value-added figure corresponding to that product is determined and this figure passed back through the product-to-industry bridge to determine which industries' income is to be changed. Having decided which industries will have their income changed, it remains to decide which components of total income will be changed. It was decided that

corporate profits, proprietors' income and net interest payments should be changed. The change in income is spread through these components based on their relative sizes.

Fifth, assumptions about monetary policy must be made. In the original LIFT, M2 was the exogenous monetary variable. Using the results of chapter 2, M2 is now endogenous and the non-borrowed monetary base is exogenous. The ratio of required reserves to M1 is an additional exogenous variable introduced when the model developed in chapter 2 is inserted into the larger interindustry model.

Conclusion

This chapter has introduced the LIFT model, which will play host to the monetary sector sub-model developed in Chapter 2. Modifications made to the model were described as well as some of the operating characteristics. It should be noted that the software underlying the model is extremely flexible, allowing a user to treat the model as a macro-model or as a tool for very specific industry applications. Modifications may be made to almost every variable or series used in the model, including the intermediate flow matrix (A matrix) or any one of the bridge matrices. In the next chapter, a base scenario of the model is developed. This base the serves as the standard to which alternative runs developed in chapters 5 and 6 are compared.

ENDNOTES

1. The most recent complete published description of an INFORUM model is contained in Almon, et. al. {1}. Descriptions of the LIFT model are currently the subject of a writing effort, although some of these descriptions exist in the form of INFORUM research reports and memoranda.

2. The coefficients have the capability of changing and in fact do change over the forecast horizon in according to time trend logistic functions or exogenous assumptions. The coefficients do not respond automatically to, say, changing relative prices.

3. The coefficients in the B matrix are functions of time and a term which is essentially the change in investment for specific sectors.

4. The following section is a highly summarized account of the work done on consumption expenditures. For a more complete account of these equations, their derivation, and their properties, see Devine {5}.

5. Almon {2}.

6. Household durables includes the following sectors:
   Furniture, mattresses and bedding, Kitchen and other household appliances, Radios, TVs, records and musical instruments, China, glassware and tableware, Floor coverings, Durable housefurnishings, n.e.c., Semi-durable housefurnishings
   Transportation includes the following sectors:
   New cars and trucks, Net purchases of used cars, Tires and tubes, Auto accessories and parts, Auto repair, Auto insurance, Bridge tolls, etc., Taxicab services, Local public transportation, Gasoline and oil.
   The one sector <u>not</u> in either of these two major groups which became the subject of the interest-rate-effect search is in major group Recreation and travel, sector Boats, recreational vehicles and aircraft.

7. A "soft" constraint is one that is not required to hold exactly. Instead of minimizing only the sum of squared residuals, we minimize a linear combination of the sum of squared residuals and the deviation from our constraint.

8. It should be noted that the system estimates for sectors Owner occupied housing and Rental housing were replaced with estimates performed leaving out the effect of relative prices in equation (4). This replacement was necessary because sensible price elasticity results could not be obtained from <u>any</u> estimation.

9. This section is a brief description of work done by Barbera {3}.

10. These equations were estimated by Brian Shea.

11. See DeLeeuw {4}.

12. These equations were estimated by Douglas Nyhus.

13. These equations were estimated by Margaret Buckler.

14. The price-income side is the subject of a thesis in progress. See Hyle {6}.

15. This work was done by Stephen Pollock.

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5. Devine, Paul. "Forecasting Personal Consumption Expenditures From Cross-Section and Time-Series Data." Ph.D. dissertation, University of Maryland, 1985.

6. Hyle, Matthew. "A Price-Income Forecasting Model of the United States." Ph.D. dissertation, University of Maryland, expected 1984.

APPENDIX 1

Sectoral equations sensitive to interest rates

Interest sensitive Construction equations
(t statistics in parentheses)

Single unit residential structrures

$$
\begin{aligned}
CSTH1 = {} & .4128 \quad (2.07) \\
& -.0518*RCMOR \quad (3.68) \\
& -.0041*RATDIF \quad (.56) \\
& +.0507*RATDIF(t-1) \quad (5.64) \\
& +102.6*CPCP \quad (2.03) \\
& +.0070*HHEAD \quad (.47) \\
& -.0024*STKH(t-1) \quad (.73)
\end{aligned}
$$

RBARSQ = .8506 D. W. = 1.77 SEE = .0336

CST1H = per-household expenditures on single unit residential structures in constant 1977 dollars
RCMOR = mortgage rate on first mortgages, conventional financing
RATDIF = AAA bond rate less 4-6 month commercial paper rate
CPCP = 3 year moving average of real, per-capita consumer expenditures
HHEAD = percentage of household heads aged between 25 and 35
STKH = stock of single unit residential structures calculated with depreciation rate = .04 divided by number of households

Mobile Homes

CST3 = 7180.3 + 312.7*RCMOR -93.76*AGEOLD +
(.23) (.94) (.26)

27.39*DPCEX
(1.49)

RBARSQ = .2839 D. W. = 0.42 SEE = 1133.1

CST3 = expenditures on mobile homes, 1977 constant dollars
RCMOR = mortgage rate, first mortgages, conventional financing
AGEOLD = percentage of households headed by persons NOT aged 25 -35
DPCEX = change in real total consumer expenditures

Additions and Alterations to residential structures

CST4 = 9058.0 + .4970*RSTK + .1924*RMSTK +
(25.41) (3.09) (3.33)

.8555*DRMSTK
(1.85)

RBARSQ = .8517 D. W. = 0.92 SEE = 681.7

CST4 = residential additions and alterations expenditures in constant 1977 dollars
RSTK = AAA bond rate less 4-6 month commercial paper rate multiplied by the lagged stock of single unit residential structures
RMSTK = mortgage rate multiplied by the lagged stock of single unit residential structures
DRMSTK = first difference in RMSTK

Industrial structures

CST6 = 705.75 + .0070*OUTMAN + .0480*DOUTMAN +
(.29) (3.54) (2.90)

.0200*DOUTMAN(t-1) + .0018*RDSTK +
(1.94) (.69)

-.0148*RDSTK(t-1)
(3.34)

RBARSQ = .4255 D. W. = 1.48 SEE = 1852.

CST6 = expenditures on industrial structures in 1977 constant dollars
OUTMAN = total manufacturing output, sum of LIFT sectors 9-48, in constant 1977 dollars
DOUTMAN = first difference on OUTMAN
RDSTK = AAA bond rate less 4-6 commercial paper rate multiplied by the lagged stock of industrial buildings (constructed with depreciation rate = .04)

Office construction

CST7 = 3740.5 -.0026*RDSTK -.0009*RDSTK(t-1) +
(3.49) (2.27) (.73)

.0169*LOUT
(3.25)

RBARSQ = .3838 D. W. = 0.85 SEE = 1106.

CST7 = office construction in 1977 constant dollars
RDSTK = AAA bond rate less 4-6 month commercial paper rate multiplied by the lagged stock of office buildings (constructed with depreciation rate = .03)
LOUT = weighted average of sum of outputs of LIFT sectors 62 and 63 with weights equal to .5, .3, .2 for three periods

Stores, Restaurants and Garages

CST8 = -5109.9 + .1552*TRES + .0129*STOUT
(3.78) (4.45) (6.72)

+ .0231*DSTOUT -1.336*RDSTK -5.620*RDSTK(t-1)
(.66) (1.22) (2.84)

RBASRSQ = .8959 D. W. = 1.30 SEE = 909.5

CST8 = 1977 constant dollar expenditures on stores, restaurants and garages
TRES = sum of single unit residential structures and multi-unit residential structures in 1977 dollars
STOUT = Sum of LIFT output for sectors 59, 60, 61, 66, and 68
DSTOUT = first difference in STOUT

Oil and Gas Well Drilling

CST14 = 5620.0 -366.01*RAT + 7930.*PDM17L +
(27.1) (6.43) (29.2)

.0092*STK14(t-1)
(1.21)

RBARSQ = .9911 D. W. = 1.99 SEE = 247.5

CST14 = expenditures on oil and gas well drilling in constant 1977 dollars
RAT = 2 period moving average of AAA bond rate
PDM17L = 3 period moving average of deflator for LIFT sector 17 (petroleum refining)
STK14 = stock of oil and gas well drilling structures, calculated with depreciation rate = .17

Railroad construction

CST15 = -393.29 + .0768*OUT49 + .0133*OUT49(t-1)
(1.45) (3.49) (.55)

-4.150*PCOALR -.0157*CST20(t-1) -39.21*RAT
(3.01) (2.89) (2.11)

RBARSQ = .7151 D. W. = 1.58 SEE = 88.61

CST15 = expenditures on railroad structures in constant 1977 dollars
OUT49 = output of LIFT sector 49
PCOALR = relative price of coal mining ro refined oil products (LIFT sectors 4 and 17) 2 period moving average
CST20 = expenditures on highway and street construction in constant 1977 dollars
RAT = 2 period moving average of AAA bond rate

Brokers' Commission on sale of structures and Used structures

CST31 = -6059.1 -142.42*RATDIF + .1984*CST1 +
(4.43) (.60) (4.93)

.0034*STK1(t-1)
(4.77)

RBARSQ = .7775 D. W. = 0.45 SEE = 1203.

CST31 = brokers' commission on sales of structures and net purchases of used structures in constant 1977 dollars
RATDIF = AAA bond rate less 4-6 month commercial paper rate
CST1 = expenditures on single unit residential structures in constant 1977 dollars
STK1 = stock of single unit residential structures, calculated with depreciation rate = .04

Inventory change equations with interest rate effects

Estimation period 1960-77

Sector	Intercept	Output	Change in output	Lagged stock	Real rate	Rsq
1	-6302.8 (.96)	.1113 (1.14)	-.1240 (.64)	-.0019 (.05)	-.0052 (1.40)	.163
6	-152.18 (1.03)	.0116 (2.53)	-.0264 (.11)	-.0350 (1.52)	-.0004 (.00)	.630
9	12029. (3.41)	.3366 (3.91)	-.0832 (1.09)	-1.183 (3.86)	-.0011 (1.17)	.592
12	-202.69 (.27)	.3404 (3.24)	-.1497 (1.08)	-.6911 (3.34)	-.00006 (.00)	.527
19	-164.50 (.61)	.1748 (1.50)	.0142 (.16)	-.648? (1.50)	-.0022 (.87)	.473
21	-525.60 (1.03)	.1079 (1.36)	-.195? (1.94)		-.0042 (1.47)	.220
23	-848.67 (2.16)	.2964 (2.94)	-.0505 (.56)	-.5168 (3.23)	-.0034 (1.22)	.786
24	-883.22 (.78)	.1691 (1.44)	.0050 (.44)	-.4354 (1.63)	-.0009 (.99)	.567
25	-1761.1 (.75)	.0989 (1.44)	-.0159 (.44)	-.1341 (1.64)	-.0026 (.99)	.252
27	370.79 (.67)	.1221 (1.10)	-.0701 (.97)	-.2773 (1.67)	-.0008 (.21)	.239
28	99.480 (.11)	.0102 (.23)	.1276 (3.23)	-.0139 (.13)	-.0001 (.09)	.746
31	-150.28 (.98)	.0349 (1.62)	.1250 (3.30)		-.0006 (.28)	.659
42	195.02 (3.90)	.1840 (3.55)	-.0917 (1.79)	-.5501 (4.35)	-.0004 (.16)	.722

Sector	Intercept	Output	Change in output	Lagged stock	Real rate	Rsq
44	-5470.7	.2259	.0992	-.0993	-.0024	.678
	(2.77)	(3.18)	(1.04)	(.95)	(.42)	
47	1242.1	.2641	-.1056	-.7880	-.0014	.557
	(2.11)	(2.08)	(.74)	(2.24)	(.38)	
48	-1764.3	.3271	-.2922	-.2359	-.0136	.163
	(1.22)	(1.26)	(1.35)	(.71)	(1.23)	
53	-4.709	.0039	-.0043		-.0001	.358
	(2.02)	(2.05)	(.48)		(.00)	

t statistics in parentheses
Real rate = 4-6 month commercial paper rate less sector specific price growth in percentage terms
Lagged stock = one period lagged stock of inventories of product
Rsq = coefficient of determination

APPENDIX 2

Titles for 78 product sectors

1 AGRICULTURE,FORESTRY,FISHERY
2 IRON ORE MINING
3 NONFERROUS METALS MINING
4 COAL MINING
5 NATURAL GAS EXTRACTION
6 CRUDE PETROLEUM
7 NON-METALLIC MINING
8 CONSTRUCTION
9 FOOD & TOBACCO
10 TEXTILES, EXC. KNITS
11 KNITTING
12 APPAREL, HOUSEHOLD TEXTILES
13 PAPER
14 PRINTING & PUBLISHING
15 AGRICULTURAL FERTILIZERS
16 OTHER CHEMICALS
17 PETROLEUM REFINING
18 FUEL OIL
19 RUBBER PRODUCTS
20 PLASTIC PRODUCTS
21 SHOES AND LEATHER
22 LUMBER
23 FURNITURE
24 STONE, CLAY, GLASS
25 FERROUS METALS
26 COPPER
27 OTHER NONFERROUS METALS
28 METAL PRODUCTS
29 ENGINES AND TURBINES
30 AGRICULTURAL MACHINERY
31 CONSTR,MINING,OILFIELD EQ
32 METALWORKING MACHINERY
33 SPECIAL INDUSTRY MACHINERY
34 MISC NON-ELECTRICAL MACH.
35 COMPUTERS
36 OTHER OFFICE EQUIPMENT
37 SERVICE INDUSTRY MACHINERY
38 COMMUNIC EQ, ELECTRONIC COMP
39 ELEC INDL APP & DISTRIB EQ
40 HOUSEHOLD APPLIANCES
41 MISC ELECTRICAL EQ
42 TV SETS,RADIOS,PHONOGRAPHS
43 MOTOR VEHICLES
44 AEROSPACE
45 SHIPS, BOATS
46 OTHER TRANSP. EQUIP.
47 INSTRUMENTS

48 MISC. MANUFACTURING
49 RAILROADS
50 TRUCKING, HWY PASS TRANSIT
51 WATER TRANSPORT
52 AIR TRANSPORT
53 PIPELINE
54 TRANSPORTAION SERVICES
55 COMMUNICATIONS SERVICES
56 ELECTRIC UTILILITIES
57 GAS UTILITY
58 WATER AND SANITATION
59 WHOLESALE TRADE
60 RETAIL TRADE
61 EATING & DRINKING PLACES
62 FINANCE & INSURANCE
63 REAL ESTATE
64 OWNER-OCCUPIED HOUSING
65 HOTELS; REPAIRS EXC AUTO
66 BUSINESS SERVICES
67 AUTOMOBILE REPAIRS
68 MOVIES AND AMUSEMENTS
69 MEDICINE,EDUCATION,NPO
70 FED & S&L GOVT ENTERPRISES
71 NON COMPETITIVE IMPORTS
72 DOMESTIC SERVANTS
73 UNIMPORTANT INDUSTRY
74 SCRAPS AND USED
75 REST OF THE WORLD INDUSTRY
76 GOVERNMENT INDUSTRY
77 INFORUM STAT. DISCREPANCY
78 NIPA STAT. DISCREPANCY

Titles for 57 order investment and employment sectors

1 AGRICULTURE(1)
2 CRUDE OIL & GAS (5-6)
3 MINING (2-4,7)
4 CONSTRUCTION (8)
5 FOOD, TOBACCO (9)
6 TEXTILES (10)
7 KNITTING (11)
8 APPAREL & HHLD TEXTILES (12)
9 PAPER (13)
10 PRINTING (14)
11 AGRICULTURAL FERTILIZER (15)
12 OTHER CHEMICALS (16)
13 PETROLEUM REFINING (17)
14 RUBBER & PLASTIC PROD (19-20)
15 FOOTWEAR & LEATHER (21)
16 LUMBER (22)
17 FUNITURE (23)
18 STONE,CLAY & GLASS (24)
19 IRON & STEEL (25)
20 NON-FERROUS METALS (26-27)
21 METAL PRODUCTS (28)
22 ENGINES & TURBINES (29)
23 AGRICULTURAL MACHINERY (30)
24 BLANK
25 METALWORKING MACHINERY (32)
26 BLANK
27 SPECIAL IND MACH (33)
28 MISC NONELEC MACH (31,34)
29 COMPUTERS,OFFICE EQ (35-36)
30 SERVICE INDUSTRY MACH (37)
31 COMMUNIC EQ, ELECTRON COMP (38)
32 ELEC APP & DISTRIB EQ (39)
33 HOUSEHOLD APPLIANCES (40)
34 ELEC LIGHT & WIRING EQ (41)
35 TV SETS,RADIOS,PHONOGRAPH (42)
36 MOTOR VEHICLES (43)
37 AEROSPACE (44)
38 SHIPS & BOATS (45)
39 OTHER TRANSP EQ (46)
40 INSTRUMENTS (47)
41 MISC MANUFACTURING (48)
42 RAILROADS (49)
43 AIR TRANSPORT (52)
44 TRUCKING,OTH TRANSPORT (50-51,53-54)
45 COMMUNICATIONS SERVICES (55)
46 ELECTRIC UTILITIES (56)
47 GAS,WATER & SANITATION (57,58)
48 WHOLESALE & RETAIL TRADE (59,60)
49 FINANCE & INSURANCE (62)
50 REAL ESTATE (63)

51 HOTELS; REPAIRS EXC.AUTO (65)
52 BUSINESS SERVICES (66)
53 AUTO REPAIR (67)
54 MOVIES & AMUSEMENTS (68)
55 MEDICINE, EDUC, NPO (69)
56 PERSONAL AUTOS
57 SALES OF USED EQUIP

Titles for 50 order income sectors

1 AGRICULTURE,FORESTRY,FISHERY
2 CRUDE OIL & NATURAL GAS
3 MINING
4 CONTRACT CONSTRUCTION
5 FOOD & TOBACCO
6 TEXTILE MILL PRODUCTS
7 APPAREL & RELATED PRODUCTS
8 PAPER & ALLIED PRODUCTS
9 PRINTING & PUBLISHING
10 CHEMICAL & ALLIED PRODUCTS
11 PETROLEUM & RELATED INDUSTRIES
12 RUBBER & MISC PLASTIC PRODUCTS
13 LEATHER & LEATHER PRODUCTS
14 LUMBER & WOOD PRODUCTS,EX FURN
15 FURNITURE & FIXTURES
16 STONE, CLAY, & GLASS PRODUCTS
17 PRIMARY METAL INDUSTRIES
18 METAL PRODUCTS
19 TRANS EQ + ORD EX MOTOR VEH
20 MACHINERY, EXCEPT ELECTRICAL
21 ELECTRICAL MACHINERY
22 MOTOR VEHICLES & EQUIPMENT
23 INSTRUMENTS & RELATED PROD.
24 MISC. MANUFACTURING IND.
25 RAILROADS
26 AIR TRANSPORTATION
27 TRUCKING & OTHER TRANSPORT
28 COMMUNICATIONS
29 EMPTY
30 ELECTRIC, GAS, & SANITARY
31 WHOLESALE & RETAIL TRADE
32 FINANCIAL & INSURANCE SERVICES
33 REAL ESTATE & COMBINATIONS OFF
34 HOTELS & REPAIR(NOT AUTO)
35 MISC. BUSINESS SERVICES
36 AUTO REPAIR
37 MOTION PICTURES & AMUSEMENTS
38 MEDICAL & EDUCATIONAL SERVICES
39 PRIVATE HOUSEHOLDS
40 FED. GOV'T ENTERPRISES
41 STATE & LOCAL GOV'T ENTERPRISES
42 INFORUM STAT. DISC.
43 NIPA STAT. DISC.
44 FED GOV'T GENERAL ADMINIST.
45 STATE & LOCAL GENERAL ADMINIST.
46 REST OF THE WORLD
47 FEDERAL NONDEFENSE
48 FEDERAL DEFENSE
49 STATE & LOCAL EDUCATION
50 STATE & LOCAL OTHER

Titles for 78 order personal consumption expenditures

1 NEW CARS
2 USED CARS
3 NEW & USED TRUCKS
4 TIRES & TUBES
5 AUTO ACCESSORIES & PARTS
6 FURNITURE,MATTRESSES,BEDSPRINGS
7 KITCHEN, HOUSEHOLD APPLIANCES
8 CHINA,GLASSWARE,TABLEWARE,UTENSILS
9 RADIO.TV,RECORDS,MUSICAL INSTRUMENT
10 FLOOR COVERINGS
11 DURABLE HOUSEFURNISHINGS NEC
12 WRITING EQUIPMENT
13 HAND TOOLS
14 JEWELERY
15 OPHTHALMIC & ORTHOPEDIC APPLIANCES
16 BOOKS & MAPS
17 WHEEL GOODS & DURABLE TOYS
18 BOATS, REC VECH., & AIRCRAFT
19 FOOD, OFF PREMISE
20 FOOD ON PREMISE
21 ALCOHOL, OFF PREMISE
22 ALCOHOL, ON PREMISE
23 SHOES & FOOTWARE
24 WOMEN'S CLOTHING
25 MEN'S CLOTHING
26 LUGGAGE
27 GASOLINE & OIL
28 FUEL OIL & COAL
29 TOBACCO
30 SEMIDURABLE HOUSEFURNISHINGS
31 DRUG PREPARATIONS & SUNDRIES
32 TOILET ARTICLES & PREPARATIONS
33 STATIONERY & WRITING SUPPLIES
34 NONDURABLE TOYS & SPORT SUPPLIES
35 FLOWERS, SEEDS, POTTED PLANTS
36 LIGHTING SUPPLIES
37 CLEANING PREPARATIONS
38 HOUSEHOLD PAPER PRODUCTS
39 MAGAZINES & NEWSPAPER
40 OTHER NONDURABLES -- IDENTITY
41 OWNER OCCUPIED SPACE RENT
42 TENANT OCCUPIED SPACE RENT
43 HOTELS. MOTELS
44 OTHER HOUSING
45 ELECTRICITY
46 NATURAL GAS
47 WATER & OTH SANITARY SERVICES
48 TELEPHONE & TELEGRAPH
49 DOMESTIC SERVICES
50 HOUSEHOLD INSURANCE

51 OTH HHLD OPERATIONS:REPAIR
52 POSTAGE
53 AUTO REPAIR
54 BRIDGE, TOLLS, ETC
55 AUTO INSURANCE
56 TAXICABS
57 LOCAL PUBLIC TRANSPORT
58 INTERCITY RAILROAD
59 INTERCITY BUSES
60 AIRLINES
61 TRAVEL AGENTS,OTH TRANS SERVICES
62 LAUNDRIES & SHOE REPAIR
63 BARBERSHOPS & BEAUTY SHOPS
64 PHYSICIANS
65 DENTISTS & OTHER PROF SERVICES
66 PRIVATE HOSPITALS & SANITARIUMS
67 HEALTH INSURANCE
68 BROKERAGE & INVESTMENT COUNSELING
69 BANK SERVICE CHRG & SERV W/O PAYMENT
70 LIFE INSURANCE
71 LEGAL SERVICES
72 FUNERAL EXPENSES,OTH PERS BUSINESS
73 RADIO & TV REPAIR
74 MOVIES, THEATRE,SPEC SPORTS
75 OTHER RECREATIONAL SERVICES
76 EDUCATION
77 RELIGIOUS & WELFARE SERVICES
78 FOREIGN TRAVEL

Titles for 31 order construction sectors

1 1 UNIT RES. STRUCTURES
2 2 OR MORE UNIT STRUCTURES
3 MOBILE HOMES
4 ADDITIONS & ALTERATIONS
5 HOTELS,MOTELS,DORMITORIES
6 INDUSTRIAL
7 OFFICES
8 STORES,RESTAURANTS,GARAGES
9 RELIGIOUS EXOGENOUS
10 EDUCATIONAL
11 HOSPITAL & INSTITUTIONAL
12 MISCELLANEOUS NR BLDG
13 FARM BLDG
14 MINING EXPLORATION SHAFTS & WELLS
15 RAILROADS
16 TELEPHONE & TELEGRAPH
17 ELECTRIC LIGHT & POWER
18 GAS & PETROLEUM PIPES
19 OTHER STRUCTURES
20 HIGHWAYS & STREETS EXOGENOUS
21 MILITARY FACILITIES EXOGENOUS
22 CONSERVATION EXOGENOUS
23 SEWER SYSTEMS EXOGENOUS
24 WATER SUPPLY FACILITIES EXOGENOUS
25 RESIDENTIAL (PUBLIC) EXOGENOUS
26 INDUSTRIAL (PUBLIC) EXOGENOUS
27 EDUCATIONAL (PUBLIC) EXOGENOUS
28 HOSPITAL (PUBLIC) EXOGENOUS
29 OTHER BUILDINGS (PUBLIC) EXOGENOUS
30 MISC. PUBLIC STRUCTURES EXOGENOUS
31 BROKER'S COMMISSION ON SALES AND NET SALES OF USED STRUCTURES

Chapter 4 The Base Case

Given the newness of the model, constructing a base scenario from the models described in chapters 2 and 3 turned out not to be a simple exercise in running the combined models. Even after the process of checking the computer programming and verifying that the various equations are indeed performing as they are supposed to, the model output must meet the test of economic "reasonableness". Equations whose properties and parameters appear reasonable when viewed separately often generate joint results which are patently unreasonable. These unreasonable results can usually be traced to an interaction of parameters that was not expected and imply restrictions on those parameters. Re-estimating equations and re-structuring the model leads to a new version of the model, which may conform to one facet of economic reasonableness, but which now may violate some other piece of economic commonsense. The process of constructing a reasonable base scenario can best be viewed as an integral part of the building of the final form of the model, because this process reveals important inter-relationships that are otherwise concealed.

In this chapter, several steps in the process are presented. First, partial results of runs are shown from the model as it was originally put together and presented. Then the modifications to the model made on the basis of these results are outlined. This process of running and revising is seldom documented. Usually only the end product is presented as if it were the initial conception. It is hoped that opening this window on the evolution of the model will not only help to

understand better the end result, but also may assist others in learning to think about the way a model works. Finally, a base scenario is presented and discussed. It should be noted from the outset that from the point of view of the model, 1982 is a strict forecast year. With one exception, no attempt was made to make the forecast for 1982 appear like the actual 1982 figures. The exception is discussed below.

Exogenous Data

In this section, assumptions made about the paths of exogenous data are presented. From chapter 3 it will be recalled that there are five major types of exogenous data required by the model. These are domestic government expenditures on goods and services and tax rates, demographic variables, foreign demand indexes by product for merchandise exports, crude oil prices, and monetary policy variables. Table 4.1 presents the assumed path of most of those variables. As is the case with all of the model-generated tables, Table 4.1 appears at the end of the chapter.

Assumptions about government expenditures are made by four types of government and three expenditure categories for each type. The compensation of employees for each type of government is assumed to be constant on a real-per-employee basis. Thus the path of total compensation reflects the assumption about the path of government employment for each government type. The assumption about expenditures on new public structures is that each government structure type (there are 10 types of government structures) will grow at 1.5% per year. Note that growth rates shown for structures in Table 4.1 differ from this

1.5% figure by the movement of maintenance expenditures on government structures.

For real purchases of goods and services by the Federal government, non-defense expenditures decline and defense expenditures increase until 1984. After 1984, more moderate defense expenditures growth is assumed and positive growth for the non-defense expenditures is renewed. For expenditures by states and localities an initial increase in the growth rate for non-education expenditures is assumed to make up for the decline in federal non-defense spending. More moderate growth rates are assumed after 1984. For state and local spending on education a very modest growth rate is assumed over the 1982-85 period with a very gradual increase in the growth rate of education expenditures assumed through the forecast horizon.

Assumptions about the federal personal income tax made in the forecast are as follows. All legislated tax changes as of June 1983 are assumed. Among these changes are indexation of marginal tax rates and exemption levels, which comes in effect in 1986. The marginal corporate tax rate is assumed to be constant, at 46%, through the forecast horizon.

All demographic data are taken from Bureau of the Census or Bureau of Labor Statistics projections. The demographic variable that has the most effect in the model is the civilian labor force. It is important because the labor force is used to calculate the unemployment rate, which then enters many of the behavioral relations of the price-income

and real sides. The general assumption is a gradual decline in the rate of growth of the labor force, starting from a growth rate of nearly 1.81% over 1982-83 to 1.11% over 1994-95.

The assumption about crude oil prices is that the rate of growth of both foreign and domestic crude oil prices is approximately equal to the rate of growth in the GNP deflator. The rate of price growth is set equal to the rate of growth in the GNP deflator from the forecast presented to the INFORUM subscribers in June of 1983. The assumption begins in 1983, so that the model uses actual 1982 oil prices when forecasting 1982 in this exercise. This is the exception to the statement made above that for the purposes of this exercise 1982 is a strict forecast year.

From chapter 2 it will be recalled that there are two exogenous monetary policy variables. These are the non-borrowed reserve base and the level of required reserves divided by M1 . It is necessary to note that although the Fed controls the non-borrowed base, it does so with targetted growth rates of broader aggregates in mind. The current announced range for M2 growth is 6% to 9% per year. Thus non-borrowed reserve base growth was set to 8% per year. With no change in the money multiplier, this growth rate puts M2 growth within the range announced by the Fed.

The ratio of required reserves to M1 is assumed to decline from 12.3% in 1982 to 10% in 1995. The 12.3% figure is the average for the variable over the estimation period. The assumed decline is due to the

assumed continuation of substitution of deposits included only in M2 for those accounts included in M1 and M2. This will tend to reduce required reserves simply because required reserve rates on transactions deposits are higher than required reserve rates on non-transactions deposits. Currently the rates are 12% on transactions deposits and 3% for non-personal time and savings deposits.

Finally, a path for the dummy variable included in the 10 year bond rate and 90 day Treasury bill rate equations must be specified. Since the argument for the inclusion of the variable centered mostly on turbulent expectations, specifying a path for this variable amounts to specifying a path for these turbulent expectations. One posibility is that the turbulence gradually disappears, so that the dummy becomes 0 after some point. Thus, the assumed path for the dummy is .5 in 1982, .25 in 1983 and 0 thereafter.

Base Case: First Attempt

Putting together the equations discussed in chapter 2 and 3 with the above assumptions resulted in a first attempt to create a base scenario from which alternatives could be run. An attempt was made to keep the number of "fixes" to a minimum. A "fix" or "add-factor" or "fudge-factor" is an exogenous over-riding of some piece of endogenous data. Fixes are usually applied for one of two reasons: either some part of the model machinery is not working in an economically sensible manner or the economy has undergone some structural change which makes some estimated piece of the model obsolete. By keeping the number of

fixes to a minimum, the coherence of the model, i.e. the way the model comes together, can be examined.

The first attempt at a base run was not very successful, forecastng only the years 1982 and 1983 before breaking down. When the model breaks down, the forecasted values for one or more variables are so nonsensical that the model stops running. The results for selected macroeconomic variables are reported in Table 4.2. The table provides both levels and growth rates when they are appropriate. Some information is also given about actual 1982 figures. No results are reported for 1984 as the unemployment rate was driven below 0 in this year, which was the point at which the model stopped. When looking at Table 4.2, it is well to remember that most of the totals shown represent sum of results from forecasts at a level of detail far more disaggregated than indicated in the table.

The forecast, while clearly missing the continued downturn between 1981 and 1982, presents a patently unreasonable forecast for 1983. While we should probably wish for such an economy, the real GNP growth rate of 10.71% between 1982 and 1983 and an unemployment rate which plummets nearly 7 percentage points to 1.5% in 1983 is unreasonable. The rate of inflation is under-predicted by nearly 3 percentage points for the 1981-82 period and is only 5.38% with the nearly 20% M2 growth and very strong recovery. While all of the product side GNP accounts show this strong growth, spectacular increases are shown in Residential structures, Non-residential structures and Equipment investment. The sole declining component of the product side of GNP is Exports, which

Table 4.2

Selected results from first attempt at base run

	1982	1983	81-82	82-83	Actual 1982	
GNP, bill. of 77 $	2131.	2372.	2.29	10.71	-1.90	
PCE	1362.	1515.	3.65	10.65	1.40	
Resident. structures	76.	115.	9.75	41.36	-15.40	
Non-resident. struct.	87.	107.	5.25	20.00	1.80	
Equipment invest.	169.	211.	-2.21	22.24	-7.50	
Inventory change	11.	36.			-3.95	level
Exports	246.	233.	-3.27	-5.72	-7.80	
Imports	238.	271.	7.46	12.99	1.40	
Comp. per man-hour (manu)			4.46	4.35	7.47	
Labor comp., bill of $	1897.	2181.	6.85	13.93	1896.	level
Return to capital	942.	1160.	4.46	20.82	949.	level
Indirect bus. taxes	252.	290.	0.18	13.81	258.	level
Labor productivity			1.27	1.69	.40	approx
Savings rate	9.02	6.27			5.80	
Treasury bill rate	9.14	8.16			10.69	
10 year Treas. bonds	10.42	9.37			13.00	
AAA bond rate	12.00	10.00			13.79	
4-6 month comm. paper	8.56	8.04			11.89	
Mortgage rate	11.84	10.53			14.49	
M2	1990.	2395.	13.21	18.33	1878.	level
Disposable income per-capita (72$)	4782.	5105.	5.25	6.54	4567.	level
Unemployment rate	8.09	1.15			9.7	
GNP deflator			3.26	5.38	6.0	

The actual 1982 numbers are annual 1981-82 growth rates unless otherwise indicated.

falls by 5.72%. This decline is very misleading however, since the decline in the total is brought about completely by a 29% decline in investment income recieved from sources outside the U. S.. The decline in investment income is itself brought about by the decline in interest rates in 1983. Exports of goods and services rose by approximately 2.64%, which was insufficient to offset the decline in the large export item.

The components of the factor payments side of GNP behave in a fashion more consistent with their historical paths. Table 4.3 reports the growth "forecasted" growth rates for Labor compensation, Return to capital, Indirect business taxes, the GNP deflator and real disposable income.

Table 4.3

Income Components, Inflation and Real Income growth, 1977-1983

	77-78	78-79	80-81	82-83
Labor compensation	12.10	11.75	10.44	13.93
Return to capital	14.27	11.37	16.11	20.82
Indirect business taxes	7.22	6.21	16.53	13.81
GNP deflator	7.39	7.82	12.38	5.38
Disposable income (77$)	4.52	2.54	2.24	7.47

The most interesting point about the results shown in Table 4.3 is that while high rates of growth of the income components were associated with high rates of inflation historically, the forecasted 1982-83 growth rates show high income growth and high real growth. The following informal account of how the model managed to generate these results will

be helpful in highlighting how the model works and in pointing out possible mechanisms for dealing with the problem of a too-robust forecast.

We start in 1983, as the model does, from a guess at personal income in current dollars, a guess at the price level and all of the exogenous data in real terms. Personal income is initially assumed to grow at a rate one percentage point faster than the rate of population growth plus the rate of growth of the overall personal consumption deflator in the previous year. It should be noted that in 1983 the assumed growth in real government spending is almost 2 percentage points higher than for 1982. This tends to push industry outputs up. Also, the "financial turbulence" dummy variable in the interest rate equations is set at .25, which will have an initial downward effect on interest rates. This will further stimulate the interest sensitive output sectors and force industry outputs up. The tendency in 1983 is for industry outputs to rise, which tends to push up employment.

The key relation on the price-income side, the equation for hourly labor compensation in manufacturing (HLC) is then calculated. Earlier it was argued that this relation largely determines the aggregate price level. The determinants of manufacturing HLC have little to do with the contemporaneous happenings in the rest of the model. The lagged values of M2 growth are quite moderate, and the growth in the merchandise imports deflator is actually negative for the 1981-82 period and near zero for the 1982-83 period. This path is mostly due to the decline in the price of imported crude oil and the large share of imports accounted

for by this product. These effects tend to moderate the rate of manufacturing HLC growth and lead to moderate increases in the rate of average price growth. Components of personal income that show large increases in the 1982-83 period and are unrelated to labor compensation are proprietors' income (18.7%) and rental income (16.9%). This amounts to very large increases in real personal income, given the moderate rate of price growth established by the manufacturing HLC equation. This increase will set the real side on a spiral of even greater growth.

Moving to the Accountant, there are two factors which may mitigate the effect of a higher real personal income generated by the price-income side. First, as income rises, so should the average rate Federal personal taxation. While this effect is normally quite small (in the model) but in the proper direction, the ratio of federal taxes to personal income actually declines by about 4.0% between 1982 and 1983. This is due to the legislated tax cuts scheduled to take place during 1983. Thus, this factor, which usually mitigates income growth, works to exacerbate the problem in this case.

The second factor which can act to mitigate the effects of increasing real income is an increase in savings rate. From Table 4.2 it can be seen that the savings rate out of personal income actually falls, which again exacerbates the problem of a too-quickly growing real income. For 1983, not only does real income increase, but the rate at which income is turned into spending also increases. To understand the reasons for this, it is necessary to recall what are the determinants of savings. From chapter 3 it will be recalled that the positive

determinants of real, per-capita savings are real, per-capita income, the change in real, per-capita income and a two-year moving average of the 4-6 month commercial paper rate. The negative determinant is the price of new automobiles relative to aggregate price deflator (which excludes the auto price). While the level of real, per-capita income and its change tend to increase real savings, (even more than income given the high income elasticity of savings) the reduction in interest rates and the rapid rate of price growth for new automobiles (11.78% compared to an average rate of price growth of 5.38%) tends to decrease savings. The result is that real savings increase less quickly than income and the spending rate out of income increases.

The problem of a too-robust economy in 1983 is the result of many factors acting in such a way as to set real disposable income on an upward spiral. It should be noted that the robustness of the 1983 forecast is independent of the starting guess at current dollar income. This fact, while clear from the structure of the model, was also verified by varying the initial guess and observing the behavior of the model. In all cases the model spiraled to lower and lower unemployment rate in 1983 until it ran up to the limit on the number of iterations of the annual loop without converging. Several steps suggested themselves as possible means to correct this problem.

Looking first to the Accountant, the rate at which real income is translated into real spending might be changed. By reducing the spending rate out of income (increasing the savings rate) the spiral would be damped.

Turning to the price-income side, the effect of ccntemporaneous values for the determinants of the manufacturing HLC equation could be included. Consider the growth in M2 for the 1982-83 period (Table 4.2). If the manufacturing HLC equation had used the 18.53% growth in M2 rather than the 13.21% growth of the previous year, the price level would have been increased relative to the values in Table 4.2 and the upward spiral in real disposable income would have been damped.

Another way to reduce the amount of real income returned to the real side would be to try to increase the components of value-added that are not part of personal income. By increasing these parts of value-added, the average level of prices will rise (via equation 12 in chapter 3) and the real value of personal income will decline. This is because while the value-added to output ratios for each industry would rise, the rise would occur only in those value-added components unrelated to personal income. The prime candidate for this kind of increase is the return to capital.

The return to capital equations include the inverse of the unemployment rate in several sectors as a positive determinant to try to make the necessary increases an automatic feature of the model. Since the relationship between the unemployment rate and the Return to capital is nonlinear, the effect on the Return to capital is stronger at lower unemployment rates than at higher unemployment rates. This effect is shown in Table 4.2. The increase, however, is too small to be of much help in increasing the price level faster than personal income. Further, the desired effect is diluted by the spreading of any excess in

the total return to capital over the sum of the forecasted pieces of return to capital to net interest payments, proprietors' income and corporate profits. (The reason for this spreading is explained in Chapter 3.) Only the last component is not included in personal income. Thus, when the total return to capital is rising because the unemployment rate is very low, and if the return to capital is rising more quickly than the sum of the individual components, much of the increase is directed to personal income. Simply by turning off the spreading to net interest payments and proprietors' income, it may be possible to reduce personal income growth while pushing up the price level. These changes will help to produce a model that displays greater economic reasonableness.

The purpose of the preceding discussion was to outline those factors which could most easily be adjusted to establish a more reasonable forecast. While a great number of experiments were carried out to try to ascertain how the model responds to various changes in structure and equations, only a limited number of runs of the model will be described. These will be the results associated with major changes in the three above-described areas.

Revisions to the model

The first experiment to be described is the removal of the spreading of the excess of the total return to capital over the sum of its components to net interest payments and proprietors' income. Any excess of the total return to capital over the sum of its pieces was

spread only to corporate profits. The effect of this change is examined by running the model once with the spreading to all three components and once with the spreading only to profits. It should be noted that the models used to test this change are not strictly comparable to the model which generated the results shown in Table 4.2. This is because the set of fixes used to generate the Table 4.2 results are different from the set of fixes used in this experiment.

Table 4.4 presents the major value-added components for the two runs of the model. The table shows that instead of helping to reduce personal income and increase the price level, spreading the excess return to capital to profits only served to allow net interest payments and proprietors' income to become larger. This means that the total return to capital equations were under-predicting relative to the equations for each of the components of the return to capital and that the excess return to capital was negative.

Table 4.4

Three Major Income Side Aggregates and Three Components of the Return to Capital for 1982

	Spread to 3 components	Spread profits only
Labor compensation	1874.25	1886.15
Indirect business taxes	248.04	249.58
Return to capital	919.45	926.69
Net interest	223.09	250.92
Corporate profits	267.01	244.01
Proprietors' income	158.73	159.63

Of course the effect of the higher personal income is to increase real economic activity and decrease the unemployemnt rate even further than the case with spreading to the three return to capital components. Average annual real GNP growth over the 1984-90 period was raised by .02 percentage points, while the average inflation rate, measured by the GNP deflator, was increased by .145 percentage points. The average unemployment rate over the 1984-90 period fell by 1 percentage point when the spreading was re-directed to profits only. The major fix that allowed the model to run to 1990 was a high, fixed savings rate at 9.0%. Since it is possible that spreading excess return to capital to any component of value-added that is included in personal income may cause the suspected problems, the change to spreading excess return to capital only to profits was retained.

The second attempt to provide an automatic mechanism for retarding the rate of growth of real income is to try to increase the rate of inflation associated with the very fast level of real growth for the 1982-84 period. As discussed before, the inflation rate is largely

determined by the rate of growth in manufacturing hourly labor compensation (HLC). Three factors keep the rate of wage increase quite moderate in the face of the rapid real growth shown in Table 4.2. These factors include the absence of contemporaneous effects of M2 in the manufacturing HLC equation, the inclusion of the term which compares the rate of growth of merchandise imports and "excess" money growth, and a very strange lag pattern on the money growth variable implied by the estimated coefficients. The first two points were briefly discussed when examining the results of the first attempt at the base scenario. To see the third problem, it is only necessary to rewrite equation 13 in chapter 3 in the following manner:

$$\begin{aligned} y_t = z_t &+ .27x_{t-1} \\ &+ .06x_{t-2} \\ &+ .16x_{t-3} \\ &+ .17x_{t-4} \\ &+ .32x_{t-5} \end{aligned}$$

where

y = percentage change in manufacturing HLC
z = nonmonetary variables related to manufacturing HLC
x = percentage change in the ratio of M2 to real GNP.

According to this lag distribution, the greatest effect of a given percentage change in the M2 to real GNP ratio comes five years after the change and comparatively little effect is felt in the intervening years. While the sum of the excess money growth effects is unity, the pattern of the effects suggests that a large increase in the M2 to real GNP ratio at first leaves wage growth unaffected but then increases wages

somewhat after a one year lag. After a one year lag however, wages are virtually unaffected by the excess money variable until an additional four years elapse. This dynamic pattern is simply unreasonable.

Since there several deficiencies in the manufacturing HLC equation, this equation was respecified and re-estimated to produce more reasonable properties. The three features of the new equation are a smoother, more reasonable lag pattern for the excess money growth term, the inclusion of a measure of the changing tightness of the labor market, and the inclusion of a more reasonable price-shock term into wage determination.

The smoother pattern for the percentage change in the M2 to real GNP ratio was chosen arbitrarily to be:

$$sm_t = .2x_t + .3x_{t-1} + .2x_{t-2} + .1x_{t-3} + .1x_{t-4} + .1x_{t-5}$$

where

sm = smoothed excess money growth over a five year period
x = percentage change in M2 to real GNP ratio.

This smoothed excess money growth variable is subtracted from the percentage change in manufacturing HLC, as is a three-year moving average of labor productivity growth. Thus the equation estimated is

$$MHLC_t - sm_t - pr_t = f(ps_t, Tight_t)$$

where

MHLC = percentage change in manufacturing HLC
sm = smoothed excess money growth variable defined above
pr = 3 year moving average of productivity growth using real GNP divided by total hourly adjusted employment as the productivity variable.
ps = price shock variable: inflation rate lagged one year less one year lagged smoothed excess money growth

variable, sm

Tight = measure of the relative tightness of the labor market, where the tightness variable is the first difference in the 2 year moving average of the inverse of the overall unemployment rate.

Only the reasons for including the last two variables need to be discussed. The price shock term is included to allow abnormally high rates of inflation brought on by exogenous shocks to affect the amount of wage inflation. It is possible to view the smoothed excess money growth term as a trend rate of inflation, around which the actual rate of inflation may deviate. Large deviations away from trend will be perceived and incorporated into wages, as was the experience in the early 1970s with oil and agricultural prices, and again in the late 1970s with another oil price shock.[1]

The labor market tightness variable that enters the equation is slightly different from the labor market variable that enters into most other wage rate change equations.[2] In most other wage rate change equations, the level of the unemployment rate, or the inverse of the unemployment rate is entered as an explanatory variable. An equation containing this type of variable may adequately describe short run behavior, but the unemployment effect must cancel out in the long run if the model is to generate a property that the actual economy seems to possess. This property is the virtual constancy of M2 velocity over the post-1950 period. Given that wages are the primary channel by which the model translates changes in other variables to changes in prices, we must be careful to incorporate the constancy of M2 velocity into the manufacturing HLC equation. One way to guarantee that this property

holds is to ensure that only excess money growth can affect wages in the long run. Consider the equation of exchange written in percentage change terms:

$$P + T = M + V,$$

where

P = percentage change in price level
T = percantage change in transactions (real growth)
M = percentage change in money supply
V = percentage change in velocity.

The present method for predicting the price level (via predicting the wage level) is:

$$P = (M - T) + \text{other variables}$$

where other variables will have a zero effect on the wage level in the long run. This is consistent with long-run constancy of velocity.

If, however, we write the standard Phillips equation allowing for monetary effects and non-transitory unemployment effects:

$$P = (M - T) + 1/U + \text{other variables}$$

then "other variables" must cancel out with the unemployment effect (1/U) if velocity is to remain constant. Since this problem is never really considered in short-term models or in estimates of short-run Phillips curves, these estimates are unsuitable for long-run forecasting. Forcing these properties on data generated from the actual economy from 1960 to 1980 results in a diminution of regression fit relative to the short-run estimates. Reasonable long term forecasts are the object of this exercise, so short run considerations of fit are

ignored when necessary.

To incorporate labor market tightness in the short run but have the effect cancel out in the long run, the first difference in a two-year moving average of the inverse of the unemployment rate is entered in the equation. Several variables of this form were tried, varying the length of the moving average and the kind of difference taken. For example, one attempt used the difference of the inverse of the current unemployment rate less a three-year moving average of the inverse of the unemployment rate. None of the other transformations of this variable enhanced the fit of the relation or were as significant in the regression as the transformation chosen.

The estimated relation is:

$$MHLC_t - sm_t - pr_t = \underset{(15.66)}{.69ps_{t-1}} + \underset{(2.83)}{11.33Tight_t}$$

RSQ = .16 D. W. = 1.11 SEE = 1.75

This equation implies that wages tend to incorporate about 70% of the difference between the actual inflation rate and a trend rate. Note that this effect will disappear in the model if there are no exogenous price shocks in the model, as the price level growth will tend to the rate of excess money growth. Thus ps should approach 0 if there are no exogenous price shocks. The "tight" variable has the expected sign. As the unemployment rate falls, the inverse of the unemployment rate rises and puts upward pressure on wage growth. Note that because the variable used is the inverse of the unemployment rate, "tight" becomes larger at

lower unemployment rates. This property should help to prevent the model from driving itself to negative unemployment rates from much higher rates, however, should the unemployment rate drift slowly down, not much additional inflation is generated.

To see how much the addition of this relation helps in producing a more reasonable forecast, the entire model was re-run with the new manufacturing HLC equation substituted for the old. The results are displayed in Table 4.5 and Table 4.6. This run was far more successful than the first attempt at the base run, proceeding to 1991 before driving the unemployment rate below 0. Table 4.5 displays results in the format of Table 4.2. Table 4.4 shows longer term growth rates for selected macroeconomic series along with 1977 to 1981 growth rates for comparison purposes.

The important feature of Table 4.5 that differentiates the overall results from those in Table 4.2 is the much faster growth in manufacturing HLC. In Table 4.5 manufacturing HLC is growing at 11.41% between 1981 and 1982 while the growth rate shown in Table 4.2 is only 4.46% bewteen 1981 and 1982. This increase in the growth rate of manufacturing HLC is reflected in the different rates of price level growth (7.11% to 3.26% in Table 4.2) which leads to higher nominal interest rates and less real growth. The ultimate effect is a reduction in real income growth and a much "softer" economy. It should be emphasized that while the pattern of the forecast remains unchanged, since 1983 is still an unreasonably rosy year, the substitution of the new manufacturing HLC equation is directly or indirectly responsible for

Table 4.5

Selected results with re-specified manufacturing HLC equation

	1982	1983	81-82	82-83	82-86	
GNP, bill. of 77 $	2099.	2303.	0.77	9.28	4.13	
PCE	1343.	1473.	2.77	9.22	4.34	
Resident. structures	71.	102.	3.22	36.36	7.59	
Non-resident. struct.	83.	101.	0.32	19.61	6.47	
Equipment invest.	164.	197.	-4.70	17.90	9.36	
Inventory change	5.	27.				
Exports	246.	235.	-3.27	-4.66	-0.18	
Imports	233.	261.	4.94	11.63	4.95	
Comp. per man-hour (manu)			11.41	8.32	8.56	
Labor comp., bill of $	1953.	2283.	9.73	15.58	11.97	
Return to capital	954.	1110.	5.74	15.14	11.87	
Indirect bus. taxes	257.	292.	2.15	12.56	10.05	
Labor productivity			0.77	1.89	0.65	
Savings rate	8.51	7.66			6.86	*
Treasury bill rate	10.78	9.44			11.15	*
10 year Treas. bonds	11.73	10.70			10.95	*
AAA bond rate	13.15	11.59			11.70	*
4-6 month comm. paper	10.53	9.53			11.17	*
Mortgage rate	12.87	11.76			11.92	*
M2	1987.	2375.	13.04	17.85	8.69	
Disposable income per-capita (72$)	4690.	5047.	3.29	7.35	2.63	
Unemployment rate	9.07	3.85			3.94	*
GNP deflator			7.11	5.91	7.64	

* indicates average level of variable over the period

the better results of this attempt relative to the first attempt at a base run.

Turning to examine the table of longer term growth rates and average levels, Table 4.6, we can see a fairly reasonable forecast for the selected variables. The rate of real GNP growth moderates

Table 4.6

Average growth rates or levels for macroeconomic aggregates
Re-specified manufactruing HLC equation

	1977-81	1982-86	1986-90
GNP real	1.94	4.13	2.13
GNP deflator	9.24	7.64	7.41
M2	8.64	8.69	8.81
Disp. Inc. real per-cap	1.46	2.63	0.74
Labor prod. (GNP/jobs)	-0.64	0.65	0.42
Treasury bill rate	9.78	11.15	11.50
AAA bond rate	10.50	11.70	11.02
Unemployment rate	6.71	3.94	2.01
Savings rate	6.02	6.86	5.39

considerably in the 1986-90 period relative to the 1982-86 period. This earlier period's figures are heavily influenced by the 9.28% growth in real GNP for 1982-83. The other variable whose 1982-86 average is not indicative of its forecasted path over the period is the unemployment rate. Excluding 1982 from the calculation of the average results in a 2.67% rate. None of the other figures in Table 4.6 are as influenced by the 1982 figures or the 1982-83 growth rate. The remainder of the variables shown in Table 4.6 show quite reasonable longer term averages or average growth rates. High rates of inflation tend to keep nominal interest rates high, which should slow growth in the interest-sensitive final demand components. The rate of growth of real per-capita disposable income is much lower over the 1986-90 period than the 1982-86 or the 1977-81 periods. While this should have had the effect of reducing real growth, the decline in the average savings rate offset some of the decline in income growth and propped up real spending. One troubling facet of the forecast is the movement of M2 velocity. For the 1977-81 period, M2 velocity increases at about 2.5% per year while for

the 1982-86 period M2 velocity increases at about 3.0% per year. For the 1986-90 period, velocity is still increasing (at about .7% per year). These results suggest that the manufacturing HLC equation does not guarantee a constant M2 velocity. The major problem of the model still appears to be the too-robust economy in 1983. It should be noted that once the unemployment rate has reached its 1983 value of 3.85%, the remainder of the forecast manages to reduce it only slightly. There is however, scant room for any further reductions in the unemployment rate without causing the model to break down. Thus, it would seem that if the model could be made to achieve a more realistic 1983 forecast, the remainder of the forecast would be more reasonable for all other variables.

There are two ways to proceed at this point. Many factors could cause the too-robust economy in 1983, only some of which are macroeconomic. Given that the final demand aggregates are sums of forecasts at a far more detailed level, it is useful to examine all of these forecasts individually to make sure that the problem of an unreasonable 1983 forecast is not a function of a handful of badly specified industry level equations. On the other hand, specifying a single macroeconomic equation, the savings rate equation, has already been suggested and somewhat proven as a possible response to the 1983 forecasting problem.

Both of these approaches are taken here, as some industry level equations are fixed and the savings rate equation is re-specified to provide a more automatic mechanism for reducing the chance of producing

an unreasonable forecast.

Fixes on individual industry equations can take two basic forms. An equation can be completely over-ridden, meaning that the forecast path for a variable is set prior to running the model, or an adjustment can be made to the forecast path during the running of the model. This latter form of fix is the preferred form, since it preserves the inter-relationships of variables in the model, while the first type of fix turns off these relations. An attempt was made to keep the number of fixes of the first type to a minimum, in order to preserve the integrity of the forecasting model. Several fixes of this type were included however and these fixes are concentrated in the industry level productivity equations and the change-in-business-inventories equations.

The change in inventories in constant 1977 dollars was fixed outright for the entire forecast horizon (from 1982 to 1995) for Agriculture, forestry, and fishery products (sector 1), Food and tobacco products (9), Other chemicals (16), Aerospace (44), and Miscellaneous manufacturing (48). In the case of Agriculture, forestry and fishery products, the forecast for inventory change was consistently large and negative. This path was changed to a small, positive amount of inventory accumulation (.1 billion in 1982), rising slowly to .5 billion in 1990 and held at that level through 1995. Just the opposite case, too much inventory accumulation, was found to be the problem for the other above-mentioned sectors. The case of Aerospace products is typical. The forecast value in 1983 is approximately three times the average of inventory change over the 1977-81 period. The level of

inventory change for this sector remained at this very high level throughout the forecast and was therefore set exogenously to some lower, but still positive level.

For labor productivity, 9 of the 55 sectors were set exogenously rather than relying on the estimated equations. For employment sectors Crude oil and natural gas, Mining, and Construction, labor productivity was declining rapidly and continuously throughout the forecast. This path was changed so that productivity was allowed to grow from the 1981 level at a very moderate .1% per year. For the sector TV sets, radio and phonograph equipment the opposite problem (too rapidly growing productivity, 9% annual average) is the case. For this sector productivity growth was specified exogenously to a rate close to .1% per year. Given the small share of total employment accounted for by these sectors (excluding Construction), the macroeconomic effects of these changes is very slight.

The macroeconomic effects of fixing productivity in the service sectors are quite profound however. Table 4.7 shows that 7 sectors accounted for slightly more than half of total employment between 1977 and 1981, and that these shares are quite constant.

Table 4.7
Percentage of total jobs accounted for by selected employment sectors

	1977	1981
Wholesale & Retail Trade	21.67	21.95
Finance & Insurance	3.90	4.01
Hotels, Non-auto repairs	3.25	3.30
Business Services	4.52	5.48
Medical, Educational, NPO	9.30	10.08
Construction	5.00	5.10
Agriculture	3.51	3.32
Total	51.15	53.24

For a fixed level of output, a higher rate of productivity growth in these sectors results in a higher unemployment rate. Thus the path of productivity in the service sectors affects the unemployment rate considerably and may be responsible for the "too rosy" forecast displayed in Tables 4.2 and 4.5.

The forecasted path of productivity for these sectors for the run of the model whose results are displayed in Table 4.5 appear in Table 4.8. Also shown are the average rates of productivity growth over two historical sub-periods and the values at which productivity growth was fixed.

Table 4.8
Sectoral labor productivity growth rates for selected periods

	1955-77	1977-81	1981-90	Fixed value
Wholesale & Retail	1.48	-0.7	0.42	
Finance & Insurance	0.63	-0.9	0.59	
Hotels, Non-auto Rep.	0.52	-1.94	-0.48	.17
Business Services	0.50	-1.06	0.31	
Med. & Educ., NPO	0.31	-0.89	-0.27	.17
Construction	0.69	-2.60	-1.98	.17
Agriculture	4.37	-0.03	2.21	

The intent of applying the fixes to the three productivity sectors is to let productivity grow only very slowly in the forecast period but to eliminate the negative productivity growth forecasted by the model.

Several fixes were applid to different final demand components to alter their various forecast paths. These fixes consist of adding or subtracting an amount from the forecast path. The most important fix is a downward adjustment to the forecast path of Single Unit Residential Structures of 6 billion constant 1977 dollars. More minor fixes of this type were applied to Multi-unit residential structures, Mobile homes, Hotels, motels and dormitories, Stores, restaurants and garages, and Mining and oil and gas well drilling.

The effect on the model of the introduction of these fixes is illustrated in Table 4.9 and Table 4.10. One immediately noticeable improvement is that the model did not break down before finishing the forecast in 1995. It should be noted that for this run the rate of M2 growth was fixed at 8% per year. The effect of the fixes was to increase the unemployment rate by 1 percentage point in 1982 and 3 percentage points in 1983. The average unemployment rate for the period

is 1 percentage point higher. The rate of inflation is lower with the fixes, primarily because of the much lower rate of M2 growth. Real GNP is 35 billion (constant 1977 dollars) lower in 1982 with the addition of the fixes. The reduction is almost equally distributed between personal consumption expenditures (20 billion dollars lower) and residential structures (15 billion dollars lower). This drop in real GNP reflects the multiplied effect of the changes made to the various sectoral expenditure paths. While the exact first year multiplier effect is not calculable because of the addition of the productivity fixes, it is clearly greater than unity, since the net exogenous reductions from expenditures was less than 35 billion.

The longer run view of the model results are shown in Table 4.10. Real GNP growth is falling slightly in the 1990-95 period relative to the 1982-86 period and the 1986-90 period. The average inflation rate moves up in the last period, primarily because of an increase in maufacturing HLC that begins in 1991. This increase itself is caused by an abrupt decline in the unemployment rate in 1991, brought on primarily by an arbitrarily chosen path for the number of multiple job holders and the civilian labor force. A short digression on model software is useful at this point, because it serves to highlight the types of problems that frequently arise in the construction of a computer model.

The software for the fix routines is written so that the user may enter as few as two points for a particular forecast path and allow the model software to linearly interpolate between these points to provide the entire forecast path. Providing three years of data (say 1981, 1990

Table 4.9

Selected results with re-specified manufacturing HLC equation and additional fixes

	1982	1983	81-82	82-83	82-86	
GNP, bill. of 77 $	2064.	2243.	-1.52	8.35	5.02	
PCE	1326.	1452.	0.79	9.24	5.34	
Resident. structures	57.	81.	-19.58	35.79	10.11	
Non-resident. struct.	81.	90.	-2.43	10.76	7.09	
Equipment invest.	160.	187.	-7.45	15.73	11.77	
Inventory change	1.4	15.8				
Exports	247.	239.	-3.02	-3.29	-0.01	
Imports	224.	249.	1.01	10.84	6.36	
Comp. per man-hour (manu)			10.44	5.43	6.84	
Labor comp., bill of $	1906.	2160.	7.36	12.49	10.92	
Return to capital	926.	1044.	2.85	12.02	11.33	
Indirect bus. taxes	253.	280.	.51	10.23	9.38	
Labor productivity			.23	2.22	1.07	
Savings rate	8.78	7.98			6.92	*
Treasury bill rate	11.29	10.77			11.38	*
10 year Treas. bonds	11.78	11.14			10.45	*
AAA bond rate	13.22	11.88			11.26	*
4-6 month comm. paper	11.16	10.97			11.42	*
Mortgage rate	12.91	12.11			11.49	*
M2	1889.	2046.	8.00	8.00	8.00	
Disposable income per-capita (72$)	4636.	4996.	2.14	7.48	3.42	
Unemployment rate	10.7	6.8			4.95	*
GNP deflator			6.93	3.78	5.88	

* indicates average level over the period

and 1995) allows the forecast path to consist of two line segments with a kink at the year specified between the endpoint years. Of course depending on the exact points chosen, the two line segments may have radically different slopes. This is what occurred with the number of multiple job holders and the civlian labor force. While several years of data was specified up to 1990, only the 1995 data point was specified

Table 4.10

Average growth rates or levels for macroeconomic aggregates
for run with additional fixes

	1977-81	1982-86	1986-90	1990-95
GNP real	1.94	2.13	2.26	1.65
GNP deflator	9.24	7.41	5.55	7.43
M2	8.64	8.00	8.00	8.00
Disp. Inc. real per-cap	1.46	3.42	1.37	0.48
Labor prod. (GNP/jobs)	-0.64	1.07	0.79	0.69
Treasury bill rate	9.78	11.38	10.68	11.89
AAA bond rate	10.50	11.26	10.22	10.68
Unemployment rate	6.71	4.95	2.68	1.62
Savings rate	6.02	6.92	5.15	3.95

after 1990. The effect was to force abrupt changes in the growth rates for these two variables. For the number of multiple job holders the growth rate for 1989-90 is 4.8%. The similar figure for 1990-91 is 2.9%. For the civilian labor force the 1989-90 growth rate is 1.1%, which abruptly changes to .8% for the 1990-91 period. Of course this problem can be easily solved by changing the software so that a more sophisticated interpolation method is used or simply by taking greater care in the specification of exogenous data. In this case the 1995 data points for each series were raised to prevent such an abrupt growth rate change. In retrospect, this problem could have been eliminated by a more careful specification of the labor force and the number of multiple job holders before the first attempt at a base forecast. The point of the digression is merely to point out a typical kind of problem encountered in modeling, which reveals itself only after having taken some seemingly innocous action. The effect on the model of these two inappropriately specified forecast paths was an abrupt 1 percentage point decline in the unemployment rate, a decline which is less important to the rest of the model at a 6% unemployment rate than at a

2% unemployment rate.

A final interesting result shown in Table 4.10 is the behavior of real, per-capita disposable income and the savings rate. These two variables together determine the largest component of final demand, personal consumption expenditures. While the rate of growth of real, per-capita disposable income slows considerably, the savings rate drops. This circumstance tends to prop up personal consumption expenditures and force the unemployment rate down. Had the savings rate remained at the 6.92% average of the 1982-86 period, the forecast would certainly have shown a lower growth rate for real GNP and a higher average unemployment rate. This conclusion leads to the examiniation of the determinants of real saving and a re-specification of the savings rate equation.

That it is possible to have the model produce a more realistic forecast by arbitrarily increasing the savings rate is not really in doubt. The only question is the height to which the savings rate must be raised to achieve a reasonable unemployment rate. Table 4.11 shows some long run macroeconomic results of a version of the model that includes all of the adjustments discussed thus far plus a savings rate fixed at 9% from 1982 through 1995. A glance at the table reveals the most reasonable macroeconomic forecast procduced so far, especially the forecast for the unemployment rate. The table illustrates the idea that it is possible to manipulate the savings rate and obtain a better forecast. Ideally we should like to estimate a savings or savings rate function that provides an automatic stabilizing force for the model, preventing the model from producing a too-robust result (as is the case

with every run of the model presented so far) but which also keeps the model out of the doldrums.

Table 4.11

Average growth rates or levels for macroeconomic aggregates
9% fixed savings rate out of personal income

	1982-86	1986-90	1990-95
GNP real	4.39	1.71	2.06
GNP deflator	4.75	4.18	4.56
M2	8.00	8.00	8.00
Disp. Inc. real per-cap	3.40	1.09	1.20
Labor prod. (GNP/jobs)	1.07	0.62	0.64
Treasury bill rate	9.62	7.41	7.20
AAA bond rate	10.40	8.37	8.03
Unemployment rate	6.99	5.52	4.08
Savings rate	9.00	9.00	9.00

The function should include an interest rate as a positive determinant of savings or the savings rate since the personal consumption expenditure equations were estimated under the constraint that no consumption sector could be positively related to interest rates. While no attempt is made to make the positive interest rate effect on savings or the savings rate exactly cancel the negative effect of interest rates on consumption, it is important that there be at least some offset of the interest rate effects.

It is clear that savings relation described in chapter 3 is incapable of acting as a stabilizing force, as can be seen in the results reported thus far. While the savings rate equation that is a standard part of the INFORUM forecasting model mostly lacks the interest rate term logically required by the revised PCE equations, it also fails

to provide the necessary stabilizing function. This function, shown in Figure 4.1, relates the savings rate out of personal income to the inverse of the unemployment rate lagged one and two periods (1/UNEMP), the percentage change in real, per-capita disposable income cubed ((PC INCOME)**3), transfer payments as a share of disposable income (TRANR), new automobile purchases as a share of disposable income (AUTOR), and the lagged savings rate. The two most important explanatory variables are the share of disposable income accounted for by new auto purchases and the cube of the percentage change in real disposable income. The importance of the lagged savings rate term points up the large degree of "inertia" in this function.

That this function is unsuitable for the present modeling purpose is fairly apparent. First, as noted before, the function does not contain an interest rate term. Second, the stabilizing qualities of the equation are very weak, especially given the high income elasticity for new automobiles in the PCE equations (see chapter 3). Within a given year, should real income begin to grow too quickly, there is very little in this equation to retard that growth. While the cube of the percentage change in real income grows as income grows, the share of income accounted for by new car purchases also grows. These two effects tend to cancel, leaving only a small stabilizing or destabilizing net effect, depending on which effect predominates during the particular run of the model being examined. Thus it is likely that should a real income growth spiral be set off as a result of some other part of the model, this particular savings rate function would be of little help in damping the spiral.

FIGURE 4.1

THE SAVINGS RATE (STANDARD INFORUM EQUATION)

0 6 SEE = 0.4567 RSQR = 0.8494 RBARSQR = 0.7892
RHO =-0.009 DW = 2.018 AAPE = 5.22

VARIABLE	REGRES-COEF	T-VALUE	ELASTICITY	MEXPLAVAL	MEAN
INTERCEPT	3.222678	2.73	0.479	21.14	1.0000
1/UNEMP(T-1)	7.165356	1.66	0.202	8.29	0.1900
1/UNEMP(T-2)	3.369045	0.78	0.095	1.89	0.1903
PC INCOME**3	0.012154	5.45	0.063	69.06	34.6883
TRANR	-6.051284	-1.27	-0.109	4.89	0.1212
AUTOR	-80.591285	-8.11	-0.423	126.07	0.0353
SAVRAT(T-1)	0.688558	5.75	0.693	75.20	6.7715
SAVRAT	DEPENDENT VARIABLE - - - - - -				6.72921

THE SAVINGS RATE (STANDARD INFORUM EQUATION)

DATE	ACTUAL IS *	PREDIC IS +	MISS IS A-P *
60	5.60	5.63	-0.03
61	6.30	5.80	0.51
62	6.03	5.79	0.23
63	5.41	5.28	0.13
64	6.72	7.10	-0.38
65	7.09	7.09	0.00
66	7.01	7.14	-0.13
67	8.10	7.48	0.61
68	7.08	7.95	-0.87
69	6.36	7.29	-0.93
70	8.04	7.61	0.42
71	8.08	7.54	0.54
72	6.50	7.02	-0.52
73	8.64	8.14	0.50
74	8.54	8.16	0.38
75	8.61	7.95	0.66
76	6.91	7.26	-0.34
77	5.65	5.83	-0.18
78	5.22	5.44	-0.22
79	5.25	5.23	0.02
80	5.56	5.61	-0.05
81	5.33	5.68	-0.35
	IS *	IS +	IS A-P *

5.000 6.000 7.000 8.000 9.000

1/UNEMP = inverse of the unemployment rate

PC INCOME**3 = cube of the percentage change in real, per capita disposable income

TRANR = share of disposable income that is transfer payments

AUTOR = share of disposable income that is purchases of new autos

SAVRAT = savings rate out of personal income

Across years, however, the function works so that years of rapid growth (low unemployment) are immediately followed by years of a high savings rate. This high savings rate helps to lead to higher unemployment. While this feature is reasonable, it does nothing to eliminate unreasonably low or high unemployment rates in the current year.

A run of the overall model was made which included all of the alterations discussed thus far but with the above-discussed standard INFORUM savings rate equation as the saving relation. Selected macroeconomic results from this run are presented in Table 4.12.

Table 4.12
Selected results using INFORUM savings rate equation

	1981-82	82-83	83-84	82-86	86-90	90-95
Real GNP	1.17	5.46	6.34	3.59	2.02	1.28
GNP deflator	6.17	4.51	4.46	5.39	4.23	4.86
M2	8.00	8.00	8.00	8.00	8.00	8.00
Real disp. inc.	4.17	5.46	4.17	2.66	1.26	0.65
Labor prod.	0.86	1.34	1.25	0.82	0.68	0.54
Treas. bills	12.04	11.09	10.29	10.47	8.62	8.06
AAA bonds	13.40	11.91	10.07	10.80	9.00	8.59
Unemp. rate	8.77	6.76	3.68	5.55	4.08	3.28
Savings rate	7.15	7.86	7.08	7.32	7.03	7.81

From Table 4.12 it can be seen that the unemployment rate falls below 4 remains at this rather low level throughtout the forecast. The savings rate equation could not prevent the unemployment rate from falling too quickly, although the rate subsequently rose to more reasonable levels and finally fell to a low of 2.19% in 1994.

To take the place of the savings function described in chapter 3 or the statndard INFORUM savings rate equation, and to avoid the necessity of fixing the savings rate at an arbitrarily high level, an equation was developed that is at once much simpler than either of the previous savings equations and more suited to the two requirements outlined above. Not surprisingly, the function does not fit as well as either of the other two functions, however, as we have seen, a good- fitting function does not automatically carry with it the properties necessary to "fit in" consistently with the rest of the model. Only two independent variables are used in the savings rate function and the function includes a lagged dependent variable. The two independent variables are a two-year moving average of the inverse of the unemployment rate (U), and a two-year moving average of the 4-6 month commercial paper rate (R).

Several attempts were made to estimate a function that was sensitive enough to the unemployment rate to provide the needed stabilizing force. The function finally chosen contains no intercept and was estimated subject to the constraint that the coefficient on the lagged dependent variable could not be larger than .3. The function is displayed in Figure 4.2. A summary of the results of running a version of the model containg this re-specified savings rate equation is presented in Table 4.13.

The pattern of the forecast is the same as we have seen before, with rapid growth occurring in the 1982-93 period and continued growth during the 1983-84 period. The difference between these results and the

Table 4.13

Summary macroeconomic results for model with re-specified savings rate
Growth rates or average levels

	81-82	82-83	83-84	82-86	86-90	90-95
GNP real	1.29	6.49	3.84	3.47	1.86	1.84
GNP deflator	6.06	4.38	4.63	5.13	4.22	4.44
M2	8.00	8.00	8.00	8.00	8.00	8.00
Disp. Inc. real per-cap.	4.19	6.18	2.69	2.70	1.23	1.02
Labor prod. (GNP/jobs)	0.91	1.47	0.79	0.86	0.62	0.63
Treasury bill rate	12.05	11.49	9.85	10.07	7.92	7.31
AAA bond rate	13.41	12.02	9.90	10.60	8.59	8.09
Unemployment rate	8.69	5.80	4.75	5.88	4.87	4.18
Savings rate	7.02	7.24	7.91	7.63	7.77	8.36
Residential str. real	-15.11	27.77	10.42	12.49	3.00	2.16

others is that the peak which occurs in 1984 is lower in this run than in any of the previous runs. This is the result of the new savings rate equation. The higher savings rate is of course the result of the rapid growth in the first place, which shows that the new equation indeed performs a stabilizing function. The average unemployment rate for the 1990-95 period is nearly a full percentage point higher in the forecast usng this new savings equation than in the forecast using the standard INFORUM savings rate equation. An interesting point is that the average rate of growth of real GNP in this same period is over a half a percentage point higher with the new savings rate function than with the INFORUM savings rate function, even in the face of the higher unemployment rate. The effect of the new savings rate equation seems to be to smooth the path of real growth, since the average rate of real GNP growth is lower for the 1986-90 period with the new equation.

FIGURE 4.2

REGRESSION WITH CONSTRAINED LAG EFFECT AND NO INTERCEPT SAVINGS RATE

2 SEE = 0.9931 RSQR = 0.0514 RBARSQ = -0.0485
RHO = 0.3723 DW = 1.255 AAPE = 11.13

VARIABLE	REGRES-COEF	T-VALUE	ELASTICITY	MEXPLAVAL	MEAN
U	17.746902	7.48	0.487	94.97	0.1888
R	0.215707	3.23	0.199	23.31	6.3509
SAVRAT(T-1)	0.300017	303.95	0.299	6697.23	6.8622
SAVRAT	DEPENDENT VARIABLE - - - - - -				6.87882

REGRESSION WITH CONSTRAINED LAG EFFECT AND NO INTERCEPT SAVINGS RATE

DATE	ACTUAL IS *	PREDIC IS +	MISS IS A-P *
60	5.59	5.94	-0.36
61	6.29	5.34	0.95
62	6.02	5.48	0.54
63	5.40	5.71	-0.31
64	6.70	5.72	0.98
65	7.08	6.60	0.47
66	7.00	7.50	-0.50
67	8.08	7.90	0.18
68	7.07	8.42	-1.35
69	6.36	8.64	-2.28
70	8.02	7.90	0.12
71	8.07	7.06	1.00
72	6.49	6.56	-0.07
73	8.64	6.76	1.88
74	8.53	7.95	0.58
75	8.60	6.94	1.66
76	6.91	6.04	0.86
77	5.94	5.67	0.26
78	6.06	5.99	0.07
79	5.86	6.87	-1.01
80	6.03	7.03	-1.01
81	6.61	7.13	-0.53
	IS *	IS +	IS A-P *

5.338 6.040 6.743 7.445 8.148

U = two period moving average of the inverse of the unemployment rate

R = two period moving average of the 4-6 month commercial paper rate

SAVRAT = savings rate out of personal income

This version of the model, with the fixes described above, the new manufacturing HLC equation and the revised savings rate equation, forms the basis for the base model from which alternative scenarios can be run. Two further issues of lesser importance will be addressed before declaring the base run complete. These issues are the size of the current dollar merchandise trade balance and the effect of the changing institutional environment on the "disintermediation" variables which enter the construction equations.

One feature of the forecast which has not yet been discussed in the quest for a reasonable forecast is the current dollar merchandise balance. Each forecast presented thus far has also produced a forecast of the trade balance. The current dollar merchandise trade balance for the latest run of the model is presented in Table 4.14, which also displays some other variables for comparison purposes.

Table 4.14
Current dollar merchandise trade balance
with selected macroeconomic series

	1982-86	1986-90	1990-95	
Trade balance (cu $)	-77.95	-130.15	-158.46	
Merch. exports (co $)	1.22	2.81	3.51	
Merch. imports (co $)	4.00	2.15	2.53	
Merch. exports deflator	4.68	3.71	4.27	
Merch. imports deflator	4.25	3.88	4.45	
GNP real	3.57	1.86	1.84	
Unemployment rate	5.88	4.87	4.18	
Exchange rate scaler	1.00	1.00	1.00	
	1982	1986	1990	1995
Trade balance as share of Merch. exports	24.00	38.00	37.00	29.00

The table points out that the current dollar trade balance continually worsens as the forecast proceeds, but that as a share of current dollar merchandise exports the balance at first increases but then declines toward the 1982 share. It is an interesting exercise to try to reduce the large current dollar deficit and observe the effects of the effort on the rest of the model.

One way to reduce the trade deficit is to slow the rate of growth of the domestic economy. By slowing the economy, the demand for imports falls and given that exports are partially driven by exogenous foreign demands and partially by the exogenous relative foreign to domestic prices, the trade deficit should become smaller.

Another way to reduce the trade deficit would be to decrease the value of the dollar relative to other currencies. By doing this, import demand is reduced and export demand is increased by making imports more expensive to domestic consumers and exports less expensive to consumers abroad. Whether this method will actually reduce the trade deficit depends on the extent to which the decline in real imports is greater than the rise in prices and whether the increase in real exports more than offsets the relative decline in the price of exports. Two runs of the model were made varying the extent to which the value of the dollar declines relative to all other currencies. The results are reported in Table 4.15. What these results point out is that the attempt to reduce the balance of merchandise trade deficit by altering the value of the dollar makes the economy stronger and reduces the unemployment rate. Essentially we see the phenomenon of incompatible domestic economy goals

Table 4.15

Exchange rate scaler runs
Growth rates or average levels

Higher exchange rate scaler

	1982-86	1986-90	1990-95
Trade balance	-76.99	-105.31	-77.02
Exports, real	2.25	4.18	4.85
Imports, real	3.61	1.38	1.86
Merch. exports deflator	4.61	4.21	4.72
Merch. imports deflator	4.99	5.08	5.54
Real GNP	3.75	1.93	1.96
Unemployment rate	5.74	4.38	3.48
Exchange rate scaler	1.07	1.11	1.17

	1982	1986	1990	1995
Trade balance as share of merch. exports	24.67	35.47	20.99	5.10

Lower exchange rate scaler

	1982-86	1986-90	1990-95
Trade balance	-76.99	-104.28	-93.76
Exports, real	2.25	3.87	3.74
Imports, real	3.61	1.60	2.22
Merch. exports deflator	4.61	4.11	4.42
Merch. imports deflator	4.99	4.43	4.54
Real GNP	3.75	1.91	1.89
Unemployment rate	5.74	4.41	3.70
Exchange rate scaler	1.07	1.10	1.10

	1982	1986	1990	1995
Trade balance as share of merch. exports	24.67	35.56	21.22	12.00

and balance of trade goals, given the exogeneity of relative foreign to domestic prices and exchange rates. It should be noted that the rate of growth of M2 was fixed at 8% per year for both scenarios. This had the effect of keeping the inflation rates of the two models nearly identical. With these results in mind, that the trade balance can be

improved with the result of only faster real growth, a fundamental property of the model is revealed. This property is of course, that the supply constraints in the model are very weak or non-existent. Thus, large increases in real demand are mostly met with increases in supply and a very small increase in prices, regardless of the initial position of the model or economy. Such a property is probably a bad one in a short term model, where capacity is nearly fixed. In a long term model, however, it is less troublesome.

A final point which must be discussed because of its implications for possible forecast scenarios is the change in financial institutions which effectively eliminate Regulation Q, and the mandated Regulation Q phaseout over the 1980-86 period. In the middle of 1978, thrift institutions were authorized to issue money market certificates which paid one-quarter of a percentage point more than the prevailing Treasury bill rate. This account was created to permit financial institutions which primarily lent for housing purposes to attract depositors, thereby avoiding the disintermediation effect of high short term interest rates combined with interest rate ceilings. While the regulations concerning this account were changed in March, 1979 so that the quarter point advantage was dis-allowed, the precedent for relaxing Regulation Q had been set. The Depository Institution Deregulation and Monetary Control Act of 1980 allowed for a gradual 6 year phaseout of Regulation Q interest ceilings and the Garn - St. Germain Depository Institutions Act of 1982 authorized thrift institutions to issue a deposit account competitive with money market mutual fund shares, which have no interest rate ceilings.

These developments have profound implications for modeling construction behavior. In the Single unit residential structures equation, the most important financial variable is the difference between the long-term interest rate and a short-term rate, which proxies for the disintermediation effect. To the extent that the rate differential no longer signals massive deposit shifts, the use of the rate difference will result in poor forecasts for the very important housing sector. Attempts to incorporate the effect of the changing institutional environment into the estimation for this equation proved fruitless. The attempt took the form of adding slope and/or intercept dummies to the equation. It was decided to impose some arbitrary fix on the equation forecast to provide for this environment change. Essentially the fix allows the rate differential to have only half as much effect in the forecast period as in the estimation period. This is done by weighting the forecasted rate differential and the average rate differential over the estimation period (excluding "credit crunch" periods) equally.

Algebraically, the fix is specified in term of the weights so that the forecasted rate differential is the sum of two parts:

$$\text{Ratdif} = \text{DIFSCL} * (\text{RAAA} - \text{RCP}) + (1-\text{DIFSCL}) * .8$$

where

Ratdif = rate differential variable used by the construction equations
RAAA = AAA rated corporate bonds
RCP = 4-6 month commercial paper rate
DIFSCL = weight on rate difference
1.0 in estimation period
.75 in 1982
.50 after 1983

An argument can be made that DIFSCL should be zero in the forecast years, since the disintermediation effect should be completely absent by virtue of the new environment. The size of the future disintermediation effect really depends on the extent to which financial institutions which primarily lend for long term purposes (mortgages) are willing to compete for short term liabilities to finance their long term assets. One possible result of the long-term-asset-short-term-liability combination is an "earnings crunch" which has lately been observed in the thrift industry. If thrift institutions wish to avoid an "earnings crunch", they may not compete as actively in the short run deposit market and some funds may flow from thrift institutions to other financial institutions. This may preserve some credit flow effect (no longer disintermediation). To allow for this possibility, DIFSCL is set to .5 over the forecast horizon.

Two runs of the model were made to examine the effects of the imposition of this scheme to deal with the new financial environment. One run of the model was made with DIFSCL set to 1.0 throughout the forecast (no change in financial environment) and an endogenous M2. The second run uses the DIFSCL pattern outlined above and also has an endogenous M2. The results for some selected macroeconomic variable are shown in Table 4.16. These two runs are not very different, each showing the same patterns of real growth and nearly identical long-term inflation rates. The long-term growth rates for residential structures, which should be the component most directly affected by the imposition

Table 4.16

Summary results with new savings equation and disintermediation scaler
Growth rates or average levels

DIFSCL set to .75 in 1983, .5 after 1983

	81-82	82-83	83-84	82-86	86-90	90-95
GNP real	1.54	6.57	2.99	3.51	1.90	2.17
GNP deflator	6.42	5.62	5.62	5.44	4.10	4.48
M2	12.46	13.56	3.28	7.62	6.51	6.66
Disp. Inc. real per-cap.	4.20	5.81	1.72	2.55	1.28	1.01
Labor prod. (GNP/jobs)	0.97	1.46	0.69	0.86	0.62	0.63
Treasury bill rate	10.97	9.49	9.50	9.27	7.34	6.62
AAA bond rate	13.07	11.35	9.82	10.39	8.22	7.71
Unemployment rate	8.52	5.53	5.21	6.01	4.84	4.19
Savings rate	6.91	6.96	7.49	7.27	7.51	8.13
Residential str. real	-12.56	32.15	8.79	12.65	3.09	1.93

DIFSCL set to 0 for entire forecast

	81-82	82-83	83-84	82-86	86-90	90-95
GNP real	1.85	6.50	2.83	3.47	1.87	1.80
GNP deflator	6.34	5.52	5.69	5.45	4.10	4.48
M2	12.85	13.12	3.14	7.57	6.44	6.69
Disp. Inc. real per-cap.	4.71	5.71	1.58	2.52	1.24	1.04
Labor prod. (GNP/jobs)	1.03	1.41	0.66	0.84	0.61	0.62
Treasury bill rate	10.93	9.56	9.47	9.18	7.32	6.57
AAA bond rate	13.06	11.34	9.81	10.39	8.21	7.70
Unemployment rate	8.28	5.31	5.13	5.85	4.76	4.12
Savings rate	6.94	7.06	7.63	7.36	7.61	8.24
Residential str. real	-11.56	34.07	8.13	12.28	3.24	1.96

of this disintermediation scaler, are virutally identical. The first two forecast years show growth rates for this component that differ by 1 and 2 percentage points respectively. The point of adding the disintermediation scaler was not so much to change the forecast results however, as much as it was to prevent the forecasting model from duplicating historical credit crunch effects in a forecast when the economy has changed to prevent such occurrences.

In summary, five major changes were made to the model described in chapter 3, aside from the addition of the monetary sector sub-model in chapter 2.

1) Redirecting the excess of the total return to capital equation over the sum of the component pieces only to corporate profits and away from proprietors' income and net interest payments.

2) Re-specifying and re-estimating the manufacturing HLC equation.

3) Re-specifying and re-estimating the savings rate equation.

4) Applying some industry specific fixes to construction, inventory change and labor productivity.

5) Creating a variable to allow for the relaxation of Regulation Q.

The results of the base run are summarized in two tables. Table 4.17 provides summary macroeconomic results for the run for 1981 and 1995. Table 4.18 provides levels and growth rates for outputs at the 78 sector level. Before concluding this chapter, it is useful to briefly examine the various components of the forecast.

The macroeconomic results of the base run are quite optimistic. The unemployment which peaks in 1982 at 8.59%, rapidly declines to 5.55% in 1983 and then slowly declines to just under 4% by 1995. The recovery in 1983 is led by residential structures and equipment investment. Even PCE, however, shows a healthy increase at 6.8% between 1982-83. The sectors which show greatest growth in terms of employment are Business, repairs and other services, Wholesale and retail trade and Durable goods manufacturing, each showing above 6.5% growth for the 1982-83 period.

For the 1982-86 period, real GNP growth is over 3.5% per year and private sector jobs are increasing at an average near 3% per year.

Over the longer run, from 1986-95, real GNP grows at a more moderate 2.7% per year rate, while private sector jobs increase at 1.63% per year. Equipment investment, residential structures and exports are the three fastest growing GNP components. Employment sectors showing faster than average growth are concentrated in the service sectors: Trade, Medicine and education, and Business, repair and other services.

For monetary variables, interest rates decline by about one-third from their 1981 peaks in 1982 and continue to decline slightly to 1989. After reversing this decline in 1990, interest rates continue a slow decline until 1995. The decline in interest rates is primarily the result of slightly moderating inflation rates. Inflation moderates until the 1989-90 period, which is fully one percentage point higher than the 1988-89 inflation rate. This spurt is due to a spurt in M2 growth in 1988-89 period. The average rate of M2 growth is 7.68% for the 1982-86 period and 8.04% for the 1986-95 period. The non-borrowed monetary base grows at 8% per year fo the entire forecast.

The pattern of industry output growth over the 1982-86 period reflects the sources of the recovery. Two particularly fast growing output sectors are Lumber and Stone, clay and glass, which sell approximately one-half and one-third of their outputs respectively directly to construction. The outputs for the Non-electrical machinery sectors (29-37), are heavily used by the final demand component

equipment investment and as a consequence, grow quite quickly over the 1982-86 period (6.08%). The output of the Motor vehicle industry (43) grows very quickly over the 1982-86 period, owing to a resurgence in consumer purchases of new automobiles and trucks and equipment investment, each final demand component purchasing about one-third of total motor vehicle output. Particularly fast growing service sector outputs are Business services and Movies and amusements. Business services, in contrast to most other service sector industries, sells most of its output as an input to make other products. Thus the fast growth in this sector is basically due to rapid growth in the entire economy, including equipment investment and construction spending. The output of the Movies and amusements industry, in contrast, is purchased mostly by consumers directly, so the fast output growth is due to the quick recovery for PCE expenditures for Movies and amusements.

For the 1986-95 period, the rates of output growth are smaller and show less variation among sectors. This is a reflection of the absence of a large recovery or decline. Non-electrical machinery (29-37), Electrical macinery (38-42) and Motor vehicles all show comparatively fast growth for the 1986-95 period. These rates primarily reflect the path of equipment investment and in the case of Motor vehicles, strong growth in personal consumption expenditures on new autos and trucks. The two fastest growing service sectors are again Business services and Movies and amusements.

Conclusion

The purpose of this chapter was to outline the steps necessary to obtain a reasonable base forecast. Many partial run have been presented along with more detailed results of the base run. In the next two chapters several alternative scenarios are presented in an attempt to ascertain the properties of the model subject to monetary policy changes.

ENDNOTES

1. See Perry {1}.

2. Examples of these equations can be found in Perry {1} and Schultze {2}.

REFERENCES

1. Perry, George L. "Inflation in Theory and Practice." Brookings Papers on Economic Activity, 1 (1980) pp. 207-60.

2. Schultze, Charles L. "Some Macro Foundations for Micro Theory." Brookings Papers on Economic Activity, 2 (1981) pp. 521-92.

BASE RUN

TABLE 4.1. EXOGENOUS ASSUMPTIONS

	1981	1982	1983	1984	1985	1986
ENERGY PRICE INDEXES						
Domestic crude oil ($/bbl)	30.62	28.07	29.50	31.70	34.10	36.60
Foreign crude oil ($/bbl)	35.26	32.80	29.91	31.71	34.11	36.61
DEMOGRAPHIC ASSUMPTIONS						
Civilian Labor Force (millions)	108.67	110.20	112.22	114.23	116.25	117.60
Population, total (in millions)	229.87	231.85	234.02	236.21	238.40	240.60
0-5 years	17.09	17.73	18.36	18.90	19.31	19.58
6-15 years	34.19	33.81	33.64	33.55	33.55	33.61
16-20 years	20.48	19.84	19.20	18.67	18.39	18.42
21-30 years	41.36	41.76	42.01	42.11	41.96	41.55
31-40 years	33.21	34.28	35.10	36.18	37.37	38.67
41-50 years	23.52	23.99	24.85	25.56	26.20	26.75
51-65 years	33.92	33.94	33.92	33.79	33.57	33.43
Over 65 years	26.10	26.50	26.95	27.45	28.05	28.57
Households	82.37	83.90	85.44	86.97	88.51	90.04
% of household heads aged 25-35	23.20	23.33	23.47	23.60	23.73	23.87
Government Purchases (77$)	415.61	417.95	427.97	437.28	449.47	460.48
Federal	155.76	158.71	163.64	167.88	174.99	182.10
Defense	104.48	113.16	119.88	125.46	131.05	136.64
Compensation of employees	43.08	43.76	44.44	45.13	45.81	46.49
Structures	2.22	2.25	2.28	2.32	2.35	2.39
Other	59.19	67.15	73.15	78.02	82.89	87.76
Non-defense	51.28	45.55	43.76	42.41	43.94	45.47
Compensation of employees	21.37	20.29	19.87	19.87	20.39	20.92
Structures	5.55	5.39	5.40	5.40	5.51	5.62
Other	24.37	19.86	18.50	17.15	18.04	18.93
State and local	259.85	259.24	264.32	269.40	274.48	278.38
Education	106.35	106.17	106.52	106.87	107.22	107.99
Compensation of employees	80.83	81.38	81.92	82.46	83.00	83.55
Structures	9.00	8.91	8.93	8.95	8.98	9.09
Other	16.52	15.88	15.67	15.45	15.24	15.36
Other	153.50	153.07	157.80	162.53	167.26	170.38
Compensation of employees	68.46	69.00	69.54	70.09	70.63	71.17
Structures	25.83	26.15	26.64	27.13	27.62	28.07
Other	59.21	57.92	61.62	65.32	69.01	71.14
Monetary variables						
Implicit reserve reqs. on M1	0.94	1.23	1.21	1.19	1.18	1.16
Non-borrowed monetary base	163.50	177.12	191.87	207.85	225.16	243.91
Real discount rate	2.50	2.50	2.50	2.50	2.50	2.50
Marginal corporate tax rate	0.46	0.46	0.46	0.46	0.46	0.46

BASE RUN

TABLE 4.1. EXOGENOUS ASSUMPTIONS
SUMMARY OF EXPONENTIAL ANNUAL GROWTH RATES

	81- 82	82- 83	83- 84	84- 85	85- 86	82- 86
ENERGY PRICE INDEXES						
Domestic crude oil ($/bbl)	-8.70	4.97	7.19	7.30	7.08	6.63
Foreign crude oil ($/bbl)	-7.23	-10.57	7.19	7.30	7.08	2.75
DEMOGRAPHIC ASSUMPTIONS						
Civilian Labor Force (millions)	1.40	1.81	1.78	1.75	1.15	1.62
Population, total (in millions)	0.86	0.93	0.93	0.92	0.92	0.93
0-5 years	3.67	3.49	2.90	2.15	1.40	2.48
6-15 years	-1.12	-0.51	-0.27	-0.00	0.19	-0.15
16-20 years	-3.19	-3.28	-2.80	-1.91	0.17	-1.85
21-30 years	0.97	0.59	0.24	-0.36	-0.97	-0.12
31-40 years	3.17	2.36	3.03	3.24	3.43	3.01
41-50 years	1.96	3.52	2.82	2.47	2.09	2.72
51-65 years	0.06	-0.06	-0.38	-0.65	-0.41	-0.38
Over 65 years	1.54	1.68	1.84	2.16	1.85	1.88
Households	1.85	1.81	1.78	1.75	1.72	1.77
% of household heads aged 25-35	0.57	0.57	0.57	0.56	0.56	0.56
Government Purchases (77$)	0.56	2.37	2.15	2.75	2.42	2.42
Federal	1.87	3.06	2.55	4.15	3.98	3.44
Defense	7.98	5.77	4.55	4.36	4.17	4.71
Compensation of employees	1.57	1.55	1.52	1.50	1.48	1.51
Structures	1.50	1.50	1.50	1.50	1.50	1.50
Other	12.62	8.56	6.44	6.05	5.71	6.69
Non-defense	-11.85	-3.99	-3.14	3.54	3.42	-0.04
Compensation of employees	-5.14	-2.13	0.00	2.61	2.55	0.76
Structures	-2.78	0.03	0.05	2.06	2.03	1.04
Other	-20.46	-7.06	-7.61	5.06	4.81	-1.20
State and local	-0.23	1.94	1.90	1.87	1.41	1.78
Education	-0.17	0.33	0.33	0.33	0.72	0.43
Compensation of employees	0.67	0.66	0.66	0.66	0.65	0.66
Structures	-0.98	0.23	0.24	0.25	1.20	0.48
Other	-3.94	-1.35	-1.38	-1.40	0.81	-0.83
Other	-0.28	3.04	2.95	2.87	1.85	2.68
Compensation of employees	0.79	0.78	0.78	0.77	0.77	0.78
Structures	1.24	1.84	1.82	1.81	1.62	1.77
Other	-2.20	6.20	5.83	5.50	3.03	5.14
Monetary variables						
Implicit reserve reqs. on M1	-63.33	-1.45	-1.47	-1.49	-1.51	-1.48
Non-borrowed monetary base	8.00	8.00	8.00	8.00	8.00	8.00
Real discount rate						
Marginal corporate tax rate						

BASE RUN

TABLE 4.1. EXOGENOUS ASSUMPTIONS

	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
ENERGY PRICE INDEXES										
Domestic crude oil ($/bbl)	36.60	38.90	41.26	43.63	45.99	48.89	51.79	54.69	57.59	60.49
Foreign crude oil ($/bbl)	36.61	38.91	41.28	43.64	46.01	48.91	51.81	54.71	57.61	60.52
DEMOGRAPHIC ASSUMPTIONS										
Civilian Labor Force (millions)	117.60	118.95	120.30	121.65	123.00	124.40	125.80	127.20	128.60	130.00
Population, total (in millions)	240.60	242.80	244.90	247.00	249.10	251.10	253.00	254.98	256.61	258.30
0-5 years	19.58	19.76	19.88	19.93	19.94	19.89	19.79	19.61	19.46	19.24
6-15 years	33.61	34.11	34.83	35.70	36.52	37.41	38.24	38.93	39.58	39.99
16-20 years	18.42	18.23	17.94	17.54	17.12	16.57	16.40	16.50	16.84	17.25
21-30 years	41.55	40.90	40.15	39.47	38.90	38.35	37.55	36.99	35.72	35.06
31-40 years	38.67	39.07	39.73	40.39	41.05	41.63	42.03	42.72	42.37	42.20
41-50 years	26.75	28.34	29.55	30.74	31.89	33.03	34.09	34.84	35.94	37.10
51-65 years	33.43	33.25	33.16	33.10	33.07	33.21	33.54	34.18	34.79	35.24
Over 65 years	28.57	29.15	29.65	30.13	30.62	31.01	31.34	31.61	31.91	32.20
Households	90.04	91.58	93.11	94.65	96.18	97.72	99.25	100.79	102.32	103.86
% of household heads aged 25-35	23.87	24.00	23.70	23.40	23.10	22.80	22.50	22.20	21.90	21.60
Government Purchases (77$)	460.48	470.70	479.23	487.76	496.28	504.66	513.03	521.41	529.78	538.16
Federal	182.10	188.43	193.06	197.70	202.33	206.86	211.39	215.92	220.45	224.99
Defense	136.64	141.44	144.94	147.64	150.75	153.85	156.96	160.06	163.16	166.27
Compensation of employees	46.49	46.39	46.29	46.19	46.08	45.98	45.88	45.78	45.68	45.57
Structures	2.39	2.42	2.46	2.50	2.54	2.57	2.61	2.65	2.69	2.73
Other	87.76	92.62	95.79	98.96	102.13	105.30	108.46	111.63	114.80	117.96
Non-defense	45.47	47.00	48.52	50.05	51.58	53.01	54.43	55.86	57.29	58.72
Compensation of employees	20.92	21.44	21.97	22.49	23.02	23.55	24.07	24.60	25.12	25.65
Structures	5.62	5.74	5.85	5.97	6.09	6.20	6.31	6.43	6.55	6.66
Other	18.93	19.82	20.70	21.59	22.47	23.26	24.05	24.83	25.62	26.40
State and local	278.38	282.27	286.17	290.06	293.96	297.80	301.64	305.49	309.33	313.17
Education	107.99	108.77	109.54	110.32	111.09	112.07	113.05	114.02	115.00	115.98
Compensation of employees	83.55	84.09	84.63	85.17	85.72	86.26	86.80	87.34	87.89	88.43
Structures	9.09	9.20	9.31	9.42	9.53	9.68	9.84	10.00	10.15	10.31
Other	15.36	15.48	15.61	15.73	15.85	16.13	16.41	16.68	16.96	17.24
Other	170.38	173.51	176.63	179.75	182.87	185.73	188.60	191.46	194.33	197.20
Compensation of employees	71.17	71.72	72.26	72.80	73.34	73.96	74.57	75.18	75.79	76.40
Structures	28.07	28.53	29.00	29.46	29.94	30.41	30.89	31.37	31.86	32.36
Other	71.14	73.26	75.37	77.48	79.58	81.37	83.14	84.91	86.68	88.44
Monetary variables										
Implicit reserve reqs. on M1	1.16	1.14	1.12	1.11	1.09	1.07	1.05	1.04	1.02	1.00
Non-borrowed monetary base	243.91	264.23	286.23	310.07	335.90	363.88	394.18	427.01	462.58	501.10
Real discount rate	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50
Marginal corporate tax rate	0.46	0.46	0.46	0.46	0.46	0.46	0.46	0.46	0.46	0.46

BASE RUN

TABLE 4.1. EXOGENOUS ASSUMPTIONS
SUMMARY OF EXPONENTIAL ANNUAL GROWTH RATES

	86- 87	87- 88	88- 89	89- 90	90- 91	91- 92	92- 93	93- 94	94- 95	86- 95
ENERGY PRICE INDEXES										
Domestic crude oil ($/bbl)	6.09	5.91	5.58	5.28	6.11	5.76	5.45	5.17	4.91	5.58
Foreign crude oil ($/bbl)	6.09	5.91	5.58	5.28	6.11	5.76	5.45	5.17	4.91	5.58
DEMOGRAPHIC ASSUMPTIONS										
Civilian Labor Force (millions)	1.14	1.13	1.12	1.10	1.13	1.12	1.11	1.09	1.08	1.11
Population, total (in millions)	0.91	0.86	0.85	0.85	0.80	0.75	0.78	0.64	0.66	0.79
0-5 years	0.93	0.59	0.25	0.07	-0.25	-0.52	-0.90	-0.78	-1.13	-0.19
6-15 years	1.46	2.10	2.46	2.26	2.41	2.21	1.77	1.66	1.04	1.93
16-20 years	-1.02	-1.62	-2.26	-2.40	-3.26	-1.05	0.59	2.05	2.41	-0.73
21-30 years	-1.59	-1.84	-1.71	-1.46	-1.42	-2.10	-2.60	-2.41	-1.86	-1.89
31-40 years	1.02	1.68	1.64	1.62	1.41	0.96	1.62	-0.83	-0.39	0.97
41-50 years	5.75	4.20	3.94	3.66	3.52	3.17	2.18	3.10	3.18	3.63
51-65 years	-0.56	-0.26	-0.19	-0.10	0.43	1.00	1.89	1.76	1.29	0.59
Over 65 years	1.99	1.72	1.60	1.60	1.27	1.07	0.84	0.95	0.91	1.33
Households	1.69	1.66	1.63	1.61	1.58	1.56	1.53	1.51	1.49	1.59
% of household heads aged 25-35	0.56	-1.26	-1.27	-1.29	-1.31	-1.32	-1.34	-1.36	-1.38	-1.11
Government Purchases (77$)	2.20	1.80	1.76	1.73	1.67	1.65	1.62	1.59	1.57	1.73
Federal	3.42	2.43	2.37	2.32	2.21	2.17	2.12	2.08	2.03	2.35
Defense	3.45	2.17	2.12	2.08	2.04	2.00	1.96	1.92	1.88	2.18
Compensation of employees	-0.22	-0.22	-0.22	-0.22	-0.22	-0.22	-0.22	-0.22	-0.22	-0.22
Structures	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50
Other	5.40	3.36	3.25	3.15	3.05	2.96	2.88	2.80	2.72	3.29
Non-defense	3.31	3.20	3.10	3.01	2.73	2.66	2.59	2.52	2.46	2.84
Compensation of employees	2.48	2.42	2.37	2.31	2.26	2.21	2.16	2.12	2.07	2.27
Structures	2.01	1.99	1.97	1.95	1.85	1.83	1.82	1.80	1.79	1.89
Other	4.58	4.38	4.19	4.02	3.45	3.33	3.22	3.11	3.01	3.70
State and local	1.39	1.37	1.35	1.33	1.30	1.28	1.27	1.25	1.23	1.31
Education	0.71	0.71	0.70	0.70	0.88	0.87	0.86	0.85	0.85	0.79
Compensation of employees	0.65	0.64	0.64	0.63	0.63	0.63	0.62	0.62	0.62	0.63
Structures	1.20	1.20	1.19	1.19	1.61	1.59	1.58	1.56	1.55	1.41
Other	0.79	0.78	0.77	0.76	1.76	1.72	1.68	1.65	1.62	1.28
Other	1.81	1.78	1.75	1.72	1.56	1.53	1.51	1.49	1.46	1.62
Compensation of employees	0.76	0.75	0.75	0.74	0.83	0.82	0.82	0.81	0.80	0.79
Structures	1.62	1.61	1.60	1.60	1.56	1.56	1.55	1.55	1.54	1.58
Other	2.94	2.84	2.76	2.68	2.22	2.16	2.11	2.06	2.01	2.42
Monetary variables										
Implicit reserve reqs. on M1	-1.54	-1.56	-1.59	-1.61	-1.64	-1.67	-1.69	-1.72	-1.75	-1.64
Non-borrowed monetary base	8.00	8.00	8.00	8.00	8.00	8.00	8.00	8.00	8.00	8.00
Real discount rate										
Marginal corporate tax rate										

BASE RUN

TABLE 4.17. SUMMARY OF RESULTS

	1981	1982	1983	1984	1985	1986
Gross National Product, (cu. $)	2984.43	3228.80	3649.40	3976.92	4299.19	4626.36
Labor compensation	1771.40	1952.51	2215.35	2414.87	2612.40	2814.46
Indirect business taxes	251.76	258.68	287.54	307.19	327.24	349.60
Return to capital	900.07	950.63	1072.17	1176.16	1276.77	1374.54
Net interest	245.45	261.41	278.40	296.50	315.77	336.29
Corporate profits	249.06	277.97	348.89	402.35	433.72	458.76
Proprietor income	147.38	159.05	183.41	203.74	224.43	246.81
Gross National Product Deflator	1.99	2.12	2.25	2.38	2.51	2.64
Hourly labor comp. index (manuf.)	144.40	160.83	172.69	183.03	192.94	204.09
Labor productivity (GNP/JOBS)	20.10	20.30	20.60	20.74	20.88	21.01
Financial variables						
Treasury bill rate	14.76	10.97	9.44	9.50	8.40	7.97
Treasury bonds , 10 year	13.91	11.66	10.33	8.76	8.30	8.05
AAA Corporate bond rate	14.17	13.07	11.34	9.80	9.03	8.71
Commercial paper rate	14.76	10.72	9.57	9.83	8.57	8.31
Mortgage rate	14.17	12.82	11.45	10.04	9.46	9.20
M2 (billions of current$)	1743.75	1972.61	2262.78	2337.02	2487.97	2682.23
Non-borrowed reserve base	163.50	177.12	191.87	207.85	225.16	243.91
Ratio of M2 to nominal GNP	0.58	0.61	0.62	0.59	0.58	0.58
Savings rate	6.42	6.90	6.94	7.46	7.55	7.39
Gross National Product (77$)	2095.23	2126.10	2271.93	2340.93	2396.74	2448.75
Personal Consumption	1313.09	1378.20	1475.87	1508.21	1541.44	1581.42
Residential Structures	68.86	60.70	83.85	91.62	94.84	100.85
Non-residential structures	82.83	86.18	91.01	94.13	97.52	97.34
Producers' durable equipment	172.33	165.31	187.36	200.79	213.13	222.50
Inventory change	9.39	4.74	19.24	19.76	16.36	16.42
Exports	254.48	246.91	236.58	244.87	245.92	241.49
Imports	221.38	233.92	249.96	255.75	261.97	271.78
Other variables						
Disp. income per capita (1972$)	4537.61	4729.71	5015.37	5101.55	5169.31	5243.73
Return to capital scaler	1.00	1.00	1.00	1.00	1.00	1.00
Foreign demand scaler	1.00	1.00	1.00	1.00	1.00	1.00
Trade balance (cu. $)						
Merchandise exports (cu. $)	218.89	213.87	230.15	251.28	266.43	272.63
Merchandise imports (cu. $)	261.71	269.78	296.77	321.72	353.31	386.51
Exchange rate scaler	1.00	1.00	1.00	1.00	1.00	1.00
Unemployment rate	7.71	8.59	9.55	9.23	9.46	9.33
Civilian jobs (millions)	104.22	104.74	110.29	112.86	114.80	116.53
Private sector jobs	88.01	88.44	93.86	96.29	98.06	99.62
Agric, Mining, Structures	9.95	9.77	10.45	10.69	10.85	10.96
Durable goods manufacturing	12.20	11.90	12.63	12.92	13.17	13.27
Non-durable goods mfg	8.13	8.00	8.12	8.17	8.09	8.00
Transp, Communic, Utilities	5.43	5.38	5.62	5.66	5.69	5.69
Trade	22.88	23.47	25.20	26.03	26.62	27.22
Finance, Insurance, Real Estate	5.88	5.99	6.37	6.59	6.70	6.82
Medicine & Education	10.51	10.53	11.10	11.33	11.60	11.92
Domestic servants	1.88	1.86	1.84	1.82	1.80	1.79
Business, Repair, Oth services	11.16	11.55	12.55	13.09	13.55	13.98

BASE RUN

TABLE 4.17. SUMMARY OF RESULTS
SUMMARY OF EXPONENTIAL ANNUAL GROWTH RATES

	81- 82	82- 83	83- 84	84- 85	85- 86	82- 86
Gross National Product, (cu. $)	7.87	12.25	8.59	7.79	7.33	8.99
Labor compensation	9.73	12.63	8.62	7.86	7.45	9.14
Indirect business taxes	2.71	10.57	6.61	6.32	6.61	7.93
Return to capital	5.47	12.03	9.26	8.21	7.38	9.22
Net interest	6.30	6.30	6.30	6.30	6.30	6.30
Corporate profits	10.98	22.72	14.26	7.51	5.61	12.53
Proprietor income	7.63	14.25	10.51	9.67	9.50	10.98
Gross National Product Deflator	6.41	5.61	5.60	5.44	5.19	5.46
Hourly labor comp. index (manuf.)	10.78	7.11	5.81	5.27	5.62	5.95
Labor productivity (GNP/JOBS)	0.96	1.47	0.69	0.65	0.65	0.87
Financial variables						
Treasury bill rate	-29.66	-15.03	0.63	-12.30	-5.23	-7.98
Treasury bonds , 10 year	-17.64	-12.15	-16.48	-8.32	-3.06	-9.25
AAA Corporate bond rate	-8.09	-14.22	-14.52	-8.27	-3.61	-10.16
Commercial paper rate	-31.95	-11.40	2.77	-13.74	-3.14	-6.37
Mortgage rate	-10.03	-11.24	-13.23	-5.91	-2.79	-8.29
M2 (billions of current$)	12.33	13.72	3.23	6.26	7.52	7.68
Non-borrowed reserve base	8.00	8.00	8.00	8.00	8.00	8.00
Ratio of M2 to nominal GNP	4.46	1.48	-5.37	-1.53	0.18	-1.31
Savings rate	7.24	0.53	7.31	1.21	-2.17	1.72
Gross National Product (77$)	1.46	6.63	2.99	2.36	2.15	3.53
Personal Consumption	4.84	6.85	2.17	2.18	2.56	3.44
Residential Structures	-12.61	32.30	8.86	3.46	6.14	12.69
Non-residential structures	3.96	5.45	3.37	3.54	-0.18	3.04
Producers' durable equipment	-4.16	12.52	6.92	5.96	4.30	7.43
Inventory change	-68.43	140.16	2.65	-18.84	0.35	31.08
Exports	-3.02	-4.27	3.45	0.43	-1.82	-0.55
Imports	5.51	6.63	2.29	2.40	3.68	3.75
Other variables						
Disp. income per capita (1972$)	4.15	5.86	1.70	1.32	1.43	2.58
Return to capital scaler						
Foreign demand scaler						
Trade balance (cu. $)						
Merchandise exports (cu. $)	-2.32	7.33	8.78	5.85	2.30	6.07
Merchandise imports (cu. $)	1.55	11.03	8.07	9.37	8.98	9.36
Exchange rate scaler						
Unemployment rate	10.72	-43.64	-5.97	4.38	-2.41	-11.91
Civilian jobs (millions)	0.50	5.16	2.30	1.70	1.50	2.67
Private sector jobs	0.49	5.95	2.55	1.82	1.59	2.98
Agric.,Mining,Structures	-1.86	6.73	2.34	1.41	1.08	2.89
Durable goods manufacturing	-2.51	6.01	2.21	1.92	0.75	2.72
Non-durable goods mfg	-1.64	1.42	0.67	-0.93	-1.22	-0.02
Transp.,Communic.,Utilities	-0.91	4.40	0.69	0.41	0.07	1.39
Trade	2.54	7.10	3.26	2.21	2.23	3.70
Finance,Insurance,Real Estate	1.91	6.13	3.32	1.78	1.76	3.25
Medicine & Education	0.18	5.27	2.00	2.41	2.66	3.08
Domestic servants	-1.02	-1.03	-1.04	-1.05	-0.37	-0.87
Business,Repair,Oth services	3.47	8.25	4.28	3.45	3.07	4.76

BASE RUN

TABLE 4.17. SUMMARY OF RESULTS

	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
Gross National Product, (cu. $)	4626.36	4987.38	5335.27	5761.08	6235.53	6715.31	7244.74	7832.38	8415.93	9080.28
Labor compensation	2814.46	3035.30	3247.55	3503.16	3795.68	4090.12	4412.76	4771.76	5129.96	5536.07
Indirect business taxes	349.60	374.51	398.81	426.58	457.53	489.46	525.06	564.00	603.34	647.38
Return to capital	1374.54	1484.29	1590.42	1726.13	1869.73	2016.16	2179.41	2360.18	2537.72	2742.16
Net interest	336.29	358.15	381.43	406.22	432.63	460.79	490.70	522.59	556.56	592.74
Corporate profits	458.76	493.96	528.52	581.09	644.49	700.17	755.56	814.69	867.99	931.20
Proprietor income	246.81	271.47	297.04	328.91	361.55	395.34	433.88	477.45	522.20	573.59
Gross National Product Deflator	2.64	2.78	2.92	3.06	3.24	3.43	3.61	3.80	4.01	4.23
Hourly labor comp. index (manuf.)	204.09	216.31	227.87	240.26	255.38	272.33	289.01	306.37	325.35	344.93
Labor productivity (GNP/JOBS)	21.01	21.18	21.31	21.50	21.67	21.82	22.00	22.18	22.33	22.51
Financial variables										
Treasury bill rate	7.97	7.60	7.38	6.67	7.06	6.88	6.61	6.54	6.36	5.92
Treasury bonds , 10 year	8.05	7.81	7.59	7.24	7.34	7.34	7.34	7.20	7.02	6.85
AAA Corporate bond rate	8.71	8.45	8.22	7.85	7.86	7.85	7.81	7.70	7.53	7.33
Commercial paper rate	8.31	7.96	7.80	6.97	7.56	7.25	6.95	6.91	6.71	6.24
Mortgage rate	9.20	8.98	8.77	8.46	8.50	8.50	8.50	8.39	8.23	8.08
M2 (billions of current$)	2682.23	2909.14	3119.84	3422.42	3707.39	3990.93	4348.62	4726.79	5080.02	5530.59
Non-borrowed reserve base	243.91	264.23	286.23	310.07	335.90	363.88	394.18	427.01	462.58	501.10
Ratio of M2 to nominal GNP	0.58	0.58	0.58	0.59	0.59	0.59	0.60	0.60	0.60	0.61
Savings rate	7.39	7.38	7.35	7.38	7.88	8.08	7.94	8.14	8.26	8.24
Gross National Product (77$)	2448.75	2509.05	2590.62	2629.59	2692.08	2740.69	2807.79	2878.50	2931.63	3003.41
Personal Consumption	1581.42	1620.76	1655.51	1702.55	1734.44	1762.25	1802.41	1838.67	1868.74	1908.15
Residential Structures	100.85	104.43	108.78	113.84	117.83	118.49	122.35	126.07	128.97	132.72
Non-residential structures	97.34	100.21	101.31	107.01	109.48	111.67	114.81	118.25	120.06	123.77
Producers' durable equipment	222.50	233.44	221.25	230.60	240.88	247.66	257.28	272.40	278.18	290.21
Inventory change	16.42	16.47	13.65	16.97	18.10	16.52	18.27	20.09	18.70	20.03
Exports	241.49	243.98	253.58	263.43	276.29	286.69	297.80	310.35	323.51	337.16
Imports	271.78	280.97	282.71	292.60	301.26	307.28	318.19	328.76	336.34	346.81
Other variables										
Disp. income per capita (1972$)	5243.73	5324.89	5390.80	5496.75	5585.78	5643.36	5718.30	5801.53	5867.05	5948.70
Return to capital scaler	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Foreign demand scaler	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Trade balance (cu. $)										
Merchandise exports (cu. $)	272.63	289.47	317.03	347.12	383.24	421.84	463.62	509.93	562.28	620.01
Merchandise imports (cu. $)	386.51	420.94	444.76	483.91	523.90	566.38	619.82	675.76	730.31	796.01
Exchange rate scaler	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Unemployment rate	5.33	5.01	5.31	4.50	4.20	4.52	4.32	4.00	4.18	3.90
Civilian jobs (millions)	116.53	118.49	119.71	122.28	124.23	125.60	127.61	129.78	131.30	133.43
Private sector jobs	99.62	101.44	102.53	104.96	106.78	108.01	109.89	111.93	113.32	115.32
Agric,Mining,Structures	10.96	11.12	11.25	11.51	11.69	11.77	11.93	12.11	12.22	12.39
Durable goods manufacturing	13.27	13.43	13.33	13.63	13.83	13.92	14.15	14.41	14.51	14.75
Non-durable goods mfg	8.00	7.95	7.88	7.87	7.84	7.77	7.72	7.69	7.62	7.58
Transp.Communic,Utilities	5.69	5.71	5.70	5.76	5.78	5.78	5.80	5.83	5.82	5.84
Trade	27.22	27.86	28.30	29.07	29.71	30.17	30.82	31.51	32.00	32.68
Finance,Insurance,Real Estate	6.82	6.95	7.05	7.20	7.33	7.41	7.53	7.66	7.75	7.88
Medicine & Education	11.92	12.21	12.43	12.79	12.99	13.20	13.47	13.72	13.96	14.24
Domestic servants	1.79	1.79	1.78	1.77	1.77	1.76	1.76	1.75	1.75	1.74
Business,Repair,Oth services	13.98	14.44	14.82	15.37	15.86	16.25	16.75	17.27	17.70	18.24

BASE RUN

TABLE 4.17. SUMMARY OF RESULTS
SUMMARY OF EXPONENTIAL ANNUAL GROWTH RATES

	86- 87	87- 88	88- 89	89- 90	90- 91	91- 92	92- 93	93- 94	94- 95	86- 95
Gross National Product, (cu. $)	7.51	6.74	7.68	7.91	7.41	7.59	7.80	7.19	7.60	7.49
Labor compensation	7.55	6.76	7.58	8.02	7.47	7.59	7.82	7.24	7.62	7.52
Indirect business taxes	6.88	6.29	6.73	7.00	6.74	7.02	7.16	6.74	7.05	6.85
Return to capital	7.68	6.91	8.19	7.99	7.54	7.79	7.97	7.25	7.75	7.67
Net interest	6.30	6.30	6.30	6.30	6.30	6.30	6.30	6.30	6.30	6.30
Corporate profits	7.39	6.76	9.48	10.35	8.29	7.61	7.53	6.34	7.03	7.87
Proprietor income	9.52	9.00	10.07	9.58	8.94	9.30	9.57	8.96	9.39	9.37
Gross National Product Deflator	5.08	5.10	4.63	5.57	5.62	5.17	5.31	5.36	5.18	5.22
Hourly labor comp. index (manuf.)	5.81	5.21	5.30	6.10	6.43	5.94	5.83	6.01	5.84	5.83
Labor productivity (GNP/JOBS)	0.77	0.62	0.92	0.76	0.70	0.83	0.80	0.66	0.82	0.76
Financial variables										
Treasury bill rate	-4.74	-2.91	-10.20	5.72	-2.58	-3.96	-1.10	-2.84	-7.15	-3.31
Treasury bonds , 10 year	-3.03	-2.91	-4.64	1.36	-0.10	-0.02	-1.93	-2.49	-2.41	-1.80
AAA Corporate bond rate	-3.00	-2.71	-4.59	0.06	-0.08	-0.60	-1.41	-2.25	-2.57	-1.91
Commercial paper rate	-4.26	-2.10	-11.14	8.13	-4.23	-4.29	-0.58	-2.87	-7.33	-3.18
Mortgage rate	-2.46	-2.36	-3.50	0.36	0.10	-0.02	-1.31	-1.91	-1.92	-1.45
M2 (billions of current$)	8.12	6.99	9.26	8.00	7.37	8.58	8.34	7.21	8.50	8.04
Non-borrowed reserve base	8.00	8.00	8.00	8.00	8.00	8.00	8.00	8.00	8.00	8.00
Ratio of M2 to nominal GNP	0.61	0.25	1.58	0.08	-0.04	0.99	0.54	0.02	0.90	0.55
Savings rate	-0.10	-0.43	0.35	6.57	2.51	-1.78	2.51	1.49	-0.25	1.21
Gross National Product (77$)	2.43	1.64	3.05	2.35	1.79	2.42	2.49	1.83	2.42	2.27
Personal Consumption	2.46	2.12	2.80	1.86	1.59	2.25	1.99	1.62	2.09	2.09
Residential Structures	3.49	4.08	4.55	3.44	0.56	3.20	2.99	2.27	2.87	3.05
Non-residential structures	2.91	1.09	5.48	2.28	1.98	2.77	2.96	1.52	3.04	2.67
Producers' durable equipment	4.80	-5.36	4.14	4.36	2.78	3.81	5.71	2.10	4.23	2.95
Inventory change	0.31	-18.82	21.79	6.46	-9.15	10.06	9.49	-7.18	6.89	2.21
Exports	1.02	3.86	3.81	4.76	3.70	3.80	4.13	4.15	4.13	3.71
Imports	3.33	0.62	3.44	2.92	1.98	3.49	3.27	2.28	3.07	2.71
Other variables										
Disp. income per capita (1972$)	1.54	1.23	1.95	1.61	1.03	1.32	1.44	1.12	1.38	1.40
Return to capital scaler										
Foreign demand scaler										
Trade balance (cu. $)										
Merchandise exports (cu. $)	6.00	9.09	9.06	9.90	9.60	9.44	9.52	9.77	9.77	9.13
Merchandise imports (cu. $)	8.53	5.50	8.44	7.94	7.80	9.02	8.64	7.76	8.61	8.03
Exchange rate scaler										
Unemployment rate	-6.14	5.77	-16.66	-6.78	7.33	-4.64	-7.74	4.56	-6.88	-3.46
Civilian jobs (millions)	1.66	1.03	2.12	1.58	1.09	1.59	1.68	1.17	1.60	1.50
Private sector jobs	1.81	1.07	2.34	1.71	1.15	1.73	1.84	1.24	1.74	1.63
Agric,Mining,Structures	1.41	1.14	2.33	1.52	0.69	1.34	1.50	0.91	1.39	1.36
Durable goods manufacturing	1.21	-0.74	2.20	1.51	0.65	1.59	1.86	0.69	1.60	1.17
Non-durable goods mfg	-0.59	-0.83	-0.15	-0.42	-0.88	-0.67	-0.36	-0.87	-0.52	-0.59
Transp,Communic,Utilities	0.45	-0.21	0.96	0.44	-0.11	0.42	0.45	-0.11	0.36	0.29
Trade	2.35	1.55	2.71	2.15	1.55	2.14	2.21	1.56	2.10	2.03
Finance,Insurance,Real Estate	1.85	1.49	2.01	1.87	1.09	1.53	1.73	1.21	1.58	1.60
Medicine & Education	2.40	1.81	2.88	1.52	1.59	2.01	1.89	1.74	1.93	1.98
Domestic servants	-0.37	-0.37	-0.37	-0.37	-0.31	-0.31	-0.31	-0.31	-0.31	-0.34
Business,Repair,Oth services	3.27	2.60	3.65	3.10	2.43	3.03	3.06	2.47	2.99	2.95

BASE RUN

TABLE 4.18. OUTPUT BY PRODUCING SECTOR (1977$)

		1981	1982	1983	1984	1985	1986
1	AGRICULTURE, FORESTRY, FISHERY	143.71	142.76	147.67	150.88	152.96	155.14
	MINING	80.86	81.18	85.63	87.23	87.60	88.02
2	IRON ORE MINING	2.46	2.47	2.69	2.70	2.75	2.78
3	NONFERROUS METALS MINING	3.11	3.06	3.44	3.62	3.72	3.59
4	COAL MINING	20.57	20.96	21.96	22.71	23.32	23.98
5	NATURAL GAS EXTRACTION	19.63	18.32	19.20	19.45	19.45	19.50
6	CRUDE PETROLEUM	28.17	29.33	30.74	30.80	30.22	29.86
7	NON-METALLIC MINING	6.92	7.03	7.63	7.94	8.14	8.30
8	CONSTRUCTION	99.90	97.38	109.57	113.86	117.10	119.88
	NON-DURABLES	671.99	684.07	725.97	747.05	757.93	769.64
9	FOOD & TOBACCO	218.11	220.39	228.50	232.48	234.68	237.46
10	TEXTILES, EXC. KNITS	34.87	35.93	39.57	41.39	42.12	43.06
11	KNITTING	9.17	9.67	10.53	10.72	10.97	11.04
12	APPAREL, HOUSEHOLD TEXTILES	41.60	44.39	48.34	50.03	50.76	52.10
13	PAPER	51.19	51.27	55.10	56.96	58.02	59.17
14	PRINTING & PUBLISHING	50.43	49.98	53.08	55.46	56.74	57.75
15	AGRICULTURAL FERTILIZERS	13.52	13.26	13.76	14.12	14.23	14.34
16	OTHER CHEMICALS	109.19	112.17	120.77	124.94	127.14	129.53
17	PETROLEUM REFINING	96.81	98.16	102.77	104.82	105.51	106.19
	18 FUEL OIL	24.33	24.43	25.53	25.59	25.58	25.77
19	RUBBER PRODUCTS	15.39	15.98	17.52	18.30	18.87	19.37
20	PLASTIC PRODUCTS	25.30	25.66	28.32	29.58	30.34	31.02
21	SHOES AND LEATHER	6.42	7.20	7.73	8.26	8.55	8.63
	DURABLES	723.11	716.60	813.20	841.76	874.84	900.96
22	LUMBER	39.84	37.53	41.26	44.06	45.39	46.78
23	FURNITURE	16.42	16.97	18.85	19.65	20.25	20.73
24	STONE, CLAY, GLASS	32.80	32.54	37.11	38.87	40.09	40.86
25	FERROUS METALS	54.06	52.81	56.49	56.83	58.54	60.16
26	COPPER	8.64	8.36	9.21	9.77	9.97	9.65
27	OTHER NONFERROUS METALS	33.10	33.27	36.88	38.29	39.77	40.59
28	METAL PRODUCTS	86.35	86.79	96.52	98.21	101.39	103.90
	NON-ELEC MACHINERY	144.57	137.52	154.00	163.73	170.85	175.36
29	ENGINES AND TURBINES	11.05	10.79	12.41	12.93	13.34	13.55
30	AGRICULTURAL MACHINERY	11.26	10.35	11.47	12.35	12.72	12.84
31	CONSTR, MINING, OILFIELD EQ	18.37	17.26	18.05	19.44	19.38	18.95
32	METALWORKING MACHINERY	15.32	13.48	15.83	17.06	17.82	18.26
33	SPECIAL INDUSTRY MACHINERY	9.12	8.55	9.11	9.86	10.18	9.95
34	MISC NON-ELECTRICAL MACH.	36.71	34.28	39.26	40.87	42.44	42.85
35	COMPUTERS	27.65	28.10	31.24	33.78	36.79	40.16
36	OTHER OFFICE EQUIPMENT	3.04	2.99	3.23	3.36	3.45	3.51
37	SERVICE INDUSTRY MACHINERY	12.06	11.72	13.40	14.09	14.74	15.30
	ELECTRICAL MACHINERY	116.63	113.68	124.94	133.16	140.27	141.43
38	COMMUNIC EQ, ELECTRONIC COMP	63.19	62.17	67.60	73.08	78.25	79.33
39	ELEC INDL APP & DISTRIB EQ	20.64	19.11	21.62	22.74	23.73	23.43
40	HOUSEHOLD APPLIANCES	10.58	10.14	10.78	11.44	11.62	11.89
41	ELEC LIGHTING & WIRING EQ	16.08	16.11	18.38	19.01	19.65	19.54
42	TV SETS, RADIOS, PHONOGRAPHS	6.14	6.15	6.56	6.89	7.03	7.24
	TRANSPORTATION EQ	144.33	150.30	186.90	184.61	191.69	203.36
43	MOTOR VEHICLES	87.33	92.65	123.39	118.40	122.53	131.29
44	AEROSPACE	38.61	38.32	41.99	44 01	45.33	46.90
45	SHIPS, BOATS	9.28	10.23	11.22	11.72	12.53	13.31
46	OTHER TRANSP. EQUIP.	9.11	9.09	10.30	10.49	11.30	11.86

BASE RUN

TABLE 4.18. OUTPUT BY PRODUCING SECTOR (1977$)

		1981	1982	1983	1984	1985	1986
47	INSTRUMENTS	28.54	28.28	30.88	33.34	34.86	35.81
48	MISC. MANUFACTURING	17.81	18.55	20.17	21.23	21.76	22.32
	TRANSPORTATION	136.14	137.40	147.80	152.36	156.53	159.92
49	RAILROADS	22.72	22.54	24.24	24.62	25.03	25.31
50	TRUCKING, HWY PASS TRANSIT	63.57	64.35	69.27	71.58	73.57	75.35
51	WATER TRANSPORT	15.44	15.11	15.86	16.31	16.68	16.80
52	AIR TRANSPORT	28.23	29.15	31.86	33.11	34.40	35.53
53	PIPELINE	3.58	3.64	3.82	3.91	3.95	3.99
54	TRANSPORTAION SERVICES	2.61	2.61	2.75	2.83	2.89	2.93
	UTILITIES	223.80	229.59	246.10	253.91	261.65	269.40
55	COMMUNICATIONS SERVICES	83.10	86.34	94.16	98.39	102.86	107.18
56	ELECTRIC UTILILITIES	78.35	79.66	84.32	86.71	88.65	90.57
57	GAS UTILITY	51.31	52.21	55.24	53.90	56.82	57.87
58	WATER AND SANITATION	11.04	11.38	12.38	12.92	13.32	13.78
59	WHOLESALE TRADE	187.85	190.13	206.07	213.92	220.12	225.91
60	RETAIL TRADE	193.65	202.88	218.77	225.92	231.36	237.71
61	EATING & DRINKING PLACES	89.33	93.28	101.34	104.37	107.08	110.12
62	FINANCE & INSURANCE	130.86	134.39	142.93	149.15	153.02	156.73
63	REAL ESTATE	158.83	161.55	174.67	179.26	181.86	185.22
64	OWNER-OCCUPIED HOUSING	154.89	163.08	174.95	178.99	183.06	187.96
	SERVICES	488.44	502.03	542.85	565.03	585.78	605.93
65	HOTELS, REPAIRS EXC AUTO	44.31	45.65	48.51	49.63	50.53	51.43
66	BUSINESS SERVICES	202.75	210.72	232.55	246.10	258.55	269.45
67	AUTOMOBILE REPAIRS	42.60	45.39	49.42	51.10	52.48	54.11
68	MOVIES AND AMUSEMENTS	23.87	24.69	26.91	28.61	29.62	30.69
69	MEDICINE,EDUCATION,NPO	174.92	175.59	185.46	189.59	194.60	200.25
70	FED & S&L GOVT ENTERPRISES	28.22	28.90	31.04	31.75	32.41	33.11
71	NON COMPETITIVE IMPORTS						
72	DOMESTIC SERVANTS	5.09	5.88	6.27	5.72	5.82	5.93
73	UNIMPORTANT INDUSTRY	8.50	8.66	9.37	9.76	10.07	10.28
74	SCRAP AND USED	2.65	3.55	3.55	3.91	4.26	4.39
75	REST OF THE WORLD INDUSTRY	36.07	36.76	26.87	28.27	27.57	25.60
76	GOVERNMENT INDUSTRY	213.73	214.43	215.77	217.54	219.83	222.13
77	II&FORUM STAT. DISCREPANCY	16.08	15.04	16.24	17.84	18.54	18.98
78	NIPA STAT. DISCREPANCY	1.22	0.00	0.00	0.00	0.00	0.00

BASE RUN

TABLE 4.18. OUTPUT BY PRODUCING SECTOR (1977$)
SUMMARY OF EXPONENTIAL ANNUAL GROWTH RATES

		81- 82	82- 83	83- 84	84- 85	85- 86	82- 86
1	AGRICULTURE, FORESTRY, FISHERY	-0.66	3.38	2.15	1.37	1.41	2.08
	MINING	0.40	5.34	1.85	0.42	0.48	2.02
2	IRON ORE MINING	0.59	6.99	1.88	1.89	0.92	2.92
3	NONFERROUS METALS MINING	-1.63	11.78	5.00	2.70	-3.54	3.98
4	COAL MINING	1.90	4.68	3.34	2.63	2.81	3.37
5	NATURAL GAS EXTRACTION	-6.91	4.70	1.31	-0.03	0.26	1.56
6	CRUDE PETROLEUM	4.02	4.69	0.21	-1.92	-1.18	0.45
7	NON-METALLIC MINING	1.66	8.19	3.91	2.54	1.99	4.16
8	CONSTRUCTION	-2.56	11.79	3.85	2.80	2.35	5.20
	NON-DURABLES	1.78	5.95	2.86	1.45	1.53	2.95
9	FOOD & TOBACCO	1.04	3.61	1.73	0.94	1.18	1.86
10	TEXTILES, EXC. KNITS	3.01	9.64	4.48	1.75	2.21	4.52
11	KNITTING	5.38	8.43	1.80	2.30	0.65	3.30
12	APPAREL, HOUSEHOLD TEXTILES	6.48	8.94	3.42	1.45	2.60	4.00
13	PAPER	0.16	7.20	3.32	1.85	1.95	3.58
14	PRINTING & PUBLISHING	-0.90	6.03	4.38	2.28	1.77	3.61
15	AGRICULTURAL FERTILIZERS	-1.94	3.63	2.59	0.84	0.71	1.94
16	OTHER CHEMICALS	2.69	7.39	3.40	1.74	1.86	3.60
17	PETROLEUM REFINING	1.38	4.59	1.98	0.66	0.64	1.97
	18 FUEL OIL	0.38	4.42	0.25	-0.06	0.72	1.33
19	RUBBER PRODUCTS	3.81	9.19	4.33	3.10	2.58	4.80
20	PLASTIC PRODUCTS	1.44	9.84	4.36	2.55	2.20	4.74
21	SHOES AND LEATHER	11.46	7.11	6.73	3.41	0.93	4.55
	DURABLES	-0.90	12.65	3.45	3.85	2.94	5.72
22	LUMBER	-5.97	9.48	6.55	2.99	3.02	5.51
23	FURNITURE	3.27	10.53	4.13	3.00	2.37	5.01
24	STONE, CLAY, GLASS	-0.78	13.12	4.65	3.09	1.90	5.69
25	FERROUS METALS	-2.34	6.74	0.61	2.96	2.73	3.26
26	COPPER	-3.36	9.65	6.00	1.96	-3.22	3.60
27	OTHER NONFERROUS METALS	0.49	10.30	3.77	3.78	2.06	4.98
28	METAL PRODUCTS	0.52	10.62	1.74	3.18	2.45	4.50
	NON-ELEC MACHINERY	-5.00	11.32	6.13	4.26	2.60	6.08
29	ENGINES AND TURBINES	-2.36	13.99	4.06	3.17	1.54	5.69
30	AGRICULTURAL MACHINERY	-8.38	10.23	7.41	2.93	0.96	5.38
31	CONSTR, MINING, OILFIELD EQ	-6.24	4.48	7.41	-0.30	-2.26	2.33
32	METALWORKING MACHINERY	-12.75	16.06	7.49	4.32	2.43	7.58
33	SPECIAL INDUSTRY MACHINERY	-6.43	6.33	7.92	3.21	-2.25	3.80
34	MISC NON-ELECTRICAL MACH.	-6.85	13.56	4.02	3.77	0.96	5.58
35	COMPUTERS	1.61	10.58	7.83	8.55	8.74	8.92
36	OTHER OFFICE EQUIPMENT	-1.62	7.84	3.82	2.56	1.85	4.02
37	SERVICE INDUSTRY MACHINERY	-2.86	13.43	5.00	4.50	3.72	6.67
	ELECTRICAL MACHINERY	-2.57	9.44	6.37	5.20	0.82	5.46
38	COMMUNIC EQ, ELECTRONIC COMP	-1.62	8.37	7.80	6.83	1.37	6.09
39	ELEC INDL APP & DISTRIB EQ	-7.72	12.33	5.04	4.26	-1.23	5.10
40	HOUSEHOLD APPLIANCES	-4.31	6.20	5.88	1.61	2.26	3.99
41	ELEC LIGHTING & WIRING EQ	0.18	13.16	3.37	3.29	-0.56	4.82
42	TV SETS, RADIOS, PHONOGRAPHS	0.18	6.49	4.97	1.98	2.96	4.10
	TRANSPORTATION EQ	4.05	21.80	-1.23	3.76	5.91	7.56
43	MOTOR VEHICLES	5.92	28.65	-4.13	3.43	6.90	8.71
44	AEROSPACE	-0.75	9.13	4.70	2.97	3.40	5.05
45	SHIPS, BOATS	9.70	9.27	4.31	6.70	6.05	6.58
46	OTHER TRANSP. EQUIP.	-0.23	12.53	1.78	7.47	4.87	6.66

BASE RUN

TABLE 4.18. OUTPUT BY PRODUCING SECTOR (1977$)
SUMMARY OF EXPONENTIAL ANNUAL GROWTH RATES

		81- 82	82- 83	83- 84	84- 85	85- 86	82- 86
47	INSTRUMENTS	-0.91	8.79	7.67	4.46	2.68	5.90
48	MISC. MANUFACTURING	4.07	8.35	5.12	2.50	2.51	4.62
	TRANSPORTATION	0.92	7.30	3.04	2.70	2.14	3.79
49	RAILROADS	-0.79	7.29	1.55	1.66	1.09	2.90
50	TRUCKING, HWY PASS TRANSIT	1.23	7.36	3.27	2.75	2.40	3.94
51	WATER TRANSPORT	-2.13	4.82	2.82	2.24	0.71	2.65
52	AIR TRANSPORT	3.20	8.89	3.85	3.83	3.23	4.95
53	PIPELINE	1.66	4.82	2.38	1.10	0.95	2.31
54	TRANSPORTAION SERVICES	-0.16	5.42	2.91	1.99	1.39	2.93
	UTILITIES	2.55	6.95	3.12	3.00	2.92	4.00
55	COMMUNICATIONS SERVICES	3.82	8.67	4.39	4.45	4.12	5.41
56	ELECTRIC UTILILITIES	1.66	5.69	2.79	2.21	2.14	3.21
57	GAS UTILITY	1.73	5.65	1.18	1.64	1.83	2.97
58	WATER AND SANITATION	3.00	8.41	4.31	3.09	3.36	4.78
59	WHOLESALE TRADE	1.21	8.05	3.74	2.86	2.59	4.31
60	RETAIL TRADE	4.66	7.54	3.22	2.38	2.71	3.96
61	EATING & DRINKING PLACES	4.32	8.30	2.94	2.57	2.80	4.15
62	FINANCE & INSURANCE	2.66	6.16	4.26	2.56	2.39	3.84
63	REAL ESTATE	1.70	7.81	2.59	1.44	1.83	3.42
64	OWNER-OCCUPIED HOUSING	5.15	7.03	2.28	2.25	2.64	3.55
	SERVICES	2.74	7.82	4.00	3.61	3.38	4.70
65	HOTELS, REPAIRS EXC AUTS	2.98	6.08	2.28	1.81	1.76	2.98
66	BUSINESS SERVICES	3.86	9.86	5.66	4.93	4.13	6.15
67	AUTOMOBILE REPAIRS	6.34	8.51	3.34	2.66	3.06	4.39
68	MOVIES AND AMUSEMENTS	3.39	8.61	6.15	3.46	3.54	5.44
69	MEDICINE, EDUCATION, NPO	0.38	5.47	2.20	2.61	2.86	3.29
70	FED & S&L GOVT ENTERPRISES	2.41	7.13	2.28	2.03	2.15	3.40
71	NON COMPETITIVE IMPORTS						
72	DOMESTIC SERVANTS	14.48	6.41	-9.09	1.60	1.98	0.22
73	UNIMPORTANT INDUSTRY	1.83	7.87	4.10	3.07	2.07	4.28
74	SCRAP AND USED	29.13	-0.13	9.78	8.49	3.01	5.29
75	REST OF THE WORLD INDUSTRY	1.89	-31.34	5.08	-2.50	-7.43	-9.05
76	GOVERNMENT INDUSTRY	0.33	0.62	0.82	1.05	1.04	0.88
77	INFORUM STAT. DISCREPANCY	-6.66	7.63	9.44	3.84	2.33	5.81
78	NIPA STAT. DISCREPANCY						

BASE RUN

TABLE 4.18. OUTPUT BY PRODUCING SECTOR (1977$)

		1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
1	AGRICULTURE, FORESTRY, FISHERY	155.14	157.88	160.50	164.02	167.06	169.48	172.47	175.53	178.05	181.09
	MINING	88.02	89.09	89.57	91.10	92.26	92.71	93.69	94.87	95.44	96.54
2	IRON ORE MINING	2.78	2.82	2.80	2.84	2.85	2.85	2.86	2.88	2.87	2.89
3	NONFERROUS METALS MINING	3.59	3.63	3.65	3.78	3.87	3.90	4.00	4.12	4.22	4.34
4	COAL MINING	23.98	24.74	25.41	26.27	27.13	27.81	28.35	29.35	30.04	30.85
5	NATURAL GAS EXTRACTION	19.50	19.62	19.63	19.83	19.97	19.90	19.93	20.01	19.94	19.98
6	CRUDE PETROLEUM	29.86	29.77	29.38	29.40	29.25	28.90	28.77	28.71	28.38	28.26
7	NON-METALLIC MINING	8.30	8.51	8.70	8.98	9.19	9.36	9.57	9.80	9.99	10.22
8	CONSTRUCTION	119.88	123.10	125.87	130.86	134.19	136.16	139.54	143.14	145.71	149.30
	NON-DURABLES	769.64	786.85	800.86	822.30	839.95	854.65	872.29	892.49	907.08	926.95
9	FOOD & TOBACCO	237.46	241.09	244.27	248.61	252.26	255.06	258.49	262.03	264.62	267.81
10	TEXTILES, EXC. KNITS	43.06	44.37	45.18	46.71	47.96	48.94	50.05	51.60	52.46	53.98
11	KNITTING	11.04	11.50	11.57	12.12	12.11	12.62	12.60	13.27	13.09	13.86
12	APPAREL, HOUSEHOLD TEXTILES	52.10	53.69	55.19	56.89	58.45	59.56	61.18	62.85	64.13	65.82
13	PAPER	59.17	60.73	61.91	63.89	65.47	66.70	68.31	70.08	71.39	73.13
14	PRINTING & PUBLISHING	57.75	59.01	59.97	61.48	62.76	63.70	64.84	66.13	67.08	68.21
15	AGRICULTURAL FERTILIZERS	14.34	14.63	15.01	15.49	15.93	16.31	16.74	17.19	17.60	18.07
16	OTHER CHEMICALS	129.53	133.62	137.50	142.98	147.77	151.95	156.78	162.14	166.65	172.15
17	PETROLEUM REFINING	106.19	107.30	107.85	109.10	110.15	110.91	112.09	113.45	114.28	115.52
18	FUEL OIL	25.77	26.05	26.18	26.55	26.77	27.05	27.51	27.91	28.19	28.63
19	RUBBER PRODUCTS	19.37	19.98	20.40	21.22	21.76	22.28	22.94	23.64	24.17	24.89
20	PLASTIC PRODUCTS	31.02	32.15	33.10	34.75	36.14	37.28	38.76	40.40	41.72	43.42
21	SHOES AND LEATHER	8.63	8.76	8.90	9.05	9.19	9.34	9.50	9.71	9.88	10.10
	DURABLES	900.96	932.27	938.58	986.48	1019.22	1043.61	1085.05	1127.91	1154.79	1199.71
22	LUMBER	46.78	47.72	48.40	50.19	50.90	51.14	52.59	53.56	54.08	55.41
23	FURNITURE	20.73	21.25	20.96	21.63	22.09	22.38	22.88	23.51	23.75	24.27
24	STONE, CLAY, GLASS	40.86	41.96	42.96	44.90	46.24	47.12	48.60	50.14	51.28	52.88
25	FERROUS METALS	60.16	61.55	61.38	62.90	63.34	63.49	64.28	64.94	64.98	65.74
26	COPPER	9.65	9.72	9.66	9.98	10.19	10.28	10.50	10.74	10.84	11.07
27	OTHER NONFERROUS METALS	40.59	42.01	42.68	44.77	46.52	47.93	49.76	51.85	53.41	55.52
28	METAL PRODUCTS	103.90	107.39	108.36	114.11	116.96	119.19	123.47	127.48	129.75	134.39
	NON-ELEC MACHINERY	175.36	182.09	180.27	189.59	198.23	204.63	213.57	224.98	231.78	242.46
29	ENGINES AND TURBINES	13.55	14.02	14.38	15.24	15.92	16.45	17.25	18.05	18.73	19.65
30	AGRICULTURAL MACHINERY	12.84	12.82	12.96	13.34	13.76	14.23	14.63	14.94	15.27	15.72
31	CONSTR, MINING, OILFIELD EQ	18.95	19.30	19.45	20.10	20.96	21.56	22.11	22.87	23.45	24.09
32	METALWORKING MACHINERY	18.26	18.80	16.99	17.62	18.09	18.10	18.52	19.43	19.37	19.88
33	SPECIAL INDUSTRY MACHINERY	9.95	9.76	9.48	9.55	9.75	9.79	9.87	10.05	10.10	10.22
34	MISC NON-ELECTRICAL MACH.	42.85	43.87	42.71	45.10	46.51	47.33	49.09	51.19	51.99	54.05
35	COMPUTERS	40.16	44.06	44.81	48.32	52.25	55.68	59.85	65.29	69.16	74.28
36	OTHER OFFICE EQUIPMENT	3.51	3.60	3.60	3.73	3.87	3.98	4.11	4.29	4.40	4.55
37	SERVICE INDUSTRY MACHINERY	15.30	15.86	15.87	16.58	17.13	17.51	18.14	18.86	19.30	20.03
	ELECTRICAL MACHINERY	141.43	145.33	147.26	154.93	162.56	168.38	175.63	184.71	191.41	200.15
38	COMMUNIC EQ, ELECTRONIC COMP	79.33	82.17	83.98	88.81	94.25	98.67	103.73	110.15	115.23	121.38
39	ELEC INDL APP & DISTRIB EQ	23.43	23.63	23.20	24.38	25.28	25.82	26.80	28.08	28.77	29.97
40	HOUSEHOLD APPLIANCES	11.89	12.12	12.29	12.60	12.96	13.15	13.37	13.68	13.90	14.16
41	ELEC LIGHTING & WIRING EQ	19.54	19.87	20.02	21.09	21.73	22.20	22.98	23.78	24.26	25.15
42	TV SETS, RADIOS, PHONOGRAPHS	7.24	7.54	7.78	8.06	8.33	8.54	8.76	9.02	9.25	9.50
	TRANSPORTATION EQ	203.36	212.93	214.71	229.01	235.01	239.61	251.70	260.90	265.82	277.18
43	MOTOR VEHICLES	131.29	137.71	138.47	149.77	153.32	155.49	164.71	171.06	173.83	182.43
44	AEROSPACE	46.90	48.82	49.58	51.28	52.70	54.09	55.63	57.20	58.37	59.82
45	SHIPS, BOATS	13.31	14.09	14.57	15.13	15.64	16.23	16.95	17.57	18.22	18.90
46	OTHER TRANSP. EQUIP.	11.86	12.30	12.09	12.82	13.36	13.80	14.42	15.07	15.40	16.04

BASE RUN

TABLE 4.18. OUTPUT BY PRODUCING SECTOR (1977$)

		1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
47	INSTRUMENTS	35.81	37.22	38.09	39.75	41.59	43.13	44.92	47.06	48.86	50.93
48	MISC. MANUFACTURING	22.32	23.11	23.84	24.72	25.60	26.33	27.16	28.05	28.83	29.71
	TRANSPORTATION	159.92	164.29	167.67	173.63	178.33	182.23	187.50	192.81	197.18	202.74
49	RAILROADS	25.31	25.73	25.97	26.71	27.16	27.48	28.04	28.59	28.95	29.53
50	TRUCKING, HWY PASS TRANSIT	75.35	77.47	78.98	81.66	83.80	85.52	87.89	90.28	92.21	94.64
51	WATER TRANSPORT	16.80	17.19	17.73	18.42	19.06	19.64	20.30	21.00	21.68	22.45
52	AIR TRANSPORT	35.53	36.86	37.85	39.56	40.90	42.08	43.62	45.16	46.45	48.08
53	PIPELINE	3.99	4.05	4.09	4.16	4.22	4.26	4.33	4.40	4.45	4.52
54	TRANSPORTAION SERVICES	2.93	2.99	3.04	3.12	3.20	3.25	3.31	3.39	3.44	3.51
	UTILITIES	269.40	278.04	284.76	294.78	303.65	311.19	320.39	330.02	337.79	347.66
55	COMMUNICATIONS SERVICES	107.18	112.09	115.85	121.37	126.50	131.11	136.55	142.26	147.17	153.10
56	ELECTRIC UTILILITIES	90.57	92.73	94.41	96.91	99.08	100.75	102.90	105.14	106.79	109.01
57	GAS UTILITY	57.87	58.98	59.81	61.25	62.27	62.96	64.01	65.06	65.71	66.79
58	WATER AND SANITATION	13.78	14.28	14.69	15.26	15.79	16.33	16.93	17.57	18.13	18.76
59	WHOLESALE TRADE	225.91	232.80	236.63	245.34	252.74	258.54	266.39	274.96	281.27	289.88
60	RETAIL TRADE	237.71	244.09	249.28	256.67	262.28	266.70	273.01	279.14	283.87	290.23
61	EATING & DRINKING PLACES	110.12	113.24	115.69	119.56	122.50	124.82	128.12	131.38	133.89	137.32
62	FINANCE & INSURANCE	156.73	160.74	164.33	168.62	173.07	176.24	180.06	184.50	187.99	192.22
63	REAL ESTATE	185.22	188.59	191.16	195.54	198.75	200.57	203.95	207.44	209.89	213.32
64	OWNER-OCCUPIED HOUSING	187.96	192.79	197.07	202.80	206.77	210.20	215.11	219.56	223.26	228.08
	SERVICES	605.93	627.10	644.68	670.19	690.75	709.05	731.93	755.43	775.96	800.57
65	HOTELS; REPAIRS EXC AUTO	51.43	52.42	53.14	54.26	55.14	55.72	56.65	57.52	58.13	59.03
66	BUSINESS SERVICES	269.45	281.56	291.81	306.43	319.49	331.05	345.09	359.90	372.79	388.29
67	AUTOMOBILE REPAIRS	54.11	55.75	57.12	59.04	60.55	61.81	63.62	65.35	66.72	68.59
68	MOVIES AND AMUSEMENTS	30.69	31.84	32.91	34.19	35.55	36.48	37.60	38.84	39.91	41.14
69	MEDICINE, EDUCATION, NPO	200.25	205.52	209.70	216.27	220.01	223.99	228.98	233.82	238.41	243.53
70	FED & S&L GOVT ENTERPRISES	33.11	33.86	34.39	35.28	35.96	36.57	37.37	38.17	38.77	39.55
71	NON COMPETITIVE IMPORTS										
72	DOMESTIC SERVANTS	5.93	5.99	6.03	6.19	6.07	6.05	6.18	6.12	6.11	6.15
73	UNIMPORTANT INDUSTRY	10.28	10.57	10.76	11.17	11.49	11.75	12.08	12.44	12.71	13.07
74	SCRAP AND USED	4.39	4.62	5.02	5.30	5.59	5.90	6.11	6.34	6.61	6.82
75	REST OF THE WORLD INDUSTRY	25.60	25.09	26.59	27.15	29.03	30.43	31.28	32.81	34.60	36.09
76	GOVERNMENT INDUSTRY	222.13	223.64	225.15	226.65	228.16	229.74	231.32	232.90	234.47	236.05
77	INFORUM STAT. DISCREPANCY	18.98	19.59	19.06	19.58	20.39	20.84	21.29	22.17	22.55	23.19
78	NIPA STAT. DISCREPANCY										

Chapter 5 Full Model Simulations

In this chapter the base run developed in the previous chapter is compared against alternative scenarios in which monetary policy variables are changed. Two scenarios are run to investigate the effects of varying the rate of growth of the non-borrowed reserve base above and below the rate assumed in the base scenario. The effects of holding the ratio of required reserves to M1 balances constant at high and low levels are contrasted with the base assumption of a slowly declining ratio. Finally, we investigate the keeping the "financial turbulence" dummy variable in the 10-year Treasury bond rate and the 90-day Treasury bill rate equations at unity rather than letting the value of the dummy to fall to 0 by 1984, as is done in the base case. It should be noted that since the tables generated by the model directly are quite long, these tables appear at the end of the chapter, so as not to unduly disrupt the flow of the text.

Money Base Scenarios

Since October, 1979, the Federal Reserve has announced targets for monetary aggregates which it feels are consistent with the goals of promoting full employment, reducing inflation and fostering real growth. The primary aggregate which the Fed controls to achieve these targets is the level of non-borrowed reserves of the financial system. In the revised LIFT model, the exogenous aggregate which the Fed is assumed to control completely is the non-borrowed reserve base, which differs from

non-borrowed reserves by the amount of currency in circulation. While the non-borrowed reserve base is assumed to be completely exogenous, it is clear that if the base is moved to be consistent with an M2 target, the base is really endogenous and M2 is exogenous. The interesting question in this environment is how the money multiplier changes, since the money multiplier will determine how much the non-borrowed reserve base must change to meet the target for the aggregate. Since the multiplier is endogenous, the question of its movement is not trivial. Two forecasts were made with the LIFT model were made in order to examine the effects of changing the path of the non-borrowed reserve base on economic activity. While this approach runs counter to the notion that M2 is exogenous and the base is endogenous, it provides information on a simpler Fed rule, namely, a no-feedback policy rule which maintains a steady growth rate in the base. The extent to which the growth in M2 differs from the growth of the base reflects the extent to which the multiplier changes.

Three forecasts are presented which differ in their initial conditions by the assumed growth in the non-borrowed monetary base. The middle case is the base forecast developed in the previous chapter. For this case, labelled BASE, the growth rate for the monetary base is set at 8% per year from 1981 to 1995. A high rate of growth scenario for the monetary base, labelled HIGH, is assumed to be 10%. A low rate of growth scenario, labelled LOW, is assumed to be 6% per year from 1981 to 1995. Three major areas of interest form the basis of our analysis of the results.

What are the macroeconomic implications of the varying growth rates of the non-borrowed monetary base?

Are the patterns of growth of employment and output at the sectoral level different for different rates of non-borrowed monetary base growth?

Do the different rates of non-borrowed reserve base growth change the variability of the forecast results?

The macroeconomic results of these three monetary base simulation are quite interesting. The results, which are presented in Table 5.1, show that slower base money growth tends to speed up aggregate real growth in the economy. Real growth is faster and the unemployment rate is lower when the rate of base money growth is slower than when the rate of base money growth is faster. This is due primarily to the lower inflation rate, which props up real disposable income and spurs consumption. Slower base money growth leads to a slower rate of M2 growth, which tends to reduce the rate of nominal wage growth and causes the reduction in the rate of aggregate price growth. The lower rate of money growth tends to push interest rates up via the "liquidity" term in the interest rate equations while the lower rate of inflation tends to keep the level of interest rates low. If nominal GNP had fully responded to the changed rate of M2 growth, velocity would have remained constant or nearly so and the inflation effect would have predominated. Velocity (or its inverse, M2/GNP) was substantially affected by the different rates of base money growth, thus interest rates are much higher in the slow base money growth scenario than in either of the faster base money growth scenarios. The 90-day Treasury bill rate is

more sensitive to the liquidity variable than is the 10-year Treasury bond rate, thus short rates rise more than long rates in response to the changing liquidity variable. The changing velocity result suggests that re-specifying the manufacturing HLC equation was an insufficient step to maintaining the constancy of M2 velocity.

The composition of real GNP changes in response to the higher real income and higher interest rates associated with lower base money growth. Residential structures, the most interest-sensitive component of final demand, is reduced in the LOW scenario substantially relative to the HIGH and BASE runs. The average growth rate for the 1990-95 period for residential structures is 1.3 percentage points lower in the LOW run than in the HIGH run. This decline is more than offset by a .23 percentage point increase in personal consumption expenditures (PCE) in the LOW run relative to the HIGH run, since the amount of PCE is so much larger than the amount of spending on residential structures.

An interesting macroeconomic variable is the savings rate, which differs substantially between the scenarios. The 1995 rate is nearly 4 percentage points higher in the LOW run than in the HIGH run. This is because the unemployment rate is lower and the 4-6 month commercial paper rate is higher in the LOW run than in the HIGH run. Such a result is to be expected since movements in the savings rate operate to stabilize the model and real income growth is so much higher in the LOW run than the HIGH run. The only mechanism to prevent the model from driving the unemployment rate below 0 in the LOW run is the higher savings rate.

Two kinds of comparisons are necessary to determine whether the course of industry outputs and the pattern of sectoral employment differs between the scenarios. First, the growth rates and levels of industry outputs may be such that it is possible to distinguish sectoral shifts. Given that the general level of employment and production differ between scenarios, it is useful to adjust the sectoral specific growth rates for the differing levels of aggregate economic activity resulting from each scenario. The bottom of Table 5.1 shows the unadjusted growth rates for sectoral employment, while Table 5.2 shows selected employment sectors with 1990-95 growth rates adjusted for the differing growth of total jobs in each scenario. In the same vein, Table 5.3 shows unadjusted levels and growth rates for industry outputs, while Table 5.4 shows selected output sectors with 1990-95 growth rates adjusted for the differing growth rates of aggregate output, measured by the rate of real GNP growth. The adjustment is made by subtracting the growth rate for the appropriate aggregate from the individual sector's rate.

Table 5.2

Relative sectoral employment growth rates for selected sectors, 1990-95

	BASE	HIGH	LOW
Total private jobs	1.54	1.47	1.63
Agriculture,Mining,Structures	-.37	-.19	-.53
Finance,Insurance,Real Estate	-.11	-.08	-.17
Medicine & Education	.29	.18	.30
Durable goods manufact.	-.26	-.28	-.08

The changing pattern of employment is a result of the shift from PCE to residential structures that occurs when higher base money growth

reduces interest rates. Sectoral employment growth relative to the growth of total private jobs differs most for the the four sectors shown in Table 5.2. The table clearly indicates that high rates of base money growth skew employment toward Agriculture, Mining and Structures and away from service sectors. The most interesting pattern is displayed in Medicine and education services and Durable goods manufacturing. The rate of growth of employment in Medicine and education relative to the rate of growth of private sector jobs is virtually identical in the BASE and LOW runs, while being substantially lower in the HIGH run. A similar case can be found in Durable goods manufacturing, for which the BASE and HIGH relative rates of employment growth are similar while the LOW run has a substantially different rate. This suggests that there is some sort of critical level of base money growth that achieves this employment growth rate shift between these sectors.

While the levels and growth rates of industry outputs are displayed in Table 5.3, (which appears at the end of the chapter) we will focus on the long-term relative growth rates for some selected sectors, which are displayed in Table 5.4.

Table 5.4

Selected sectoral output growth rates for 1990-95 relative to real GNP growth

	BASE	HIGH	LOW
Real GNP	2.19	2.11	2.29
Iron Ore Mining	-1.92	-1.97	-1.50
Nonferrous Metals Mining	0.13	0.11	0.25
Coal Mining	0.38	0.32	0.41
Non-durables (sec 9-21)	-0.22	-0.21	-0.32
Lumber	-0.49	-0.45	-0.37
Stone, Clay and Glass	0.50	0.61	0.42
Ferrous Metals	-1.45	-1.49	-1.01
Metal Products	0.59	0.61	0.76
Engines and Turbines	2.02	2.03	2.29
Metalworking Machinery	-0.30	-0.14	0.15
Special Industry Machinery	-1.25	-1.31	-1.07
Electrical Machinery (38-42)	1.97	1.82	2.32
Motor vehicles	1.29	1.29	1.94
Transportation (49-54)	0.38	0.46	0.48
Utilities (55-58)	0.52	0.46	0.47
Retail Trade	-0.16	-0.22	-0.22
Business Services	1.71	1.74	1.72
Movies and Amusements	0.73	1.00	1.09
Medicine, Education, NPO	-0.16	-0.27	-0.16

Table 5.4 shows the rates of growth of selected sectors less the rate of growth of real GNP. If the different rates of base money growth resulted only in a different rate of growth of aggregate activity, the three columns in Table 5.4 would differ only in the first row. However, the relative growth rates for output also reflect the shift from PCE to residential structures that occurs at high rates of base money growth. Several sectors which might not immediately come to mind as likely to be affected by such a shift are indeed affected. For example, Iron ore mining grows more slowly with fast money growth than with slow base money growth, even after adjusting the output growth rates for differences in the level of aggregate growth. It might be expected that

slow base money growth (LOW), with its high interest rates and low inflation rates would cause the service sectors to rise at the expense of the sectors more related to construction activity. While a small shift to service sectors is evident, the largest shifts from HIGH to LOW occur in Iron ore mining, Ferrous metals, Engines and turbines, Metalworking machinery, Metal products and Motor vehicles. These shifts are inter-related. Motor vehicle output increase in the LOW run relative to the other two runs because of increased personal consumption expenditures on new autos and trucks and because of the slightly higher equipment investment in the LOW run versus the others. (Recall from the previous chapter that these two final demand components account for about two-thirds of the sales of total Motor vehicle output.) About half of the output of Metalworking machinery is purchased directly for final use by equipment investment sectors. Nearly 20% of engine and turbine output is purchased for final use by equipment investment and for intermediate use by the Motor vehicles industry. The output of the Iron ore mining industry is purchased almost exclusively by the Ferrous metals sectors, which itself sell about 30% of its output to the Metal products and Motor vehicles industries. Nearly 15% of the Metal products industry is purchased as an input to the Motor vehicles industry. Thus, faster growth in the Motor vehicles industry tends to push up the outputs of some mining sectors and machinery sectors, which might not ordinarily be associated with an economy skewed toward faster PCE growth.

The Stone, clay and glass industry is one example of an industry whose output growth relative to aggregate growth is reduced when the rate of base money growth is reduced. This is because this industry is very closely linked to construction activity, selling about a third of its output to that final demand component directly.

To address the question of whether the variability of the forecast path changes when the rate of base money growth changes, means and variances of the forecasted growth rates (or levels where appropriate) for the 1982-95 period for selected macroeconomic variables and selected industry outputs are presented. These statistics for the macroeconomic variables are shown in Table 5.5, and the similar statistics for industry outputs are shown in Table 5.6.

Table 5.5
Means and variances of growth rates or levels 1982-95

	Base		High		Low	
	mean	variance	mean	variance	mean	variance
GNP real	2.57	1.26	2.50	1.15	2.62	1.09
PCE real	2.67	1.44	2.63	1.48	2.69	1.46
Resident. struct.	4.69	9.27	5.40	9.08	3.84	8.60
Equip. invest.	3.72	4.36	3.64	4.07	3.79	3.84
GNP deflator	5.38	0.40	6.16	0.31	4.74	0.53
M2	8.25	2.50	9.95	2.49	6.56	2.44
AAA bond rate	8.75	1.64	8.03	2.01	9.50	1.29
Unemp. rate	5.01	1.18	5.23	0.90	4.60	1.23

Only slight increases or decreases in variances can be observed when the rate of base money growth is changed. The largest differences are to be seen between the HIGH and LOW scenarios. The mean rate of Residential structures growth is nearly 2 percentage points higher with faster base money growth (HIGH) than with lower base money growth (LOW).

All of the other final demand components show slightly lower growth with lower base money growth. The average rate of GNP deflator growth is about 1.5 percentage points higher in the HIGH run than in the LOW run, although the variance of the rate is lower in the HIGH run. The higher rate of inflation in the HIGH run is associated with a lower average AAA bond rate than the LOW run, but the variance of the AAA rate is higher with higher base money growth. This seemingly anomolous result (lower interest rates with higher inflation), is due to the movement of the ratio of M2 to nominal GNP, which forces interest rates down further than the inflation rate forces them up. The HIGH run has a higher average unemployment rate than either of the other two scenarios. One interesting feature is that the variance of the average unemployment rate for the HIGH run is lower than in either of the other two runs. Such differences are quite small, however.

Table 5.6
Means and variances of growth rates for selected output sectors, 1982-95

	Base		High		Low	
	mean	variance	mean	variance	mean	variance
Lumber	2.36	3.37	2.72	2.77	2.30	2.76
Stone,Clay,Glass	3.52	2.93	3.46	2.83	3.34	2.73
Engines,Turbines	4.11	3.45	3.88	3.26	4.36	3.19
Motor vehicles	5.26	7.39	5.29	6.89	5.31	6.70
Utilities	3.15	1.14	3.04	1.08	3.18	1.03
Retail trade	2.75	1.29	2.86	1.55	2.87	1.56
Medicine, Ed., NPO	2.36	1.10	2.24	1.04	2.49	1.02

Table 5.6 reports the mean growth rates and variances of selected industry output sectors. Very small differences can be found in mean growth rates or variances, even comparing the HIGH and LOW runs. The largest of these small differences in average growth rates can be found in Lumber, which grows quickly on average in the HIGH run than the LOW

run. Medicine, education, and NPO, on the other hand, grows more slowly in the HIGH run than in the LOW run. This is consistent with the shift from residential structures to PCE that occurs when base money growth is reduced. The variances of the output growth rates show virtually no differences across scenarios.

To conclude this section, while considerable difference can be found across scenarios of high and low rates of base money growth for macroeconomic variables and the industry pattern of employment and output, very little difference can be found in the variability of the forecast across scenarios. The macroeconomic differences can be attributed to the differing rates of inflation associated with higher base money growth, and the movements in the ratio of M2 to nominal GNP in the HIGH scenario which reduces interest rates. These factors lead to predictable industry employment and output shifts.

Required Reserves

One other variable that is exogenous to the monetary sub-model is the ratio of required reserves to M1 balances. In the base forecast presented in the previous chapter, this variable was assumed to decline slowly to 1995 from the average over the estimation period of the money multiplier equation. The average for this variable over the estimation period is 12.3% and this was assumed to decline to 10.0% by 1995 in the base run. To test the sensitivity of the model to changes in this assumption, two runs of the model were made. In the first run, the

ratio of required reserves to M1 deposits was kept at 12.3% for the entire forecast horizon. In the second run, the variable was kept at the 1981 level of 9.4%. Since the money multiplier is inversely related to the required reserve ratio, we should expect to see lower-than-base M2 growth when the ratio is high and the reverse when the ratio is low. The macroeconomic results of these three runs, including the base, are displayed in Table 5.7. The scenarios are labelled HIGH for high levels of required reserves, LOW for low levels of required reserves and BASE for results of the base developed in the previous chapter. The sectoral output results for these runs are shown in Table 5.8, which appears at the end of the chapter.

As Table 5.7 shows, the macroeconomic forecast of the model is nearly impervious to the change in the policy variable under consideration. The 1990-95 average growth rates for real GNP are all within .02 percentage points of each other, as are the average rates of growth of private jobs. Average M2 growth for the 1990-95 period is highest for the BASE run (8%) and nearly identical for the LOW and HIGH runs. This is due to the differences in the 90-day Treasury bill rate between the LOW and HIGH runs. Treasury bill rates in 1990 and 1995 are highest in the LOW run and lowest in the HIGH run. The money multiplier equation tends to give the same results because the lower Treasury bill rate tends to decrease the multiplier at the same time the lower level of required reserves relative to M1 tends to increase the multiplier for the LOW run, while the opposite situation prevails in the HIGH run.

The components of final demand most affected by the reserve requirement change over the 1990-95 period are residential structures and equipment investment. Residential structures grow .1 percentage point faster in the BASE case than in either of the other two scenarios, while equipment investment grows .1 percentage point slower in the BASE case than in either of the other two cases. The 1990-95 growth rates for aggregated sectoral employment show the greatest divergence in Durable goods manufacturing and in Business, repairs and other services. For these sectors the BASE scenario shows slower growth than for either of the other two scenarios. Of the two alternatives, LOW and HIGH, a higher level of required reserves relative to M1 also has the highest rate of employment growth. It must be emphasized that these differences are very slight.

Of sectoral outputs over the 1990-95 period, only one sector of substantial size shows different growth rates between the three runs. This sector is Motor vehicles, which grows at an average of 3.7% for the HIGH run, an average of 3.48% per year for the BASE run and an average of 3.44% per year in the LOW run. By virtue of the interindustry structure, Metalworking machinery, Ferrous metals and Iron ore mining show faster growth for the HIGH run than for the other two scenarios. The growth differential is brought about by the slightly higher level of disposable income forecasted in the HIGH run. While consumption in the aggregate does not grow more quickly in the HIGH run, the sectoral differences of the PCE equations between runs results in the slightly different rates of output growth. Further evidence can be found by looking at the ouput for the Movies and amusements sector, which is

primarily a PCE determined sector with a high estimated income elasticity (2.54). This sector also shows faster growth for the HIGH run.

Interest_rate_equation_dummy

In the estimation of the monetary sub-model, it was necessary to introduce a dummy variable to account for financial market turbulence. The path of this dummy variable in the base scenario is: .5 in 1982, .25 in 1983 and 0 throughout the rest of the forecast. This path represents the idea that the financial turbulence which forced the use of the dummy begins to subside after 1981. The opposite assumpton is that financial turbulence remains at the 1981 level, or that the path of the dummy is unity throughout the forecast. A run of the model was made with this dummy variable set to unity throughout the forecast horizon and the comparison of this run with the base run is the subject of the final comparison of this chapter. Table 5.9 presents the level and growth rate results for macroeconomic and employment aggregates. Table 5.11 shows the industry output levels and growth rates for the two runs and appears at the end of the chapter.

The macroeconomic results of keeping the dummy variable at unity are quite predictable. Maintaining the dummy essentially adds about 3 percentage points to the level of interest rates. The 90-day Treasury bill rate is 3.22 percentage points higher in 1990 and 2.94 percentage points higher in 1995 when the interest rate dummy is set to unity. Higher interest rates tend to reduce residential structures

substantially which tends to reduce the other components of final demand by pulling industry outputs down. By 1985, the higher interest rate run has reduced residential structures by 12 billion 1977 dollars relative to the base run, a difference which increases only slightly as the forecast proceeds. By 1995 higher interest rates force residential structures down by about 14 billion 1977 dollars and decrease PCE and non-residential structures by about 2 billion each. Equipment investment is 4 billion dollars lower with higher interest rates. These declines result in an unemployment rate which is .65 percentage points higher with higher interest rates in 1995. It should be pointed out that looking at growth rates is somewhat misleading in this comparison, since what appears to have happened is a downward shift in the level of activity which leaves growth rates relatively constant.

Turning to the industry output table, Table 5.11, over the 1990 to 1995 period, very little difference can be found. Most of the difference in the levels of output and growth rates can be found in the early part of the forecast. By 1995, the Lumber industry output is only about 4% lower with higher interest rates. The growth rate for the Lumber industry for the 1990-95 period is actually higher with higher interest rates. This seems to be the result of the model rising to some desired level of activity from a lower starting point in the run with higher interest rates.

Table 5.10 presents the average growth rates or levels for selected macroeconomic variables and the variances of the growth rates. Table 5.12 presents similar information for selected industry output sectors.

For the macroeconomic table, the largest difference in average growth rates can be found in residential structures and equipment investment. Equipment investment has a smaller variance with high interest rates than with lower interest rates. The differences shown in the table are quite small.

Table 5.10
Means and variances of selected macroeconomic variables 1982-95

	Base		Dummy set to 1.0	
	mean	variance	mean	variance
GNP real	2.57	1.26	2.51	1.07
PCE real	2.67	1.44	2.66	1.33
Resident. struc.	4.69	9.27	3.88	8.52
Equip. invest.	3.72	4.36	3.62	3.83
GNP deflator	5.38	0.40	5.40	0.39
M2	8.25	2.50	8.46	2.28
AAA bond rate	8.75	1.64	10.94	1.28
Unemployment rate	5.01	1.18	5.83	1.15

Finally, Table 5.12 points out the slight shift of output away from sectors associated with residential structures in favor of services. Lumber and Stone, clay and glass show the two largest declines in average growth with higher interest rates. Only Retail trade and Medicine, education and non-profit organizations of the selected sectors show an increase in growth rates with higher interest rates. No major changes in variances are revealed in Table 5.12, although the majority of the selected sectors show very slightly lower variances with the interest rate dummy set to unity.

Table 5.12
Means and variances of growth rates for selected output sectors, 1982-95

	Base		Dummy set to 1.0	
	mean	variance	mean	variance
Lumber	2.36	3.37	2.08	3.43
Stone,Clay,Glass	3.52	2.93	3.19	2.79
Engines,turbines	4.11	3.45	4.02	3.15
Motor vehicles	5.26	7.39	5.10	6.81
Utilities	3.15	1.14	3.10	1.01
Retail trade	2.75	1.29	2.85	1.42
Medicine,Ed., NPO	2.36	1.10	2.39	1.08

To conclude this section, very predictable results are obtained when interest rates are increased exogenously. A downward shift in activity relative to the base is experienced immediately. There is some evidence that the economy is growing slightly faster in the 1990-95 period with higher interest rates than the base case, as if the model is converging on the same level or real activity in both cases. This seems especially true for PCE, which is lower in the high interest rate run by 7 billion 1977 dollars in 1985, 5 billion lower in 1990 and 2 billion lower in 1995. It seems reasonable to conclude that if the model had been run to 2000 or beyond, the results of the two runs would be identical. This suggests that the model, like the economy. can adjust in the long term to consistent and maintained changes in initial conditions.

BASE MONEY COMPARISONS

TABLE 5.1. SUMMARY OF RESULTS

	(BASE) 1981	(BASE) 1985	(HIGH) 1985	(LOW) 1985	(BASE) 1990	(HIGH) 1990	(LOW) 1990	(BASE) 1995	(HIGH) 1995	(LOW) 1995
Gross National Product. (cu. $)	2984.43	4299.19	4375.91	4231.41	6239.53	6547.75	5933.25	9080.28	10032.94	8369.72
Labor compensation	1771.40	2612.40	2669.39	2569.00	3795.68	4015.26	3600.04	5536.07	6172.18	5086.38
Indirect business taxes	251.76	327.24	331.69	322.44	457.53	477.21	436.64	647.38	707.88	597.40
Return to capital	900.07	1276.77	1290.66	1258.73	1869.73	1936.57	1790.50	2742.16	2980.17	2545.83
Net interest	245.45	315.77	315.77	315.77	432.63	432.63	432.63	592.74	592.74	592.74
Corporate profits	249.06	433.72	451.52	413.21	644.49	707.46	580.23	931.20	1137.84	763.84
Proprietor income	147.38	224.43	224.27	225.07	361.55	360.06	362.56	573.59	570.31	576.86
Gross National Product Deflator	1.99	2.51	2.55	2.46	3.24	3.42	3.07	4.23	4.72	3.87
Hourly labor comp. index (manuf.)	144.40	192.94	198.79	187.94	255.38	276.38	237.37	344.93	397.69	306.09
Labor productivity (GNP/JOBS)	20.10	20.88	20.87	20.88	21.67	21.61	21.68	22.51	22.43	22.54
Financial variables										
Treasury bill rate	14.76	8.40	7.31	9.46	7.06	4.39	9.58	5.92	2.11	10.00
Treasury bonds , 10 year	13.91	8.30	8.04	8.65	7.34	6.33	8.36	6.85	5.31	8.64
AAA Corporate bond rate	14.17	9.03	8.81	9.30	7.86	6.96	8.79	7.33	5.85	9.06
Commercial paper rate	14.76	8.57	7.58	9.58	7.56	5.07	9.92	6.24	2.66	10.21
Mortgage rate	14.17	9.46	9.22	9.77	8.50	7.58	9.41	8.08	6.67	9.69
M2 (billions of current$)	1743.75	2487.97	2660.13	2327.58	3707.39	4306.63	3168.12	5530.59	7018.52	4366.71
Non-borrowed reserve base	163.50	225.16	243.91	207.85	335.90	402.14	280.57	501.10	663.02	378.73
Ratio of M2 to nominal GNP	0.58	0.58	0.61	0.55	0.59	0.66	0.53	0.61	0.70	0.52
Savings rate	6.42	7.55	7.35	7.96	7.88	6.82	9.18	8.24	6.55	10.39
Gross National Product (77$)	2095.23	2396.74	2396.12	2403.10	2692.08	2675.69	2698.33	3003.41	2973.66	3025.28
Personal Consumption	1313.09	1541.44	1543.64	1545.10	1734.44	1736.67	1730.45	1908.15	1898.70	1913.43
Residential Structures	68.86	94.84	98.00	92.46	117.83	126.79	108.54	132.72	146.73	117.90
Non-residential structures	82.83	97.52	96.35	98.47	109.48	107.65	110.00	123.77	121.99	125.41
Producers' durable equipment	172.33	213.13	212.73	213.31	240.88	236.86	241.68	290.21	286.69	292.91
Inventory change	9.39	16.36	16.40	16.37	18.10	18.31	16.35	20.03	20.77	20.42
Exports	254.48	245.92	242.18	250.38	276.29	259.05	291.99	337.16	312.87	362.25
Imports	221.38	261.97	262.68	262.47	301.26	305.95	296.98	346.81	352.28	345.12
Other variables										
Disp. income-per capita (1972$)	4537.61	5169.31	5161.24	5209.21	5585.78	5517.36	5665.32	5948.70	5793.52	6130.35
Return to capital scaler	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Foreign demand scaler	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Trade balance (cu. $)	0.00	0.00	-86.88	-86.88	0.00	-140.65	-140.65	0.00	-176.00	-176.00
Merchandise exports (cu. $)	218.89	266.43	268.79	264.61	383.24	381.90	382.22	620.01	649.50	599.94
Merchandise imports (cu. $)	261.71	353.31	355.59	351.80	523.90	536.62	510.43	796.01	856.87	738.79
Exchange rate scaler	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.06	0.94
Unemployment rate	7.71	5.46	5.44	5.23	4.20	4.56	4.01	3.90	4.56	3.28
Civilian jobs (millions)	104.22	114.80	114.82	115.07	124.23	123.79	124.47	133.43	132.98	134.23
Private sector jobs	88.01	98.06	98.08	98.33	106.78	106.34	107.02	115.32	114.47	116.12
Agric.Mining.Structures	9.95	10.85	10.87	10.84	11.69	11.76	11.58	12.39	12.53	12.23
Durable goods manufacturing	12.20	13.17	13.15	13.23	13.83	13.60	13.95	14.75	14.44	15.07
Non-durable goods mfg	8.13	8.09	8.09	8.11	7.84	7.78	7.88	7.58	7.50	7.63
Transp.Communic.Utilities	5.43	5.69	5.69	5.70	5.78	5.75	5.82	5.84	5.79	5.91
Trade	22.88	26.62	26.64	26.67	29.71	29.64	29.67	32.68	32.43	32.76
Finance,Insurance,Real Estate	5.88	6.70	6.71	6.71	7.33	7.34	7.31	7.88	7.87	7.86
Medicine & Education	10.51	11.60	11.58	11.68	12.99	12.89	13.17	14.24	13.99	14.21
Domestic servants	1.88	1.80	1.80	1.80	1.77	1.77	1.77	1.74	1.74	1.74
Business,Repair,Oth services	11.16	13.55	13.56	13.60	15.06	15.84	15.91	18.24	18.18	18.44

BASE MONEY COMPARISONS

TABLE 5.1. SUMMARY OF RESULTS
SUMMARY OF EXPONENTIAL ANNUAL GROWTH RATES

	(BASE) 81- 85	(HIGH) 81- 85	(LOW) 81- 85	(BASE) 85- 90	(HIGH) 85- 90	(LOW) 85- 90	(BASE) 90- 95	(HIGH) 90- 95	(LOW) 90- 95	(BASE) 81- 95
Gross National Product, (cu. $)	9.13	9.57	8.73	7.44	8.06	6.76	7.52	8.54	6.88	7.95
Labor compensation	9.71	10.25	9.29	7.47	8.17	6.75	7.55	8.60	6.91	8.14
Indirect business taxes	6.56	6.89	6.19	6.70	7.28	6.06	6.94	7.89	6.27	6.75
Return to capital	8.74	9.01	8.38	7.63	8.12	7.05	7.66	8.62	7.04	7.96
Net interest	6.30	6.30	6.30	6.30	6.30	6.30	6.30	6.30	6.30	6.30
Corporate profits	13.87	14.87	12.66	7.92	8.98	6.79	7.36	9.50	5.50	9.42
Proprietor income	10.51	10.50	10.58	9.54	9.47	9.54	9.23	9.20	9.29	9.71
Gross National Product Deflator	5.76	6.21	5.30	5.11	5.85	4.44	5.33	6.42	4.59	5.38
Hourly labor comp. index (manuf.)	7.24	7.99	6.59	5.61	6.59	4.67	6.01	7.28	5.09	6.22
Labor productivity (GNP/JOBS)	0.94	0.93	0.95	0.75	0.70	0.75	0.76	0.74	0.78	0.81
Financial variables										
Treasury bill rate	-14.09	-17.57	-11.10	-3.47	-10.21	0.28	-3.53	-14.63	0.86	-6.52
Treasury bonds , 10 year	-12.90	-13.70	-11.88	-2.46	-4.79	-0.69	-1.39	-3.91	0.68	-5.06
AAA Corporate bond rate	-11.28	-11.87	-10.92	-2.77	-4.71	-1.14	-1.38	-3.49	0.62	-4.70
Commercial paper rate	-13.58	-16.66	-10.80	-2.50	-8.02	0.70	-3.86	-12.93	0.58	-6.15
Mortgage rate	-10.10	-10.76	-9.30	-2.15	-3.90	-0.75	-1.01	-2.57	0.59	-4.02
M2 (billions of current$)	8.89	10.56	7.22	7.98	9.64	6.17	8.00	9.77	6.42	8.24
Non-borrowed reserve base	8.00	10.00	6.00	8.00	10.00	6.00	8.00	10.00	6.00	8.00
Ratio of M2 to nominal GNP	-0.24	0.99	-1.51	0.54	1.58	-0.59	0.48	1.23	-0.46	0.30
Savings rate	4.07	3.39	5.39	0.85	-1.50	2.85	0.90	-0.80	2.49	1.79
Gross National Product (77$)	3.36	3.35	3.43	2.32	2.21	2.32	2.19	2.11	2.29	2.57
Personal Consumption	4.01	4.04	4.07	2.36	2.36	2.27	1.91	1.78	2.01	2.67
Residential Structures	8.00	8.82	7.37	4.34	5.15	3.21	2.38	2.92	1.66	4.69
Non-residential structures	4.08	3.78	4.32	2.32	2.22	2.22	2.45	2.50	2.62	2.87
Producers' durable equipment	5.31	5.26	5.33	2.45	2.15	2.50	3.73	3.82	3.85	3.72
Inventory change	13.89	13.94	13.89	2.02	2.20	-0.02	2.03	2.52	4.44	5.41
Exports	-0.86	-1.24	-0.41	2.33	1.35	3.07	3.98	3.78	4.31	2.01
Imports	4.21	4.28	4.26	2.80	3.05	2.47	2.82	2.82	3.00	3.21
Other variables										
Disp. income per capita (1972$)	3.26	3.22	3.45	1.55	1.33	1.68	1.26	0.98	1.58	1.93
Return to capital scaler										
Foreign demand scaler										
Trade balance (cu. $)										
Merchandise exports (cu. $)	4.91	5.13	4.74	7.27	7.02	7.35	9.62	10.62	9.02	7.44
Merchandise imports (cu. $)	7.50	7.66	7.40	7.88	8.23	7.44	8.37	9.36	7.40	7.95
Exchange rate scaler										
Unemployment rate	-8.63	-8.71	-9.72	-5.25	-3.55	-5.32	-1.47	-0.01	-3.99	-4.86
Civilian jobs (millions)	2.42	2.42	2.48	1.58	1.50	1.57	1.43	1.37	1.51	1.76
Private sector jobs	2.70	2.71	2.77	1.70	1.62	1.69	1.54	1.47	1.63	1.93
Agric,Mining,Structures	2.16	2.22	2.14	1.50	1.56	1.32	1.17	1.28	1.10	1.57
Durable goods manufacturing	1.91	1.87	2.02	0.99	0.68	1.06	1.28	1.19	1.55	1.35
Non-durable goods mfg	-0.12	-0.15	-0.07	-0.64	-0.77	-0.59	-0.66	-0.73	-0.63	-0.50
Transp.Communic,Utilities	1.15	1.15	1.23	0.34	0.21	0.39	0.20	0.15	0.33	0.52
Trade	3.78	3.80	3.83	2.20	2.13	2.13	1.91	1.80	1.98	2.55
Finance,Insurance,Real Estate	3.28	3.32	3.31	1.80	1.79	1.71	1.43	1.39	1.46	2.09
Medicine & Education	2.46	2.41	2.63	2.25	2.14	2.40	1.83	1.65	1.93	2.16
Domestic servants	-1.03	-1.03	-1.03	-0.37	-0.37	-0.37	-0.31	-0.31	-0.31	-0.54
Business,Repair,Oth services	4.86	4.88	4.95	3.14	3.10	3.14	2.80	2.76	2.95	3.51

BASE MONEY COMPARISONS

TABLE 5.3. OUTPUT BY PRODUCING SECTOR (1977$)

		(BASE) 1981	(BASE) 1985	(HIGH) 1985	(LOW) 1985	(BASE) 1990	(HIGH) 1990	(LOW) 1990	(BASE) 1995	(HIGH) 1995	(LOW) 1995
1	AGRICULTURE, FORESTRY, FISHERY	143.71	152.96	152.79	153.59	167.06	165.15	168.53	181.09	178.25	182.55
	MINING	80.86	87.60	87.60	87.89	92.26	91.45	92.69	96.54	95.30	97.42
2	IRON ORE MINING	2.46	2.75	2.73	2.79	2.85	2.69	2.94	2.89	2.71	3.06
3	NONFERROUS METALS MINING	3.11	3.72	3.70	3.74	3.87	3.76	3.93	4.34	4.20	4.46
4	COAL MINING	20.57	23.32	23.31	23.44	27.13	26.85	27.42	30.85	30.32	31.38
5	NATURAL GAS EXTRACTION	19.63	19.45	19.47	19.56	19.97	19.80	20.14	19.98	19.60	20.29
6	CRUDE PETROLEUM	28.17	30.22	30.26	30.21	29.25	29.22	29.05	28.26	28.30	27.99
7	NON-METALLIC MINING	6.92	8.14	8.14	8.16	9.19	9.14	9.21	10.22	10.16	10.24
8	CONSTRUCTION	99.90	117.10	117.72	116.69	134.19	136.39	131.41	149.30	153.22	145.11
	NON-DURABLES	671.99	757.93	757.30	759.55	839.95	833.43	843.57	926.95	916.50	931.05
9	FOOD & TOBACCO	218.11	234.68	234.75	235.11	252.26	250.86	253.37	267.81	264.71	268.22
10	TEXTILES, EXC. KNITS	34.87	42.12	41.97	42.23	47.96	47.37	48.13	53.98	53.19	54.34
11	KNITTING	9.17	10.97	10.95	10.98	12.11	12.05	12.07	13.86	13.71	13.83
12	APPAREL, HOUSEHOLD TEXTILES	41.60	50.76	50.64	50.86	58.45	58.08	58.43	65.82	64.99	66.05
13	PAPER	51.19	58.02	57.88	58.27	65.47	64.53	66.04	73.13	71.85	74.04
14	PRINTING & PUBLISHING	50.43	56.74	56.68	57.02	62.76	62.37	63.35	68.21	67.58	69.08
15	AGRICULTURAL FERTILIZERS	13.52	14.23	14.18	14.32	15.93	15.61	16.18	18.07	17.64	18.36
16	OTHER CHEMICALS	109.19	127.14	126.83	127.48	147.77	145.64	149.22	172.15	169.20	173.68
17	PETROLEUM REFINING	96.81	105.51	105.39	105.52	110.15	110.06	109.79	115.52	115.56	115.04
	18 FUEL OIL	24.33	25.58	25.60	25.70	26.77	26.58	26.92	28.63	28.25	28.88
19	RUBBER PRODUCTS	15.39	18.87	18.92	18.82	21.76	21.81	21.58	24.89	25.00	24.76
20	PLASTIC PRODUCTS	25.30	30.34	30.31	30.46	36.14	35.67	36.45	43.42	42.71	43.95
21	SHOES AND LEATHER	6.42	8.55	8.60	8.48	9.19	9.39	8.96	10.10	10.36	9.71
	DURABLES	723.11	874.84	873.75	879.48	1019.22	1001.56	1024.64	1199.71	1173.87	1228.13
22	LUMBER	39.84	45.39	45.83	45.46	50.90	51.12	49.95	55.41	55.53	54.97
23	FURNITURE	16.42	20.25	20.37	20.45	22.09	22.10	22.25	24.27	24.07	24.77
24	STONE, CLAY, GLASS	32.80	40.09	40.24	40.10	46.24	46.48	45.73	52.88	53.24	52.38
25	FERROUS METALS	54.06	58.54	57.87	59.37	63.34	59.78	65.38	65.74	61.66	69.70
26	COPPER	8.64	9.97	9.93	10.03	10.19	9.89	10.32	11.07	10.69	11.45
27	OTHER NONFERROUS METALS	33.10	39.77	39.60	40.02	46.52	46.27	47.17	55.52	53.94	57.12
28	METAL PRODUCTS	86.35	101.39	101.12	101.93	116.96	115.44	117.01	134.39	132.29	136.26
	NON-ELEC MACHINERY	144.57	170.85	170.42	171.58	198.23	193.37	201.04	242.46	236.46	249.24
29	ENGINES AND TURBINES	11.05	13.34	13.29	13.40	15.92	15.46	16.18	19.65	19.02	20.34
30	AGRICULTURAL MACHINERY	11.26	12.72	12.70	12.73	13.76	13.46	13.94	15.72	15.34	15.84
31	CONSTR, MINING, OILFIELD EQ	18.37	19.38	19.28	19.36	20.96	20.34	21.29	24.09	23.38	24.69
32	METALWORKING MACHINERY	15.32	17.82	17.78	17.83	18.09	17.60	18.20	19.88	19.42	20.56
33	SPECIAL INDUSTRY MACHINERY	9.12	10.18	10.14	10.20	9.75	9.43	9.96	10.22	9.82	10.58
34	MISC NON-ELECTRICAL MACH.	36.71	42.44	42.22	42.66	46.51	45.22	47.02	54.05	52.45	55.78
35	COMPUTERS	27.65	36.79	36.75	37.09	52.25	50.99	53.38	74.28	72.69	76.59
36	OTHER OFFICE EQUIPMENT	3.04	3.45	3.50	3.54	3.87	3.80	4.03	4.55	4.43	4.82
37	SERVICE INDUSTRY MACHINERY	12.06	14.74	14.76	14.77	17.13	17.07	17.04	20.03	19.93	20.03
	ELECTRICAL MACHINERY	116.63	140.27	139.76	141.22	162.56	158.44	165.40	200.15	192.81	208.31
38	COMMUNIC EQ, ELECTRONIC COMP	63.19	78.25	77.80	78.77	94.25	91.39	96.22	121.38	116.20	127.09
39	ELEC INDL APP & DISTRIB EQ	20.64	23.73	23.58	23.86	25.28	24.50	25.73	29.97	28.85	31.25
40	HOUSEHOLD APPLIANCES	10.58	11.62	11.65	11.71	12.96	12.86	13.09	14.16	13.95	14.43
41	ELEC LIGHTING & WIRING EQ	16.08	19.65	19.69	19.77	21.73	21.44	21.88	25.15	24.48	25.85
42	TV SETS, RADIOS, PHONOGRAPHS	6.14	7.03	7.05	7.10	8.33	8.25	8.47	9.50	9.32	9.69
	TRANSPORTATION EQ	144.33	191.69	192.14	192.44	235.01	233.67	232.32	277.18	274.43	282.07
43	MOTOR VEHICLES	87.33	122.53	123.29	122.61	153.32	154.43	148.57	182.43	183.01	183.55
44	AEROSPACE	38.61	45.33	45.22	46.01	52.70	50.89	54.69	59.82	57.25	62.92
45	SHIPS, BOATS	9.28	12.53	12.52	12.53	15.64	15.52	15.61	18.90	18.80	19.12
46	OTHER TRANSP. EQUIP.	9.11	11.30	11.12	11.29	13.36	12.82	13.45	16.04	15.36	16.48

BASE MONEY COMPARISONS

TABLE 5.3. OUTPUT BY PRODUCING SECTOR (1977$)

		(BASE) 1981	(BASE) 1985	(HIGH) 1985	(LOW) 1985	(BASE) 1990	(HIGH) 1990	(LOW) 1990	(BASE) 1995	(HIGH) 1995	(LOW) 1995
47	INSTRUMENTS	28.54	34.86	34.75	35.08	41.59	40.69	42.34	50.93	49.52	52.05
48	MISC. MANUFACTURING	17.81	21.76	21.72	21.81	25.60	25.29	25.74	29.71	29.21	29.82
	TRANSPORTATION	136.14	156.53	157.00	157.56	178.33	177.84	180.07	202.74	202.26	206.80
49	RAILROADS	22.72	25.03	25.02	25.12	27.16	26.85	27.30	29.53	29.07	29.92
50	TRUCKING, HWY PASS TRANSIT	63.57	73.57	73.54	73.69	83.80	83.38	83.88	94.64	94.04	95.34
51	WATER TRANSPORT	15.44	16.68	16.64	16.82	19.06	18.61	19.51	22.45	21.86	23.23
52	AIR TRANSPORT	28.23	34.40	34.95	35.06	40.90	41.62	41.96	48.08	49.32	50.27
53	PIPELINE	3.58	3.95	3.96	3.95	4.22	4.21	4.20	4.52	4.52	4.51
54	TRANSPORTAION SERVICES	2.61	2.89	2.89	2.91	3.20	3.16	3.22	3.51	3.45	3.53
	UTILITIES	223.80	261.65	261.31	262.24	303.65	301.06	304.44	347.66	342.39	349.46
55	COMMUNICATIONS SERVICES	83.10	102.86	102.43	102.66	126.50	125.18	126.19	153.10	150.67	152.90
56	ELECTRIC UTILILITIES	78.35	88.65	88.68	89.24	99.08	98.20	100.16	109.01	106.98	110.90
57	GAS UTILITY	51.31	56.82	56.89	57.19	62.27	61.79	62.77	66.79	65.54	67.77
58	WATER AND SANITATION	11.04	13.32	13.31	13.16	15.79	15.89	15.36	18.76	19.20	17.90
59	WHOLESALE TRADE	187.85	220.12	220.09	220.60	252.74	250.93	253.00	289.88	286.75	291.58
60	RETAIL TRADE	193.65	231.36	231.81	231.70	262.28	262.84	260.68	290.23	288.90	289.28
61	EATING & DRINKING PLACES	89.33	107.08	107.23	107.49	122.50	122.27	122.62	137.32	136.09	138.31
62	FINANCE & INSURANCE	130.86	153.02	153.17	153.17	173.07	173.07	172.63	192.22	191.72	192.05
63	REAL ESTATE	158.83	181.86	182.39	181.95	198.75	199.60	197.59	213.32	214.08	212.09
64	OWNER-OCCUPIED HOUSING	154.89	183.06	183.34	183.52	206.77	207.03	206.33	228.08	226.88	228.71
	SERVICES	488.44	585.78	585.64	588.24	690.75	688.08	694.81	800.57	793.81	810.04
65	HOTELS; REPAIRS EXC AUTO	44.31	50.53	50.47	50.62	55.14	54.97	55.21	59.03	58.67	59.54
66	BUSINESS SERVICES	202.75	258.55	258.65	259.19	319.49	318.25	319.95	388.29	385.76	390.90
67	AUTOMOBILE REPAIRS	42.60	52.48	52.43	52.51	60.55	60.39	60.09	68.59	67.76	68.31
68	MOVIES AND AMUSEMENTS	23.87	29.62	29.88	30.01	35.55	36.19	36.48	41.14	42.27	43.16
69	MEDICINE, EDUCATION, NPO	174.92	194.60	194.21	195.91	220.01	218.28	223.08	243.53	239.36	248.14
70	FED & S&L GOVT ENTERPRISES	28.22	32.41	32.41	32.28	35.96	36.02	35.54	39.55	39.83	38.90
71	NON COMPETITIVE IMPORTS										
72	DOMESTIC SERVANTS	5.09	5.82	5.70	5.78	6.07	5.88	6.03	6.15	5.92	6.48
73	UNIMPORTANT INDUSTRY	8.50	10.07	10.05	10.11	11.49	11.32	11.60	13.07	12.85	13.30
74	SCRAP AND USED	2.65	4.26	4.17	4.35	5.59	5.14	6.00	6.82	6.31	7.45
75	REST OF THE WORLD INDUSTRY	36.07	27.57	26.41	28.26	29.03	24.51	32.47	36.09	29.45	40.34
76	GOVERNMENT INDUSTRY	213.73	219.83	219.83	219.83	228.16	228.16	228.16	236.05	236.05	236.05
77	INFORUM STAT. DISCREPANCY	16.08	18.54	18.39	18.44	20.39	19.98	20.38	23.19	22.76	22.89
78	NIPA STAT. DISCREPANCY	1.22	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

BASE MONEY COMPARISONS

TABLE 5.3. OUTPUT BY PRODUCING SECTOR (1977$)
SUMMARY OF EXPONENTIAL ANNUAL GROWTH RATES

		(BASE) 81- 85	(HIGH) 81- 85	(LOW) 81- 85	(BASE) 85- 90	(HIGH) 85- 90	(LOW) 85- 90	(BASE) 90- 95	(HIGH) 90- 95	(LOW) 90- 95	(BASE) 81- 95
1	AGRICULTURE, FORESTRY, FISHERY	1.56	1.53	1.66	1.76	1.56	1.86	1.61	1.53	1.60	1.65
	MINING	2.00	2.00	2.09	1.04	0.86	1.06	0.91	0.82	1.00	1.27
2	IRON ORE MINING	2.84	2.58	3.15	0.66	-0.27	1.09	0.27	0.14	0.79	1.14
3	NONFERROUS METALS MINING	4.46	4.30	4.58	0.78	0.35	0.99	2.32	2.22	2.54	2.38
4	COAL MINING	3.14	3.13	3.27	3.03	2.83	3.14	2.57	2.43	2.70	2.90
5	NATURAL GAS EXTRACTION	-0.23	-0.20	-0.09	0.53	0.33	0.59	0.02	-0.20	0.15	0.13
6	CRUDE PETROLEUM	1.79	1.79	1.74	-0.65	-0.70	-0.78	-0.69	-0.64	-0.74	0.02
7	NON-METALLIC MINING	4.08	4.06	4.12	2.43	2.31	2.42	2.11	2.13	2.12	2.79
8	CONSTRUCTION	3.97	4.10	3.88	2.73	2.94	2.38	2.13	2.33	1.98	2.87
	NON-DURABLES	3.01	2.99	3.06	2.05	1.92	2.10	1.97	1.90	1.97	2.30
9	FOOD & TOBACCO	1.83	1.84	1.88	1.45	1.33	1.50	1.20	1.08	1.14	1.47
10	TEXTILES, EXC. KNITS	4.72	4.64	4.79	2.60	2.42	2.61	2.37	2.32	2.43	3.12
11	KNITTING	4.48	4.43	4.51	1.99	1.92	1.90	2.69	2.58	2.73	2.95
12	APPAREL, HOUSEHOLD TEXTILES	4.97	4.91	5.02	2.82	2.74	2.78	2.37	2.25	2.45	3.28
13	PAPER	3.13	3.07	3.24	2.41	2.18	2.50	2.21	2.15	2.29	2.55
14	PRINTING & PUBLISHING	2.95	2.92	3.07	2.02	1.91	2.10	1.66	1.60	1.73	2.16
15	AGRICULTURAL FERTILIZERS	1.28	1.18	1.42	2.25	1.92	2.45	2.52	2.45	2.53	2.07
16	OTHER CHEMICALS	3.80	3.74	3.87	3.01	2.77	3.15	3.05	3.00	3.04	3.25
17	PETROLEUM REFINING	2.15	2.17	2.15	0.86	0.83	0.79	0.95	0.97	0.93	1.26
18	FUEL OIL	1.25	1.27	1.37	0.91	0.75	0.93	1.34	1.22	1.41	1.16
19	RUBBER PRODUCTS	5.11	5.17	5.04	2.84	2.84	2.74	2.69	2.73	2.74	3.44
20	PLASTIC PRODUCTS	4.55	4.52	4.64	3.50	3.25	3.59	3.67	3.61	3.74	3.86
21	SHOES AND LEATHER	7.18	7.32	6.98	1.44	1.75	1.08	1.90	1.97	1.62	3.24
	DURABLES	4.76	4.73	4.89	3.05	2.73	3.06	3.26	3.18	3.62	3.62
22	LUMBER	3.26	3.50	3.30	2.29	2.18	1.88	1.70	1.66	1.92	2.36
23	FURNITURE	5.23	5.38	5.49	1.74	1.64	1.68	1.88	1.71	2.15	2.79
24	STONE, CLAY, GLASS	5.02	5.11	5.02	2.85	2.88	2.63	2.69	2.72	2.71	3.41
25	FERROUS METALS	1.99	1.70	2.34	1.57	0.65	1.93	0.74	0.62	1.28	1.40
26	COPPER	3.56	3.46	3.71	0.43	-0.08	0.57	1.66	1.55	2.08	1.77
27	OTHER NONFERROUS METALS	4.58	4.48	4.75	3.14	2.68	3.29	3.54	3.50	3.83	3.69
28	METAL PRODUCTS	4.01	3.95	4.15	2.86	2.65	2.76	2.78	2.72	3.05	3.16
	NON-ELEC MACHINERY	4.18	4.11	4.28	2.97	2.53	3.17	4.03	4.02	4.30	3.69
29	ENGINES AND TURBINES	4.72	4.61	4.82	3.53	3.03	3.77	4.21	4.14	4.58	4.11
30	AGRICULTURAL MACHINERY	3.04	3.02	3.07	1.58	1.16	1.82	2.66	2.61	2.55	2.38
31	CONSTR, MINING, OILFIELD EQ	1.34	1.21	1.32	1.57	1.07	1.90	2.78	2.79	2.96	1.94
32	METALWORKING MACHINERY	3.78	3.73	3.80	0.30	-0.20	0.41	1.89	1.97	2.44	1.86
33	SPECIAL INDUSTRY MACHINERY	2.76	2.67	2.80	-0.86	-1.45	-0.47	0.94	0.80	1.22	0.82
34	MISC NON-ELECTRICAL MACH.	3.62	3.49	3.76	1.83	1.37	1.94	3.01	2.97	3.42	2.76
35	COMPUTERS	7.14	7.11	7.34	7.01	6.55	7.28	7.04	7.09	7.22	7.06
36	OTHER OFFICE EQUIPMENT	3.15	3.55	3.81	2.33	1.65	2.62	3.24	3.06	3.58	2.89
37	SERVICE INDUSTRY MACHINERY	5.02	5.06	5.08	3.00	2.90	2.86	3.13	3.10	3.23	3.63
	ELECTRICAL MACHINERY	4.61	4.52	4.78	2.95	2.51	3.16	4.16	3.93	4.61	3.86
38	COMMUNIC EQ, ELECTRONIC COMP	5.34	5.20	5.51	3.72	3.22	4.00	5.06	4.80	5.56	4.66
39	ELEC INDL APP & DISTRIB EQ	3.48	3.32	3.62	1.27	0.77	1.51	3.40	3.27	3.89	2.66
40	HOUSEHOLD APPLIANCES	2.35	2.40	2.53	2.17	1.98	2.23	1.77	1.63	1.94	2.08
41	ELEC LIGHTING & WIRING EQ	5.00	5.05	5.16	2.02	1.70	2.03	2.92	2.66	3.33	3.19
42	TV SETS, RADIOS, PHONOGRAPHS	3.40	3.47	3.65	3.40	3.14	3.53	2.62	2.46	2.69	3.12
	TRANSPORTATION EQ	7.09	7.15	7.19	4.08	3.91	3.77	3.30	3.22	3.88	4.66
43	MOTOR VEHICLES	8.47	8.62	8.48	4.48	4.50	3.84	3.48	3.40	4.23	5.26
44	AEROSPACE	4.01	3.95	4.38	3.01	2.36	3.46	2.53	2.35	2.80	3.13
45	SHIPS, BOATS	7.49	7.47	7.50	4.43	4.31	4.40	3.79	3.83	4.05	5.08
46	OTHER TRANSP. EQUIP.	5.39	4.98	5.37	3.35	2.85	3.50	3.66	3.62	4.05	4.04

BASE MONEY COMPARISONS

TABLE 5.3. OUTPUT BY PRODUCING SECTOR (1977$)
SUMMARY OF EXPONENTIAL ANNUAL GROWTH RATES

		(BASE) 81- 85	(HIGH) 81- 85	(LOW) 81- 85	(BASE) 85- 90	(HIGH) 85- 90	(LOW) 85- 90	(BASE) 90- 95	(HIGH) 90- 95	(LOW) 90- 95	(BASE) 81- 95
47	INSTRUMENTS	5.00	4.92	5.15	3.53	3.16	3.76	4.05	3.93	4.13	4.14
48	MISC. MANUFACTURING	5.01	4.96	5.06	3.25	3.05	3.31	2.98	2.88	2.94	3.66
	TRANSPORTATION	3.49	3.56	3.65	2.61	2.49	2.67	2.57	2.57	2.77	2.84
49	RAILROADS	2.43	2.41	2.52	1.63	1.41	1.66	1.67	1.59	1.83	1.87
50	TRUCKING, HWY PASS TRANSIT	3.65	3.64	3.69	2.60	2.51	2.59	2.43	2.41	2.56	2.84
51	WATER TRANSPORT	1.94	1.87	2.14	2.67	2.25	2.97	3.27	3.21	3.49	2.67
52	AIR TRANSPORT	4.94	5.34	5.42	3.46	3.49	3.59	3.24	3.39	3.61	3.80
53	PIPELINE	2.49	2.51	2.49	1.28	1.24	1.22	1.39	1.41	1.38	1.67
54	TRANSPORTAION SERVICES	2.54	2.57	2.67	2.00	1.78	2.02	1.89	1.76	1.88	2.12
	UTILITIES	3.91	3.87	3.96	2.98	2.83	2.98	2.71	2.57	2.76	3.15
55	COMMUNICATIONS SERVICES	5.33	5.23	5.28	4.14	4.01	4.12	3.82	3.71	3.85	4.36
56	ELECTRIC UTILILITIES	3.09	3.10	3.25	2.23	2.04	2.31	1.91	1.71	2.04	2.36
57	GAS UTILITY	2.55	2.58	2.71	1.83	1.65	1.86	1.40	1.18	1.53	1.88
58	WATER AND SANITATION	4.69	4.67	4.38	3.39	3.54	3.10	3.45	3.79	3.06	3.79
59	WHOLESALE TRADE	3.96	3.96	4.02	2.76	2.62	2.74	2.74	2.67	2.84	3.10
60	RETAIL TRADE	4.45	4.50	4.49	2.51	2.51	2.36	2.03	1.89	2.08	2.89
61	EATING & DRINKING PLACES	4.53	4.57	4.63	2.69	2.63	2.63	2.28	2.14	2.41	3.07
62	FINANCE & INSURANCE	3.91	3.94	3.94	2.46	2.44	2.39	2.10	2.05	2.13	2.75
63	REAL ESTATE	3.38	3.46	3.40	1.78	1.80	1.69	1.41	1.40	1.42	2.11
64	OWNER-OCCUPIED HOUSING	4.18	4.21	4.24	2.44	2.43	2.34	1.96	1.83	2.06	2.76
	SERVICES	4.54	4.54	4.65	3.30	3.22	3.33	2.95	2.86	3.07	3.53
65	HOTELS, REPAIRS EXC AUTO	3.29	3.26	3.33	1.74	1.71	1.74	1.36	1.30	1.51	2.05
66	BUSINESS SERVICES	6.08	6.09	6.14	4.23	4.15	4.21	3.90	3.85	4.01	4.64
67	AUTOMOBILE REPAIRS	5.21	5.19	5.23	2.86	2.83	2.70	2.49	2.30	2.56	3.40
68	MOVIES AND AMUSEMENTS	5.40	5.62	5.73	3.65	3.83	3.90	2.92	3.11	3.36	3.89
69	MEDICINE, EDUCATION, NPO	2.67	2.62	2.83	2.45	2.34	2.60	2.03	1.84	2.13	2.36
70	FED & S&L GOVT ENTERPRISES	3.46	3.47	3.37	2.08	2.11	1.92	1.91	2.01	1.81	2.41
71	NON COMPETITIVE IMPORTS										
72	DOMESTIC SERVANTS	3.35	2.87	3.20	0.85	0.62	0.86	0.28	0.14	1.42	1.36
73	UNIMPORTANT INDUSTRY	4.22	4.16	4.33	2.65	2.38	2.75	2.58	2.53	2.74	3.07
74	SCRAP AND USED	11.82	11.31	12.37	5.45	4.17	6.43	3.98	4.10	4.30	6.74
75	REST OF THE WORLD INDUSTRY	-6.72	-7.80	-6.10	1.03	-1.49	2.78	4.35	3.67	4.34	0.00
76	GOVERNMENT INDUSTRY	0.70	0.70	0.70	0.74	0.74	0.74	0.68	0.68	0.68	0.71
77	INFORUM STAT. DISCREPANCY	3.56	3.36	3.42	1.90	1.65	2.00	2.58	2.61	2.32	2.62
78	NIPA STAT. DISCREPANCY										

REQUIRED RESERVE RATIO RUNS

TABLE 5.7. SUMMARY OF RESULTS

	(BASE) 1981	(BASE) 1985	(HIGH) 1985	(LOW) 1985	(BASE) 1990	(HIGH) 1990	(LOW) 1990	(BASE) 1995	(HIGH) 1995	(LOW) 1995
Gross National Product, (cu. $)	2984.43	4299.19	4302.83	4349.23	6235.53	6197.61	6271.86	9080.28	9008.78	9105.14
Labor compensation	1771.40	2612.40	2618.05	2650.01	3795.68	3777.16	3827.81	5536.07	5500.80	5564.67
Indirect business taxes	251.76	327.24	326.87	329.99	457.53	453.97	458.86	647.38	640.47	647.05
Return to capital	900.07	1276.77	1275.20	1285.56	1869.73	1855.00	1872.11	2742.16	2714.78	2738.71
Net interest	245.45	315.77	315.77	315.77	432.63	432.63	432.63	592.74	592.74	592.74
Corporate profits	249.06	433.72	430.78	441.41	644.49	632.39	644.39	931.20	908.77	924.76
Proprietor income	147.38	224.43	225.08	224.58	361.55	361.70	361.24	573.59	574.27	574.03
Gross National Product Deflator	1.99	2.51	2.51	2.54	3.24	3.22	3.26	4.23	4.19	4.24
Hourly labor comp. index (manuf.)	144.40	192.94	192.80	196.40	255.38	253.56	258.37	344.93	340.90	346.84
Labor productivity (GNP/JOBS)	20.10	20.88	20.88	20.87	21.67	21.66	21.64	22.51	22.50	22.49
Financial variables										
Treasury bill rate	14.76	8.40	8.46	7.95	7.06	7.36	6.68	5.92	6.50	5.77
Treasury bonds , 10 year	13.91	8.30	8.36	8.27	7.34	7.48	7.10	6.85	7.10	6.73
AAA Corporate bond rate	14.17	9.03	9.08	9.00	7.86	7.98	7.63	7.33	7.58	7.21
Commercial paper rate	14.76	8.57	8.64	8.17	7.56	7.85	7.23	6.24	6.82	6.15
Mortgage rate	14.17	9.46	9.51	9.43	8.50	8.61	8.27	8.08	8.30	7.96
M2 (billions of current$)	1743.75	2487.97	2480.33	2568.79	3707.39	3637.92	3762.56	5530.59	5381.98	5567.06
Non-borrowed reserve base	163.50	225.16	225.16	225.16	335.90	335.90	335.90	501.10	501.10	501.10
Ratio of M2 to nominal GNP	0.58	0.58	0.58	0.59	0.59	0.59	0.60	0.61	0.60	0.61
Savings rate	6.42	7.55	7.69	7.41	7.88	8.16	7.75	8.24	8.69	8.25
Gross National Product (77$)	2095.23	2396.74	2401.36	2395.32	2692.08	2691.38	2686.12	3003.41	3004.63	3000.35
Personal Consumption	1313.09	1541.44	1545.66	1544.04	1734.44	1733.76	1734.38	1908.15	1906.32	1908.04
Residential Structures	68.86	94.84	95.11	96.23	117.83	116.58	119.26	132.72	130.57	133.64
Non-residential structures	82.83	97.52	97.68	96.80	109.48	109.40	109.44	123.77	123.75	123.99
Producers' durable equipment	172.33	213.13	213.17	211.64	240.88	239.85	239.15	290.21	290.49	289.68
Inventory change	9.39	16.36	16.63	16.42	18.10	17.45	17.74	20.03	20.23	19.87
Exports	254.48	245.92	246.58	243.69	276.29	278.54	272.18	337.16	341.93	334.59
Imports	221.38	261.97	262.97	263.00	301.26	300.50	302.34	346.81	346.84	347.65
Other variables										
Disp. income per capita (1972$)	4537.61	5169.31	5192.36	5169.13	5585.78	5602.53	5576.55	5948.70	5975.16	5949.71
Return to capital scaler	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Foreign demand scaler	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Trade balance (cu. $)	0.00	0.00	-86.68	-86.68	0.00	-140.65	-140.65	0.00	-176.00	-176.00
Merchandise exports (cu. $)	218.89	266.43	266.80	267.55	383.24	383.88	380.15	620.01	622.85	616.90
Merchandise imports (cu. $)	261.71	353.31	354.01	354.84	523.90	521.02	525.71	796.01	791.43	796.83
Exchange rate scaler	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Unemployment rate	7.71	5.46	5.27	5.48	4.20	4.18	4.31	3.90	3.79	3.90
Civilian jobs (millions)	104.22	114.80	115.02	114.78	124.23	124.26	124.10	133.43	133.57	133.42
Private sector jobs	88.01	98.06	98.28	98.03	106.78	106.80	106.65	115.32	115.46	115.31
Agric,Mining,Structures	9.95	10.85	10.86	10.85	11.69	11.67	11.70	12.39	12.37	12.41
Durable goods manufacturing	12.20	13.17	13.21	13.14	13.83	13.84	13.76	14.75	14.81	14.69
Non-durable goods mfg	8.13	8.09	8.10	8.08	7.84	7.84	7.82	7.58	7.59	7.58
Transp.Communic.Utilities	5.43	5.69	5.70	5.68	5.78	5.79	5.78	5.84	5.86	5.85
Trade	22.88	26.62	26.67	26.62	29.71	29.67	29.66	32.68	32.62	32.63
Finance,Insurance,Real Estate	5.88	6.70	6.71	6.71	7.33	7.33	7.33	7.88	7.87	7.88
Medicine & Education	10.51	11.60	11.63	11.60	12.99	13.02	12.98	14.24	14.29	14.25
Domestic servants	1.88	1.80	1.80	1.80	1.77	1.77	1.77	1.74	1.74	1.74
Business,Repair,Oth services	11.16	13.55	13.59	13.56	15.86	15.89	15.87	18.24	18.33	18.30

REQUIRED RESERVE RATIO RUNS

TABLE 5.7. SUMMARY OF RESULTS
SUMMARY OF EXPONENTIAL ANNUAL GROWTH RATES

	(BASE) 81- 85	(HIGH) 81- 85	(LOW) 81- 85	(BASE) 85- 90	(HIGH) 85- 90	(LOW) 85- 90	(BASE) 90- 95	(HIGH) 90- 95	(LOW) 90- 95	(BASE) 81- 95
Gross National Product, (cu. $)	9.13	9.15	9.41	7.44	7.30	7.32	7.52	7.48	7.46	7.95
Labor compensation	9.71	9.77	10.07	7.47	7.33	7.35	7.55	7.52	7.48	8.14
Indirect business taxes	6.56	6.53	6.76	6.70	6.57	6.59	6.94	6.88	6.87	6.75
Return to capital	8.74	8.71	8.91	7.63	7.50	7.52	7.66	7.62	7.61	7.96
Net interest	6.30	6.30	6.30	6.30	6.30	6.30	6.30	6.30	6.30	6.30
Corporate profits	13.87	13.70	14.31	7.92	7.68	7.57	7.36	7.23	7.22	9.42
Proprietor income	10.51	10.59	10.53	9.54	9.49	9.81	9.23	9.25	9.26	9.71
Gross National Product Deflator	5.76	5.74	6.07	5.11	5.02	5.03	5.33	5.28	5.24	5.38
Hourly labor comp. index (manuf.)	7.24	7.23	7.69	5.61	5.48	5.49	6.01	5.92	5.89	6.22
Labor productivity (GNP/JOBS)	0.94	0.94	0.93	0.75	0.74	0.73	0.76	0.76	0.76	0.81
Financial variables										
Treasury bill rate	-14.09	-13.92	-15.45	-3.47	-2.79	-3.49	-3.53	-2.47	-2.92	-6.52
Treasury bonds , 10 year	-12.90	-12.73	-12.99	-2.46	-2.22	-3.05	-1.39	-1.03	-1.08	-5.06
AAA Corporate bond rate	-11.28	-11.14	-11.34	-2.77	-2.57	-3.21	-1.38	-1.04	-1.12	-4.70
Commercial paper rate	-13.58	-13.38	-14.79	-2.50	-1.91	-2.49	-3.86	-2.81	-3.23	-6.15
Mortgage rate	-10.10	-9.97	-10.18	-2.15	-1.98	-2.63	-1.01	-0.74	-0.77	-4.02
M2 (billions of current$)	8.69	8.81	9.68	7.98	7.66	7.63	8.00	7.83	7.84	8.24
Non-borrowed reserve base	8.00	8.00	8.00	8.00	8.00	8.00	8.00	8.00	8.00	8.00
Ratio of M2 to nominal GNP	-0.24	-0.34	0.27	0.54	0.36	0.21	0.48	0.35	0.38	0.30
Savings rate	4.07	4.84	3.60	0.85	1.17	0.89	0.90	1.27	1.26	1.79
Gross National Product (77$)	3.36	3.41	3.35	2.32	2.28	2.29	2.19	2.20	2.21	2.57
Personal Consumption	4.01	4.08	4.05	2.36	2.30	2.32	1.91	1.90	1.91	2.67
Residential Structures	8.00	8.07	8.37	4.34	4.07	4.29	2.38	2.27	2.28	4.69
Non-residential structures	4.08	4.12	3.89	2.32	2.27	2.45	2.45	2.47	2.50	2.87
Producers' durable equipment	5.31	5.32	5.14	2.45	2.36	2.44	3.73	3.83	3.83	3.72
Inventory change	13.89	14.29	13.97	2.02	0.96	1.55	2.03	2.96	2.27	5.41
Exports	-0.86	-0.79	-1.08	2.33	2.44	2.21	3.98	4.10	4.13	2.01
Imports	4.21	4.30	4.31	2.80	2.67	2.79	2.82	2.87	2.79	3.21
Other variables										
Disp. income per capita (1972$)	3.26	3.37	3.26	1.55	1.52	1.52	1.26	1.29	1.30	1.93
Return to capital scaler										
Foreign demand scaler										
Trade balance (cu. $)										
Merchandise exports (cu. $)	4.91	4.95	5.02	7.27	7.28	7.03	9.62	9.68	9.68	7.44
Merchandise imports (cu. $)	7.50	7.55	7.61	7.88	7.73	7.86	8.37	8.36	8.32	7.95
Exchange rate scaler										
Unemployment rate	-8.63	-9.51	-8.53	-5.25	-4.65	-4.83	-1.47	-1.94	-1.96	-4.86
Civilian jobs (millions)	2.42	2.47	2.41	1.58	1.55	1.56	1.43	1.44	1.45	1.76
Private sector jobs	2.70	2.76	2.70	1.70	1.66	1.68	1.54	1.56	1.56	1.93
Agric.Mining.Structures	2.16	2.20	2.16	1.50	1.44	1.52	1.17	1.15	1.18	1.57
Durable goods manufacturing	1.91	1.98	1.86	0.99	0.93	0.92	1.28	1.36	1.32	1.35
Non-durable goods mfg	-0.12	-0.10	-0.17	-0.64	-0.66	-0.66	-0.66	-0.65	-0.63	-0.50
Transp.Communic.Utilities	1.15	1.21	1.14	0.34	0.33	0.33	0.20	0.24	0.25	0.52
Trade	3.78	3.83	3.78	2.20	2.13	2.16	1.91	1.90	1.91	2.59
Finance,Insurance,Real Estate	3.28	3.32	3.30	1.80	1.75	1.78	1.43	1.42	1.44	2.09
Medicine & Education	2.46	2.55	2.46	2.25	2.24	2.25	1.83	1.85	1.86	2.16
Domestic servants	-1.03	-1.03	-1.03	-0.37	-0.37	-0.37	-0.31	-0.31	-0.31	-0.54
Business,Repair,Oth services	4.86	4.93	4.88	3.14	3.13	3.14	2.80	2.86	2.85	3.51

REQUIRED RESERVE RATIO RUNS

TABLE 3.8 OUTPUT BY PRODUCING SECTOR (1977$)

		(BASE) 1981	(BASE) 1985	(HIGH) 1985	(LOW) 1985	(BASE) 1990	(HIGH) 1990	(LOW) 1990	(BASE) 1995	(HIGH) 1995	(LOW) 1995
1	AGRICULTURE, FORESTRY, FISHERY	143.71	152.96	153.29	152.89	167.06	167.21	166.57	181.09	181.06	181.06
	MINING	80.86	87.60	87.78	87.49	92.26	92.33	92.07	96.54	96.61	96.60
2	IRON ORE MINING	2.46	2.75	2.76	2.73	2.85	2.86	2.81	2.89	2.92	2.86
3	NONFERROUS METALS MINING	3.11	3.72	3.72	3.69	3.87	3.87	3.84	4.34	4.36	4.33
4	COAL MINING	20.57	23.32	23.38	23.30	27.13	27.21	27.11	30.85	30.95	30.91
5	NATURAL GAS EXTRACTION	19.63	19.45	19.52	19.45	19.97	20.02	19.96	19.98	20.02	20.06
6	CRUDE PETROLEUM	28.17	30.22	30.25	30.19	29.25	29.17	29.17	28.26	28.15	28.24
7	NON-METALLIC MINING	6.92	8.14	8.15	8.13	9.19	9.19	9.17	10.22	10.22	10.21
8	CONSTRUCTION	99.90	117.10	117.27	117.25	134.19	133.77	134.65	149.30	148.65	149.72
	NON-DURABLES	671.99	757.93	758.69	756.92	839.95	839.50	837.39	926.95	926.06	925.69
9	FOOD & TOBACCO	218.11	234.68	234.98	234.67	252.26	252.22	251.70	267.81	266.96	267.92
10	TEXTILES, EXC. KNITS	34.87	42.12	42.11	41.94	47.96	47.86	47.73	53.98	53.95	53.79
11	KNITTING	9.17	10.97	10.96	10.94	12.11	12.07	12.07	13.86	13.79	13.82
12	APPAREL, HOUSEHOLD TEXTILES	41.60	50.76	50.79	50.64	58.45	58.31	58.25	65.82	65.65	65.61
13	PAPER	51.19	58.02	58.12	57.88	65.47	65.47	65.17	73.13	73.18	72.97
14	PRINTING & PUBLISHING	50.43	56.74	56.89	56.69	62.76	62.93	62.78	68.21	68.50	68.38
15	AGRICULTURAL FERTILIZERS	13.52	14.23	14.26	14.20	15.93	15.95	15.84	18.07	18.11	18.04
16	OTHER CHEMICALS	109.19	127.14	127.22	126.79	147.77	147.72	146.97	172.15	172.21	171.49
17	PETROLEUM REFINING	96.81	105.51	105.57	105.46	110.15	110.00	109.99	115.52	115.31	115.49
	18 FUEL OIL	24.33	25.58	25.66	25.59	26.77	26.81	26.74	28.63	28.64	28.67
19	RUBBER PRODUCTS	15.39	18.87	18.88	18.87	21.76	21.70	21.72	24.89	24.89	24.82
20	PLASTIC PRODUCTS	25.30	30.34	30.41	30.30	36.14	36.14	35.97	43.42	43.51	43.30
21	SHOES AND LEATHER	6.42	8.55	8.53	8.55	9.19	9.13	9.20	10.10	10.01	10.05
	DURABLES	723.11	874.84	878.56	873.82	1019.22	1018.85	1012.91	1199.71	1205.32	1194.62
22	LUMBER	39.84	45.39	45.73	45.70	50.90	50.83	50.84	55.41	55.30	55.35
23	FURNITURE	16.42	20.25	20.43	20.35	22.09	22.18	22.15	24.27	24.47	24.29
24	STONE, CLAY, GLASS	32.80	40.09	40.21	40.13	46.24	46.14	46.23	52.88	52.78	52.89
25	FERROUS METALS	54.06	58.54	58.77	57.95	63.34	63.71	62.64	65.74	66.54	65.35
26	COPPER	8.64	9.97	10.00	9.92	10.19	10.19	10.09	11.07	11.13	11.01
27	OTHER NONFERROUS METALS	33.10	39.77	39.87	39.56	46.52	46.58	46.19	55.52	55.82	55.30
28	METAL PRODUCTS	86.35	101.39	101.78	101.27	116.96	116.77	116.41	134.39	134.49	133.95
	NON-ELEC MACHINERY	144.57	170.85	171.23	170.06	198.23	198.28	196.65	242.46	243.90	241.73
29	ENGINES AND TURBINES	11.05	13.34	13.36	13.27	15.92	15.95	15.77	19.65	19.76	19.52
30	AGRICULTURAL MACHINERY	11.26	12.72	12.71	12.66	13.76	13.77	13.68	15.72	15.68	15.67
31	CONSTR, MINING, OILFIELD EQ	18.37	19.38	19.30	19.14	20.96	20.92	20.65	24.09	24.13	23.84
32	METALWORKING MACHINERY	15.32	17.82	17.87	17.74	18.09	17.98	17.88	19.88	20.03	19.80
33	SPECIAL INDUSTRY MACHINERY	9.12	10.18	10.17	10.11	9.75	9.76	9.64	10.22	10.27	10.15
34	MISC NON-ELECTRICAL MACH.	36.71	42.44	42.54	42.23	46.51	46.41	46.04	54.05	54.32	53.79
35	COMPUTERS	27.65	36.79	36.96	36.68	52.25	52.46	52.02	74.28	75.05	74.36
36	OTHER OFFICE EQUIPMENT	3.04	3.45	3.52	3.50	3.87	3.95	3.89	4.55	4.66	4.59
37	SERVICE INDUSTRY MACHINERY	12.06	14.74	14.79	14.74	17.13	17.08	17.08	20.03	20.01	20.01
	ELECTRICAL MACHINERY	116.63	140.27	140.62	139.73	162.56	162.90	161.42	200.15	201.36	199.44
38	COMMUNIC EQ, ELECTRONIC COMP	63.19	78.25	78.35	77.82	94.25	94.48	93.47	121.38	122.22	120.83
39	ELEC INDL APP & DISTRIB EQ	20.64	23.73	23.75	23.56	25.28	25.30	25.04	29.97	30.14	29.82
40	HOUSEHOLD APPLIANCES	10.58	11.62	11.68	11.62	12.96	13.00	12.97	14.16	14.21	14.21
41	ELEC LIGHTING & WIRING EQ	16.08	19.65	19.76	19.68	21.73	21.75	21.61	25.15	25.24	25.05
42	TV SETS, RADIOS, PHONOGRAPHS	6.14	7.03	7.08	7.05	8.33	8.38	8.34	9.50	9.54	9.53
	TRANSPORTATION EQ	144.33	191.69	193.21	192.68	235.01	234.09	233.49	277.18	278.84	275.13
43	MOTOR VEHICLES	87.33	122.53	123.75	123.64	153.32	152.10	152.36	182.43	182.99	180.92
44	AEROSPACE	38.61	45.33	45.68	45.38	52.70	53.14	52.45	59.82	60.87	59.74
45	SHIPS, BOATS	9.28	12.53	12.55	12.52	15.64	15.61	15.57	18.90	18.98	18.71
46	OTHER TRANSP. EQUIP.	9.11	11.30	11.23	11.14	13.36	13.24	13.11	16.04	15.99	15.75

REQUIRED RESERVE RATIO RUNS

TABLE 5.8. OUTPUT BY PRODUCING SECTOR (1977$)

		(BASE) 1981	(BASE) 1985	(HIGH) 1985	(LOW) 1985	(BASE) 1990	(HIGH) 1990	(LOW) 1990	(BASE) 1995	(HIGH) 1995	(LOW) 1995
47	INSTRUMENTS	28.54	34.86	34.94	34.74	41.59	41.64	41.35	50.93	51.08	50.71
48	MISC. MANUFACTURING	17.81	21.76	21.77	21.72	25.60	25.54	25.45	29.71	29.62	29.47
	TRANSPORTATION	136.14	156.53	157.45	157.00	178.33	179.37	178.81	202.74	204.96	203.88
49	RAILROADS	22.72	25.03	25.10	25.01	27.16	27.17	27.05	29.53	29.58	29.45
50	TRUCKING, HWY PASS TRANSIT	63.57	73.57	73.69	73.51	83.80	83.76	83.63	94.64	94.83	94.53
51	WATER TRANSPORT	15.44	16.68	16.74	16.65	19.06	19.17	18.97	22.45	22.69	22.42
52	AIR TRANSPORT	28.23	34.40	35.06	34.98	40.90	41.87	41.77	48.08	49.85	49.47
53	PIPELINE	3.58	3.95	3.96	3.95	4.22	4.21	4.21	4.52	4.51	4.52
54	TRANSPORTAION SERVICES	2.61	2.89	2.90	2.89	3.20	3.20	3.18	3.51	3.50	3.49
	UTILITIES	223.80	261.65	261.88	261.19	303.65	303.26	302.63	347.66	346.63	347.15
55	COMMUNICATIONS SERVICES	83.10	102.86	102.58	102.35	126.50	125.83	125.64	153.10	152.05	152.24
56	ELECTRIC UTILILITIES	78.35	88.65	89.00	88.68	99.08	99.40	99.09	109.01	109.30	109.36
57	GAS UTILITY	51.31	56.82	57.07	56.89	62.27	62.44	62.25	66.79	66.84	66.98
58	WATER AND SANITATION	11.04	13.32	13.24	13.27	15.79	15.59	15.65	18.76	18.44	18.56
59	WHOLESALE TRADE	187.85	220.12	220.51	219.89	252.74	252.42	251.89	289.88	289.64	289.25
60	RETAIL TRADE	193.65	231.36	231.87	231.67	262.28	261.72	262.03	290.23	289.00	289.58
61	EATING & DRINKING PLACES	89.33	107.08	107.45	107.27	122.50	122.53	122.43	137.32	137.35	137.29
62	FINANCE & INSURANCE	130.86	153.02	153.19	153.04	173.07	172.90	172.99	192.22	191.91	192.23
63	REAL ESTATE	158.83	181.86	182.26	182.08	198.73	198.58	198.81	213.32	213.07	213.46
64	OWNER-OCCUPIED HOUSING	154.89	183.06	183.58	183.38	206.77	206.70	206.77	228.08	227.83	228.11
	SERVICES	488.44	585.78	587.43	585.94	690.75	691.97	690.75	800.57	803.36	802.07
65	HOTELS; REPAIRS EXC AUTO	44.31	50.53	50.57	50.48	55.14	55.14	55.09	59.03	59.18	59.13
66	BUSINESS SERVICES	202.75	258.55	259.11	258.54	319.49	319.53	319.08	388.29	388.88	388.22
67	AUTOMOBILE REPAIRS	42.60	52.48	52.50	52.43	60.55	60.31	60.35	68.59	68.03	68.41
68	MOVIES AND AMUSEMENTS	23.87	29.62	29.95	29.89	35.55	36.32	36.29	41.14	42.79	42.51
69	MEDICINE, EDUCATION, NPO	174.92	194.60	195.31	194.60	220.01	220.66	219.94	243.53	244.48	243.80
70	FED & S&L GOVT ENTERPRISES	28.22	32.41	32.37	32.38	35.96	35.77	35.80	39.55	39.28	39.39
71	NON COMPETITIVE IMPORTS										
72	DOMESTIC SERVANTS	5.09	5.82	5.78	5.75	6.07	6.00	5.96	6.15	6.23	5.99
73	UNIMPORTANT INDUSTRY	8.50	10.07	10.09	10.05	11.49	11.50	11.44	13.07	13.12	13.05
74	SCRAP AND USED	2.65	4.26	4.27	4.20	5.59	5.68	5.52	6.82	7.01	6.77
75	REST OF THE WORLD INDUSTRY	36.07	27.57	27.29	26.66	29.03	29.13	27.69	36.09	35.96	35.03
76	GOVERNMENT INDUSTRY	213.73	219.83	219.83	219.83	228.16	228.16	228.16	236.05	236.05	236.05
77	INFORUM STAT. DISCREPANCY	16.08	18.54	18.39	18.28	20.39	20.18	20.14	23.19	22.87	23.00
78	NIPA STAT. DISCREPANCY	1.22	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

REQUIRED RESERVE RATIO RUNS

TABLE 5.8. OUTPUT BY PRODUCING SECTOR (1977$)
SUMMARY OF EXPONENTIAL ANNUAL GROWTH RATES

		(BASE) 81- 85	(HIGH) 81- 85	(LOW) 81- 85	(BASE) 85- 90	(HIGH) 85- 90	(LOW) 85- 90	(BASE) 90- 95	(HIGH) 90- 95	(LOW) 90- 95	(BASE) 81- 95
1	AGRICULTURE, FORESTRY, FISHERY	1.96	1.61	1.54	1.76	1.74	1.72	1.61	1.59	1.67	1.65
	MINING	2.00	2.06	1.97	1.04	1.01	1.02	0.91	0.91	0.96	1.27
2	IRON ORE MINING	2.84	2.92	2.60	0.66	0.72	0.59	0.27	0.39	0.38	1.14
3	NONFERROUS METALS MINING	4.46	4.46	4.27	0.78	0.81	0.81	2.32	2.35	2.37	2.38
4	COAL MINING	3.14	3.21	3.12	3.03	3.03	3.03	2.57	2.57	2.62	2.90
5	NATURAL GAS EXTRACTION	-0.23	-0.14	-0.23	0.53	0.51	0.52	0.02	-0.01	0.10	0.13
6	CRUDE PETROLEUM	1.75	1.77	1.73	-0.65	-0.73	-0.69	-0.69	-0.71	-0.69	0.02
7	NON-METALLIC MINING	4.08	4.11	4.04	2.43	2.40	2.42	2.11	2.12	2.14	2.79
8	CONSTRUCTION	3.97	4.01	4.00	2.73	2.63	2.77	2.13	2.11	2.12	2.87
	NON-DURABLES	3.01	3.03	2.98	2.05	2.02	2.02	1.97	1.96	2.00	2.30
9	FOOD & TOBACCO	1.83	1.86	1.83	1.45	1.42	1.40	1.20	1.14	1.25	1.47
10	TEXTILES, EXC. KNITS	4.72	4.72	4.61	2.60	2.56	2.59	2.37	2.39	2.39	3.12
11	KNITTING	4.48	4.47	4.42	1.99	1.94	1.96	2.69	2.65	2.71	2.93
12	APPAREL, HOUSEHOLD TEXTILES	4.97	4.97	4.92	2.82	2.77	2.80	2.37	2.37	2.38	3.28
13	PAPER	3.13	3.17	3.07	2.41	2.38	2.37	2.21	2.23	2.26	2.55
14	PRINTING & PUBLISHING	2.95	2.01	2.93	2.02	2.02	2.04	1.66	1.70	1.71	2.16
15	AGRICULTURAL FERTILIZERS	1.28	1.32	1.21	2.25	2.24	2.19	2.52	2.54	2.60	2.07
16	OTHER CHEMICALS	3.80	3.82	3.73	3.01	2.99	2.95	3.05	3.07	3.09	3.25
17	PETROLEUM REFINING	2.15	2.17	2.14	0.86	0.82	0.84	0.95	0.94	0.98	1.26
18	FUEL OIL	1.25	1.33	1.26	0.91	0.88	0.88	1.34	1.32	1.40	1.16
19	RUBBER PRODUCTS	5.11	5.12	5.10	2.84	2.78	2.81	2.69	2.74	2.68	3.44
20	PLASTIC PRODUCTS	4.55	4.61	4.51	3.50	3.45	3.43	3.67	3.71	3.71	3.86
21	SHOES AND LEATHER	7.18	7.11	7.17	1.44	1.36	1.46	1.90	1.84	1.79	3.24
	DURABLES	4.76	4.87	4.73	3.05	2.96	2.95	3.26	3.36	3.30	3.62
22	LUMBER	3.26	3.45	3.43	2.29	2.11	2.13	1.70	1.69	1.70	2.36
23	FURNITURE	5.23	5.46	5.36	1.74	1.64	1.69	1.88	1.97	1.85	2.79
24	STONE, CLAY, GLASS	5.02	5.09	5.04	2.85	2.76	2.83	2.69	2.69	2.69	3.41
25	FERROUS METALS	1.99	2.09	1.74	1.57	1.62	1.55	0.74	0.87	0.85	1.40
26	COPPER	3.56	3.63	3.45	0.43	0.39	0.34	1.66	1.76	1.74	1.77
27	OTHER NONFERROUS METALS	4.58	4.65	4.45	3.14	3.11	3.10	3.54	3.62	3.60	3.69
28	METAL PRODUCTS	4.01	4.11	3.99	2.86	2.75	2.79	2.78	2.83	2.81	3.16
	NON-ELEC MACHINERY	4.18	4.23	4.06	2.97	2.93	2.91	4.03	4.14	4.13	3.69
29	ENGINES AND TURBINES	4.72	4.75	4.58	3.53	3.54	3.45	4.21	4.29	4.26	4.11
30	AGRICULTURAL MACHINERY	3.04	3.03	2.93	1.58	1.61	1.59	2.66	2.59	2.72	2.38
31	CONSTR.MINING,OILFIELD EQ	1.34	1.24	1.03	1.57	1.61	1.52	2.78	2.86	2.88	1.94
32	METALWORKING MACHINERY	3.78	3.89	3.68	0.30	0.12	0.16	1.89	2.16	2.04	1.86
33	SPECIAL INDUSTRY MACHINERY	2.76	2.74	2.58	-0.86	-0.82	-0.94	0.94	1.01	1.03	0.82
34	MISC NON-ELECTRICAL MACH.	3.62	3.69	3.50	1.83	1.74	1.73	3.01	3.15	3.11	2.76
35	COMPUTERS	7.14	7.25	7.06	7.01	7.01	6.99	7.04	7.16	7.15	7.06
36	OTHER OFFICE EQUIPMENT	3.15	3.70	3.51	2.33	2.28	2.16	3.24	3.30	3.28	2.89
37	SERVICE INDUSTRY MACHINERY	5.02	5.10	5.03	3.00	2.88	2.94	3.13	3.17	3.17	3.63
	ELECTRICAL MACHINERY	4.61	4.68	4.52	2.95	2.94	2.89	4.16	4.24	4.23	3.86
38	COMMUNIC EQ. ELECTRONIC COMP	5.34	5.38	5.21	3.72	3.74	3.66	5.06	5.15	5.14	4.66
39	ELEC INDL APP & DISTRIB EQ	3.48	3.51	3.30	1.27	1.26	1.22	3.40	3.51	3.49	2.66
40	HOUSEHOLD APPLIANCES	2.35	2.46	2.35	2.17	2.15	2.19	1.77	1.77	1.83	2.08
41	ELEC LIGHTING & WIRING EQ	5.00	5.15	5.05	2.02	1.92	1.87	2.92	2.98	2.96	3.19
42	TV SETS, RADIOS, PHONOGRAPHS	3.40	3.56	3.46	3.40	3.37	3.36	2.62	2.60	2.68	3.12
	TRANSPORTATION EQ	7.09	7.29	7.22	4.08	3.84	3.84	3.30	3.50	3.28	4.66
43	MOTOR VEHICLES	8.47	8.71	8.69	4.48	4.13	4.18	3.48	3.70	3.44	5.26
44	AEROSPACE	4.01	4.20	4.04	3.01	3.02	2.90	2.53	2.72	2.60	3.13
45	SHIPS, BOATS	7.49	7.53	7.48	4.43	4.37	4.35	3.79	3.91	3.68	5.08
46	OTHER TRANSP. EQUIP.	5.39	5.24	5.02	3.35	3.29	3.27	3.66	3.77	3.67	4.04

REQUIRED RESERVE RATIO RUNS

TABLE 5.8. OUTPUT BY PRODUCING SECTOR (1977$)
SUMMARY OF EXPONENTIAL ANNUAL GROWTH RATES

		(BASE) 81- 85	(HIGH) 81- 85	(LOW) 81- 85	(BASE) 85- 90	(HIGH) 85- 90	(LOW) 85- 90	(BASE) 90- 95	(HIGH) 90- 95	(LOW) 90- 95	(BASE) 81- 95
47	INSTRUMENTS	5.00	5.06	4.91	3.53	3.51	3.48	4.05	4.09	4.08	4.14
48	MISC. MANUFACTURING	5.01	5.02	4.96	3.25	3.19	3.17	2.98	2.97	2.93	3.66
	TRANSPORTATION	3.49	3.64	3.56	2.61	2.61	2.60	2.57	2.67	2.62	2.84
49	RAILROADS	2.43	2.49	2.40	1.63	1.58	1.57	1.67	1.70	1.70	1.87
50	TRUCKING, HWY PASS TRANSIT	3.65	3.69	3.63	2.60	2.56	2.58	2.43	2.48	2.45	2.84
51	WATER TRANSPORT	1.94	2.03	1.89	2.67	2.70	2.61	3.27	3.37	3.35	2.67
52	AIR TRANSPORT	4.94	5.42	5.36	3.46	3.55	3.55	3.24	3.49	3.38	3.80
53	PIPELINE	2.49	2.51	2.48	1.28	1.24	1.26	1.39	1.39	1.42	1.67
54	TRANSPORTAION SERVICES	2.54	2.64	2.57	2.00	1.93	1.91	1.89	1.83	1.81	2.12
	UTILITIES	3.91	3.93	3.86	2.98	2.93	2.95	2.71	2.67	2.74	3.15
55	COMMUNICATIONS SERVICES	5.33	5.26	5.21	4.14	4.09	4.10	3.82	3.79	3.84	4.36
56	ELECTRIC UTILILITIES	3.09	3.19	3.10	2.23	2.21	2.22	1.91	1.90	1.97	2.36
57	GAS UTILITY	2.55	2.66	2.58	1.83	1.80	1.80	1.40	1.36	1.46	1.88
58	WATER AND SANITATION	4.69	4.54	4.60	3.39	3.27	3.29	3.48	3.36	3.42	3.79
59	WHOLESALE TRADE	3.96	4.01	3.94	2.76	2.70	2.72	2.74	2.75	2.77	3.10
60	RETAIL TRADE	4.45	4.50	4.48	2.51	2.42	2.46	2.03	1.98	2.00	2.89
61	EATING & DRINKING PLACES	4.53	4.62	4.57	2.69	2.63	2.64	2.28	2.28	2.29	3.07
62	FINANCE & INSURANCE	3.91	3.94	3.91	2.46	2.42	2.45	2.10	2.09	2.11	2.75
63	REAL ESTATE	3.38	3.44	3.41	1.78	1.72	1.76	1.41	1.41	1.42	2.11
64	OWNER-OCCUPIED HOUSING	4.18	4.25	4.22	2.44	2.37	2.40	1.96	1.95	1.96	2.76
	SERVICES	4.54	4.61	4.55	3.30	3.28	3.29	2.95	2.99	2.99	3.53
65	HOTELS; REPAIRS EXC AUTO	3.29	3.31	3.26	1.74	1.73	1.75	1.36	1.42	1.41	2.05
66	BUSINESS SERVICES	6.08	6.13	6.08	4.23	4.19	4.21	3.90	3.93	3.92	4.64
67	AUTOMOBILE REPAIRS	5.21	5.22	5.19	2.86	2.77	2.81	2.49	2.41	2.51	3.40
68	MOVIES AND AMUSEMENTS	5.40	5.67	5.63	3.65	3.86	3.88	2.92	3.28	3.16	3.89
69	MEDICINE, EDUCATION, NPO	2.67	2.76	2.67	2.45	2.44	2.45	2.03	2.05	2.06	2.36
70	FED & S&L GOVT ENTERPRISES	3.46	3.43	3.44	2.08	2.00	2.01	1.91	1.87	1.91	2.41
71	NON COMPETITIVE IMPORTS										
72	DOMESTIC SERVANTS	3.35	3.18	3.09	0.85	0.76	0.69	0.28	0.74	0.11	1.36
73	UNIMPORTANT INDUSTRY	4.22	4.27	4.16	2.65	2.62	2.61	2.58	2.63	2.62	3.07
74	SCRAP AND USED	11.82	11.87	11.45	5.45	5.74	5.49	3.98	4.20	4.09	6.74
75	REST OF THE WORLD INDUSTRY	-6.72	-6.97	-7.56	1.03	1.31	0.75	4.35	4.21	4.71	0.00
76	GOVERNMENT INDUSTRY	0.70	0.70	0.70	0.74	0.74	0.74	0.68	0.68	0.68	0.71
77	INFORUM STAT. DISCREPANCY	3.56	3.36	3.21	1.90	1.86	1.93	2.58	2.50	2.65	2.62
78	NIPA STAT. DISCREPANCY										

INTEREST RATE DUMMY COMPARISONS

TABLE 5.9. SUMMARY OF RESULTS

	(BASE) 1981	(BASE) 1989	(DUM=1) 1989	(BASE) 1990	(DUM=1) 1990	(BASE) 1995	(DUM=1) 1995
Gross National Product, (cu. $)	2984.43	4299.19	4250.95	6235.53	6233.06	9080.28	9039.04
Labor compensation	1771.40	2612.40	2593.41	3795.68	3809.05	5536.07	5529.26
Indirect business taxes	251.76	327.24	323.60	457.53	455.57	647.38	642.88
Return to capital	900.07	1276.77	1252.46	1869.73	1856.25	2742.16	2713.32
Net interest	245.45	315.77	315.77	432.63	432.63	592.74	592.74
Corporate profits	249.06	433.72	423.13	644.49	641.77	931.20	912.66
Proprietor income	147.38	224.43	221.53	361.55	357.96	573.59	569.17
Gross National Product Deflator	1.99	2.51	2.51	3.24	3.27	4.23	4.24
Hourly labor comp. index (manuf.)	144.40	192.94	194.67	255.38	259.20	344.93	347.66
Labor productivity (GNP/JOBS)	20.10	20.88	20.83	21.67	21.64	22.51	22.47
Financial variables							
Treasury bill rate	14.76	8.40	11.47	7.06	10.28	5.92	8.88
Treasury bonds , 10 year	13.91	8.30	10.72	7.34	9.87	6.85	9.14
AAA Corporate bond rate	14.17	9.03	11.38	7.86	10.30	7.33	9.58
Commercial paper rate	14.76	8.57	11.53	7.56	10.49	6.24	8.94
Mortgage rate	14.17	9.46	11.67	8.50	10.83	8.08	10.20
M2 (billions of current$)	1743.75	2487.97	2560.93	3707.39	3835.56	5530.59	5704.30
Non-borrowed reserve base	163.50	225.16	225.16	335.90	335.90	501.10	501.10
Ratio of M2 to nominal GNP	0.58	0.58	0.60	0.59	0.62	0.61	0.63
Savings rate	6.42	7.55	7.67	7.88	8.00	8.24	8.28
Gross National Product (77$)	2095.23	2396.74	2363.12	2692.08	2668.10	3003.41	2979.79
Personal Consumption	1313.09	1541.44	1533.25	1734.44	1729.63	1908.15	1906.61
Residential Structures	68.86	94.84	82.67	117.83	103.54	132.72	118.59
Non-residential structures	82.83	97.52	94.24	109.48	106.94	123.77	121.18
Producers' durable equipment	172.33	213.13	204.17	240.88	238.93	290.21	286.08
Inventory change	9.39	16.36	13.88	18.10	17.91	20.03	19.38
Exports	254.48	245.92	246.82	276.29	278.74	337.16	338.52
Imports	221.38	261.97	261.40	301.26	303.89	346.81	348.75
Other variables							
Disp. income per capita (1972$)	4537.61	5169.31	5160.82	5585.78	5591.07	5948.70	5960.38
Return to capital scaler	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Foreign demand scaler	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Trade balance (cu. $)	0.00	0.00	-86.88	0.00	-140.65	0.00	-176.00
Merchandise exports (cu. $)	218.89	266.43	261.94	303.24	382.66	620.01	615.55
Merchandise imports (cu. $)	261.71	353.31	347.43	523.90	520.92	796.01	790.63
Exchange rate scaler	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Unemployment rate	7.71	5.46	6.63	4.20	4.98	3.90	4.55
Civilian jobs (millions)	104.22	114.80	113.45	124.23	123.28	133.43	132.59
Private sector jobs	88.01	98.06	96.70	106.78	105.82	115.32	114.48
Agric,Mining,Structures	9.95	10.85	10.50	11.69	11.34	12.39	12.06
Durable goods manufacturing	12.20	13.17	12.80	13.83	13.64	14.75	14.52
Non-durable goods mfg	8.13	8.09	8.01	7.84	7.78	7.58	7.54
Transp,Communic,Utilities	5.43	5.69	5.62	5.78	5.74	5.84	5.81
Trade	22.88	26.62	26.32	29.71	29.49	32.68	32.47
Finance,Insurance,Real Estate	5.88	6.70	6.64	7.33	7.28	7.88	7.83
Medicine & Education	10.51	11.60	11.61	12.99	13.00	14.24	14.28
Domestic servants	1.88	1.80	1.80	1.77	1.77	1.74	1.74
Business,Repair,Oth services	11.16	13.55	13.42	15.86	15.80	18.24	18.23

INTEREST RATE DUMMY COMPARISONS

TABLE 5.9. SUMMARY OF RESULTS
SUMMARY OF EXPONENTIAL ANNUAL GROWTH RATES

	(BASE) 81- 85	(DUM=1) 81- 85	(BASE) 85- 90	(DUM=1) 85- 90	(BASE) 90- 95	(DUM=1) 90- 95
Gross National Product, (cu. $)	9.13	8.84	7.44	7.65	7.52	7.43
Labor compensation	9.71	9.53	7.47	7.69	7.55	7.45
Indirect business taxes	6.56	6.28	6.70	6.84	6.94	6.89
Return to capital	8.74	8.26	7.63	7.87	7.66	7.59
Net interest	6.30	6.30	6.30	6.30	6.30	6.30
Corporate profits	13.87	13.25	7.92	8.33	7.36	7.04
Proprietor income	10.51	10.19	9.54	9.60	9.23	9.28
Gross National Product Deflator	5.76	5.84	5.11	5.23	5.33	5.22
Hourly labor comp. index (manuf.)	7.24	7.47	5.61	5.73	6.01	5.87
Labor productivity (GNP/JOBS)	0.94	0.89	0.75	0.77	0.76	0.75
Financial variables						
Treasury bill rate	-14.09	-6.29	-3.47	-2.19	-3.53	-2.94
Treasury bonds , 10 year	-12.90	-6.51	-2.46	-1.66	-1.39	-1.52
AAA Corporate bond rate	-11.28	-5.49	-2.77	-1.98	-1.38	-1.47
Commercial paper rate	-13.58	-6.17	-2.50	-1.88	-3.86	-3.21
Mortgage rate	-10.10	-4.85	-2.15	-1.50	-1.01	-1.20
M2 (billions of current$)	8.89	9.61	7.98	8.08	8.00	7.94
Non-borrowed reserve base	8.00	8.00	8.00	8.00	8.00	8.00
Ratio of M2 to nominal GNP	-0.24	0.76	0.54	0.42	0.48	0.50
Savings rate	4.07	4.45	0.85	0.85	0.90	0.68
Gross National Product (77$)	3.36	3.01	2.32	2.43	2.19	2.21
Personal Consumption	4.01	3.88	2.36	2.41	1.91	1.95
Residential Structures	8.00	4.57	4.34	4.90	2.38	2.71
Non-residential structures	4.08	3.22	2.32	2.53	2.45	2.50
Producers' durable equipment	5.31	4.24	2.45	3.14	3.73	3.60
Inventory change	13.89	9.78	2.02	5.09	2.03	1.58
Exports	-0.86	-0.76	2.33	2.43	3.98	3.89
Imports	4.21	4.15	2.80	3.01	2.82	2.75
Other variables						
Disp. income per capita (1972$)	3.26	3.22	1.55	1.60	1.26	1.28
Return to capital scaler						
Foreign demand scaler						
Trade balance (cu. $)	0.00	0.00	0.00	9.63	0.00	4.48
Merchandise exports (cu. $)	4.91	4.49	7.27	7.58	9.62	9.51
Merchandise imports (cu. $)	7.50	7.08	7.88	8.10	8.37	8.34
Exchange rate scaler						
Unemployment rate	-8.63	-3.79	-5.25	-5.72	-1.47	-1.81
Civilian jobs (millions)	2.42	2.12	1.58	1.66	1.43	1.46
Private sector jobs	2.70	2.35	1.70	1.80	1.54	1.57
Agric,Mining,Structures	2.16	1.36	1.50	1.53	1.17	1.24
Durable goods manufacturing	1.91	1.20	0.99	1.27	1.28	1.26
Non-durable goods mfg	-0.12	-0.39	-0.64	-0.57	-0.66	-0.63
Transp,Communic,Utilities	1.15	0.84	0.34	0.45	0.20	0.24
Trade	3.78	3.49	2.20	2.28	1.91	1.92
Finance,Insurance,Real Estate	3.28	3.05	1.80	1.83	1.43	1.47
Medicine & Education	2.46	2.47	2.25	2.27	1.83	1.89
Domestic servants	-1.03	-1.03	-0.37	-0.37	-0.31	-0.31
Business,Repair,Oth services	4.86	4.62	3.14	3.26	2.80	2.86

INTEREST RATE DUMMY COMPARISONS

TABLE 5.11. OUTPUT BY PRODUCING SECTOR (1977$)

		(BASE) 1981	(BASE) 1985	(DUM=1) 1985	(BASE) 1990	(DUM=1) 1990	(BASE) 1995	(DUM=1) 1995
1	AGRICULTURE, FORESTRY, FISHERY	143.71	152.96	152.48	167.06	166.28	181.09	180.58
	MINING	80.86	87.60	86.16	92.26	91.24	96.54	95.75
2	IRON ORE MINING	2.46	2.75	2.63	2.85	2.78	2.89	2.83
3	NONFERROUS METALS MINING	3.11	3.72	3.60	3.87	3.80	4.34	4.28
4	COAL MINING	20.57	23.32	23.13	27.13	26.97	30.85	30.75
5	NATURAL GAS EXTRACTION	19.63	19.45	19.27	19.97	19.82	19.98	19.91
6	CRUDE PETROLEUM	28.17	30.22	29.57	29.25	28.82	28.26	27.91
7	NON-METALLIC MINING	6.92	8.14	7.96	9.19	9.04	10.22	10.06
8	CONSTRUCTION	99.90	117.10	111.26	134.19	128.06	149.30	143.34
	NON-DURABLES	671.99	757.93	750.30	839.95	834.14	926.95	921.61
9	FOOD & TOBACCO	218.11	234.68	234.39	252.26	251.60	267.81	267.49
10	TEXTILES, EXC. KNITS	34.87	42.12	41.27	47.96	47.43	53.98	53.46
11	KNITTING	9.17	10.97	10.92	12.11	12.08	13.86	13.82
12	APPAREL, HOUSEHOLD TEXTILES	41.60	50.76	50.43	58.45	58.28	65.82	65.64
13	PAPER	51.19	58.02	57.17	65.47	64.86	73.13	72.56
14	PRINTING & PUBLISHING	50.43	56.74	56.24	62.76	62.48	68.21	68.10
15	AGRICULTURAL FERTILIZERS	13.52	14.23	14.14	15.93	15.81	18.07	17.97
16	OTHER CHEMICALS	109.19	127.14	125.08	147.77	146.26	172.15	170.45
17	PETROLEUM REFINING	96.81	105.51	104.35	110.15	109.32	115.52	114.83
	18 FUEL OIL	24.33	25.58	25.38	26.77	26.61	28.63	28.50
19	RUBBER PRODUCTS	15.39	18.87	18.30	21.76	21.38	24.89	24.53
20	PLASTIC PRODUCTS	25.30	30.34	29.67	36.14	35.66	43.42	42.86
21	SHOES AND LEATHER	6.42	8.55	8.35	9.19	9.00	10.10	9.89
	DURABLES	723.11	874.84	843.77	1019.22	1003.64	1199.71	1180.56
22	LUMBER	39.84	45.39	43.20	50.90	48.78	55.41	53.31
23	FURNITURE	16.42	20.23	19.87	22.09	22.12	24.27	24.24
24	STONE, CLAY, GLASS	32.80	40.09	38.46	46.24	44.66	52.88	51.27
25	FERROUS METALS	54.06	58.94	55.77	63.34	61.69	65.74	64.48
26	COPPER	8.64	9.97	9.59	10.19	9.97	11.07	10.84
27	OTHER NONFERROUS METALS	33.10	39.77	38.33	46.92	45.71	55.52	54.60
28	METAL PRODUCTS	86.35	101.39	98.03	116.96	114.88	134.39	132.06
	NON-ELEC MACHINERY	144.57	170.85	164.57	198.23	196.45	242.46	239.30
29	ENGINES AND TURBINES	11.05	13.34	12.83	15.92	15.75	19.65	19.41
30	AGRICULTURAL MACHINERY	11.26	12.72	12.49	13.76	13.70	15.72	15.66
31	CONSTR, MINING, OILFIELD EQ	18.37	19.38	18.54	20.96	20.36	24.09	23.45
32	METALWORKING MACHINERY	15.32	17.82	16.71	18.09	17.92	19.88	19.34
33	SPECIAL INDUSTRY MACHINERY	9.12	10.18	9.87	9.75	9.71	10.22	10.12
34	MISC NON-ELECTRICAL MACH.	36.71	42.44	40.84	46.51	46.01	54.05	53.20
35	COMPUTERS	27.65	36.79	35.62	52.25	52.29	74.28	73.69
36	OTHER OFFICE EQUIPMENT	3.04	3.45	3.40	3.87	3.91	4.55	4.57
37	SERVICE INDUSTRY MACHINERY	12.06	14.74	14.29	17.13	16.79	20.03	19.66
	ELECTRICAL MACHINERY	116.63	140.27	137.83	162.56	161.52	200.15	198.03
38	COMMUNIC EQ, ELECTRONIC COMP	63.19	78.25	77.18	94.25	93.89	121.38	120.19
39	ELEC INDL APP & DISTRIB EQ	20.64	23.73	23.03	25.28	25.06	29.97	29.51
40	HOUSEHOLD APPLIANCES	10.58	11.62	11.49	12.96	12.84	14.16	14.09
41	ELEC LIGHTING & WIRING EQ	16.08	19.65	19.12	21.73	21.40	25.15	24.71
42	TV SETS, RADIOS, PHONOGRAPHS	6.14	7.03	7.02	8.33	8.34	9.50	9.52
	TRANSPORTATION EQ	144.33	191.69	182.30	235.01	231.17	277.18	272.53
43	MOTOR VEHICLES	87.33	122.53	114.22	153.32	149.55	182.43	178.27
44	AEROSPACE	38.61	45.33	45.00	52.70	52.82	59.82	59.79
45	SHIPS, BOATS	9.28	12.53	12.17	15.64	15.52	18.90	18.68
46	OTHER TRANSP. EQUIP.	9.11	11.30	10.91	13.36	13.27	16.04	15.79

INTEREST RATE DUMMY COMPARISONS

TABLE 5.11. OUTPUT BY PRODUCING SECTOR (1977$)

		(BASE) 1981	(BASE) 1985	(DUM=1) 1985	(BASE) 1990	(DUM=1) 1990	(BASE) 1995	(DUM=1) 1995
47	INSTRUMENTS	28.54	34.86	34.31	41.59	41.28	50.93	50.47
48	MISC. MANUFACTURING	17.81	21.76	21.50	25.60	25.43	29.71	29.44
	TRANSPORTATION	136.14	156.53	154.23	178.33	177.66	202.74	202.63
49	RAILROADS	22.72	25.03	24.44	27.16	26.77	29.83	29.16
50	TRUCKING, H&Y PASS TRANSIT	63.57	73.57	72.26	83.80	82.98	94.64	93.85
51	WATER TRANSPORT	15.44	16.68	16.41	19.06	18.93	22.45	22.33
52	AIR TRANSPORT	28.23	34.40	34.35	40.90	41.63	48.08	49.33
53	PIPELINE	3.58	3.95	3.91	4.22	4.18	4.52	4.49
54	TRANSPORTAION SERVICES	2.61	2.89	2.87	3.20	3.18	3.51	3.48
	UTILITIES	223.80	261.65	259.58	303.65	301.35	347.66	345.49
55	COMMUNICATIONS SERVICES	83.10	102.86	101.60	126.50	125.12	153.10	151.52
56	ELECTRIC UTILILITIES	78.35	88.65	88.27	99.08	98.68	109.01	108.87
57	GAS UTILITY	51.31	56.82	56.59	62.27	61.98	66.79	66.63
58	WATER AND SANITATION	11.04	13.32	13.12	15.79	15.57	18.76	18.48
59	WHOLESALE TRADE	187.85	220.12	216.28	252.74	250.13	289.88	286.97
60	RETAIL TRADE	193.65	231.36	229.40	262.28	260.64	290.23	288.64
61	EATING & DRINKING PLACES	89.33	107.08	106.44	122.50	122.16	137.32	137.06
62	FINANCE & INSURANCE	130.86	153.02	152.23	173.07	172.38	192.22	191.77
63	REAL ESTATE	158.83	181.86	178.09	198.75	195.16	213.32	210.02
64	OWNER-OCCUPIED HOUSING	154.89	183.06	182.17	206.77	206.24	228.08	227.95
	SERVICES	488.44	585.78	581.44	690.75	688.31	800.57	799.58
65	HOTELS, REPAIRS EXC AUTO	44.31	50.53	50.17	55.14	55.01	59.03	59.09
66	BUSINESS SERVICES	202.75	258.55	254.71	319.49	316.63	388.27	385.34
67	AUTOMOBILE REPAIRS	42.60	52.48	52.02	60.55	60.06	68.59	68.09
68	MOVIES AND AMUSEMENTS	23.87	29.62	29.88	35.55	36.42	41.14	42.70
69	MEDICINE, EDUCATION, NPO	174.92	194.60	194.66	220.01	220.19	243.53	244.36
70	FED & S&L GOVT ENTERPRISES	28.22	32.41	32.06	35.96	35.69	39.55	39.26
71	NON COMPETITIVE IMPORTS							
72	DOMESTIC SERVANTS	5.09	5.82	5.92	6.07	6.00	6.15	6.06
73	UNIMPORTANT INDUSTRY	8.50	10.07	9.87	11.49	11.37	13.07	12.95
74	SCRAP AND USED	2.65	4.26	4.16	5.59	5.55	6.82	6.79
75	REST OF THE WORLD INDUSTRY	36.07	27.57	28.36	29.03	29.20	36.09	35.85
76	GOVERNMENT INDUSTRY	213.73	219.83	219.83	228.16	228.16	236.05	236.05
77	INFORUM STAT. DISCREPANCY	16.08	18.54	18.12	20.39	20.14	23.19	22.81
78	NIPA STAT. DISCREPANCY	1.22	0.00	0.00	0.00	0.00	0.00	0.00

INTEREST RATE DUMMY COMPARISONS

TABLE 5.11. OUTPUT BY PRODUCING SECTOR (1977$)
SUMMARY OF EXPONENTIAL ANNUAL GROWTH RATES

		(BASE) 81- 85	(DUM=1) 81- 85	(BASE) 85- 90	(DUM=1) 85- 90	(BASE) 90- 95	(DUM=1) 90- 95
1	AGRICULTURE, FORESTRY, FISHERY	1.56	1.48	1.76	1.73	1.61	1.65
	MINING	2.00	1.59	1.04	1.15	0.91	0.97
2	IRON ORE MINING	2.84	1.69	0.66	1.10	0.27	0.38
3	NONFERROUS METALS MINING	4.46	3.63	0.78	1.11	2.32	2.37
4	COAL MINING	3.14	2.94	3.03	3.08	2.57	2.62
5	NATURAL GAS EXTRACTION	-0.23	-0.46	0.53	0.56	0.02	0.08
6	CRUDE PETROLEUM	1.75	1.21	-0.65	-0.51	-0.69	-0.64
7	NON-METALLIC MINING	4.08	3.50	2.43	2.54	2.11	2.16
8	CONSTRUCTION	3.97	2.69	2.73	2.81	2.13	2.25
	NON-DURABLES	3.01	2.76	2.05	2.12	1.97	1.99
9	FOOD & TOBACCO	1.83	1.80	1.45	1.42	1.20	1.22
10	TEXTILES, EXC. KNITS	4.72	4.21	2.60	2.78	2.37	2.40
11	KNITTING	4.48	4.38	1.99	2.01	2.69	2.70
12	APPAREL, HOUSEHOLD TEXTILES	4.97	4.81	2.82	2.89	2.37	2.38
13	PAPER	3.13	2.76	2.41	2.53	2.21	2.25
14	PRINTING & PUBLISHING	2.95	2.73	2.02	2.10	1.66	1.72
15	AGRICULTURAL FERTILIZERS	1.28	1.11	2.25	2.24	2.52	2.56
16	OTHER CHEMICALS	3.80	3.40	3.01	3.13	3.05	3.06
17	PETROLEUM REFINING	2.15	1.88	0.86	0.93	0.95	0.98
18	FUEL OIL	1.25	1.05	0.91	0.94	1.34	1.38
19	RUBBER PRODUCTS	5.11	4.34	2.84	3.11	2.69	2.75
20	PLASTIC PRODUCTS	4.55	3.99	3.50	3.68	3.67	3.68
21	SHOES AND LEATHER	7.18	6.59	1.44	1.49	1.90	1.89
	DURABLES	4.76	3.86	3.05	3.47	3.26	3.25
22	LUMBER	3.26	2.02	2.29	2.43	1.70	1.78
23	FURNITURE	5.23	4.77	1.74	2.14	1.88	1.83
24	STONE, CLAY, GLASS	5.02	3.98	2.85	2.99	2.69	2.76
25	FERROUS METALS	1.99	0.78	1.57	2.02	0.74	0.88
26	COPPER	3.56	2.59	0.43	0.78	1.66	1.67
27	OTHER NONFERROUS METALS	4.58	3.67	3.14	3.52	3.54	3.56
28	METAL PRODUCTS	4.01	3.17	2.86	3.17	2.78	2.79
	NON-ELEC MACHINERY	4.18	3.24	2.97	3.54	4.03	3.95
29	ENGINES AND TURBINES	4.72	3.75	3.53	4.09	4.21	4.18
30	AGRICULTURAL MACHINERY	3.04	2.59	1.58	1.86	2.66	2.67
31	CONSTR, MINING, OILFIELD EQ	1.34	0.23	1.57	1.88	2.78	2.83
32	METALWORKING MACHINERY	3.78	2.17	0.30	1.40	1.89	1.92
33	SPECIAL INDUSTRY MACHINERY	2.76	1.98	-0.86	-0.32	0.94	0.82
34	MISC NON-ELECTRICAL MACH.	3.62	2.66	1.83	2.38	3.01	2.90
35	COMPUTERS	7.14	6.33	7.01	7.68	7.04	6.92
36	OTHER OFFICE EQUIPMENT	3.15	2.81	2.33	2.81	3.24	3.11
37	SERVICE INDUSTRY MACHINERY	5.02	4.24	3.00	3.23	3.13	3.16
	ELECTRICAL MACHINERY	4.61	4.17	2.95	3.17	4.16	4.08
38	COMMUNIC EQ, ELECTRONIC COMP	5.34	5.00	3.72	3.92	5.06	4.94
39	ELEC INDL APP & DISTRIB EQ	3.48	2.73	1.27	1.69	3.40	3.27
40	HOUSEHOLD APPLIANCES	2.35	2.05	2.17	2.23	1.77	1.86
41	ELEC LIGHTING & WIRING EQ	5.00	4.32	2.02	2.26	2.92	2.88
42	TV SETS, RADIOS, PHONOGRAPHS	3.40	3.35	3.40	3.45	2.62	2.66
	TRANSPORTATION EQ	7.09	5.84	4.08	4.75	3.30	3.29
43	MOTOR VEHICLES	8.47	6.71	4.48	5.39	3.48	3.51
44	AEROSPACE	4.01	3.83	3.01	3.21	2.93	2.48
45	SHIPS, BOATS	7.49	6.77	4.43	4.86	3.79	3.71
46	OTHER TRANSP. EQUIP.	5.39	4.51	3.35	3.92	3.66	3.47

INTEREST RATE DUMMY COMPARISONS

TABLE 5.11. OUTPUT BY PRODUCING SECTOR (1977$)
SUMMARY OF EXPONENTIAL ANNUAL GROWTH RATES

		(BASE) 81- 85	(DUM=1) 81- 85	(BASE) 85- 90	(DUM=1) 85- 90	(BASE) 90- 95	(DUM=1) 90- 95
47	INSTRUMENTS	5.00	4.61	3.53	3.70	4.05	4.02
48	MISC. MANUFACTURING	5.01	4.71	3.25	3.36	2.98	2.93
	TRANSPORTATION	3.49	3.12	2.61	2.83	2.57	2.63
49	RAILROADS	2.43	1.83	1.63	1.82	1.67	1.71
50	TRUCKING, HWY PASS TRANSIT	3.65	3.20	2.60	2.77	2.43	2.46
51	WATER TRANSPORT	1.94	1.53	2.67	2.85	3.27	3.31
52	AIR TRANSPORT	4.94	4.91	3.46	3.84	3.24	3.40
53	PIPELINE	2.49	2.20	1.28	1.35	1.39	1.43
54	TRANSPORTAION SERVICES	2.54	2.32	2.00	2.06	1.89	1.81
	UTILITIES	3.91	3.71	2.98	2.98	2.71	2.73
55	COMMUNICATIONS SERVICES	5.33	5.03	4.14	4.16	3.82	3.83
56	ELECTRIC UTILILITIES	3.09	2.98	2.23	2.23	1.91	1.96
57	GAS UTILITY	2.55	2.45	1.83	1.82	1.40	1.45
58	WATER AND SANITATION	4.69	4.31	3.39	3.42	3.45	3.42
59	WHOLESALE TRADE	3.96	3.52	2.76	2.91	2.74	2.75
60	RETAIL TRADE	4.45	4.24	2.51	2.55	2.03	2.04
61	EATING & DRINKING PLACES	4.53	4.38	2.69	2.76	2.28	2.30
62	FINANCE & INSURANCE	3.91	3.78	2.46	2.49	2.10	2.13
63	REAL ESTATE	3.38	2.86	1.78	1.83	1.41	1.47
64	OWNER-OCCUPIED HOUSING	4.18	4.06	2.44	2.48	1.96	2.00
	SERVICES	4.54	4.36	3.30	3.37	2.95	3.00
65	HOTELS, REPAIRS EXC AUTO	3.29	3.10	1.74	1.84	1.36	1.43
66	BUSINESS SERVICES	6.08	5.70	4.23	4.35	3.90	3.93
67	AUTOMOBILE REPAIRS	5.21	5.00	2.86	2.87	2.49	2.51
68	MOVIES AND AMUSEMENTS	5.40	5.62	3.65	3.96	2.92	3.18
69	MEDICINE, EDUCATION, NPO	2.67	2.67	2.45	2.47	2.03	2.08
70	FED & S&L GOVT ENTERPRISES	3.46	3.19	2.08	2.15	1.91	1.91
71	NON COMPETITIVE IMPORTS						
72	DOMESTIC SERVANTS	3.35	2.05	0.85	1.67	0.28	0.21
73	UNIMPORTANT INDUSTRY	4.22	3.72	2.65	2.83	2.58	2.60
74	SCRAP AND USED	11.82	11.25	5.45	5.75	3.98	4.05
75	REST OF THE WORLD INDUSTRY	-6.72	-6.01	1.03	0.58	4.35	4.10
76	GOVERNMENT INDUSTRY	0.70	0.70	0.74	0.74	0.68	0.68
77	INFORUM STAT. DISCREPANCY	3.56	2.99	1.90	2.12	2.58	2.48
78	NIPA STAT. DISCREPANCY						

Chapter 6 Comparison with Other Models

The purpose of this chapter is to compare the results of simulations done with the model developed in the earlier chapters to similar simulations done with three other long-term forecasting models. The three other models are strictly macroeconomic models and do not provide industry detail.

Three Long Term Models of Money Growth

On September 1, 1982 the Subcommittee on Monetary and Fiscal Policy of the Joint Economic Committee of the Congress of the United States (JEC) issued a study entitled "Three Large Scale Model Simulations of Four Money Growth Scenarios". The purpose of the study is to shed light on the behavior of macroeconomic variables over the 1982 to 1991 period under differing rates of growth of the money supply. The three models used in the simulation study were the quarterly Chase Econometrics model, the annual Data Resources Incorporated (DRI) model, and the Wharton annual model. The four simulations had radically different monetary aggregate growth rates. These are:

1) M1 growth falls to zero percent in one year (1981-1982) which is the maintained rate through 1991.
2) M1 growth declines gradually to zero percent over the period 1982-1986 and remains at 0 from 1987 to 1991.
3) M1 growth is constant at three percent over the 1982 to 1991 period.
4) M1 growth moves up to ten percent from 1982 to 1986 and remains at ten percent through 1991.

Each model was simulated twice for each alternative. In one simulation, no judgmental fixes were applied to the forecast. For this kind of simulation, a base scenario was run, presumably with several judgmental fixes to help the model look reasonable. From this base, only the growth rate in M1 was changed and the model re-run. Any change in the forecast path from the base represents the effect of changing M1 growth in the model. This kind of simulation is labelled "pure" because no extra judgment was allowed to change the forecast from the results of the base. There are twelve pure simulations in the JEC study, one for each M1 growth scenario (4) and for each modeller (3).

In contrast to the pure simulations, modellers were asked to present "managed" simulations for the M1 scenarios. In these simulations, model output from the pure simulation which ran counter to economic reasonableness or in some way offended the sensibilities of the managers was allowed to be changed via judgmental fixes. It should be stressed that these fixes are in addition to those applied to arrive at a base. Again there are twelve managed simulations, each with a pure simulation counterpart.

For the purpose of this study, the pure simulations are of more interest than the managed simulations. Comparing the pure simulation results of the model developed in this thesis to other models designed for similar purposes should enable one to draw conclusions about whether the model described in this thesis represents an improvement over the other models, or is a mere restatement of the other models. Ideally, all of the judgment of the forecasts necessary to perform reasonable simulation exercises should be represented in the equations and structure of the model. Thus, a model requiring less fixes should

generally be preferred to a model requiring more fixes. The robustness of the model to simulation exercises can be defined as the ability of the model to respond sensibly to the simulation scenarios without additional judgmental fixes. One way to judge the robustness of the model is to run the models without judgmental fixes and observe which model makes the most economic sense. That comparison is the subject of the remainder of this chapter.

Implementing the Scenarios

For two of the models, the Chase model and the DRI model, M1 targets are attained through manipulation of the level of non-borrowed reserves. For the Wharton model, only M2 is available as a monetary aggregate to be controlled. Thus, Wharton translated the M1 simulation targets into M2 simulation targets. In the model developed for this thesis, either approach could have been used. Since, however, the ultimate result of manipulating non-borrowed reserves would have been Wharton type growth rates for M2, these Wharton type growth rates were applied to M2 directly. This makes M2 exogenous and turns off the money multiplier equation developed in Chapter 2. This is no great loss, however, because the thrust of the exercise is how the monetary sector affects the other sectors in the model. The M2 paths used for the four simulations are:

1) M2 at 8.8% 1981-82 4.0% annually 1983-91

2) M2 at 8.8% 1981-82 linear decline to 4.0% by 1987
4% annually thereafter

3) M2 at 8.8% 1981-82 7.0% annually 1983-91

4) M2 at 8.8% 1981-82 linear increase to 14.0% by 1987
14.0% annually thereafter.

Five tables show the macroeconomic results of the three models used in the Joint Economic Committee study and the LIFT model under the various monetary aggregate growth rates.

Base Scenarios

The Chase, DRI and Wharton models have as base scenarios forecasts presented to subscribers or forecasts "fixed" to give a reasonable looking forecast. No information is available on the number or strength of the fixes applied to achieve these results, however, it is extremely unlikely that no fixes were applied to models to derive the base runs. It must be emphasized that no attempt was made to make the LIFT forecast for 1982 appear more like the actual 1982 figures. Thus, while the other three models forecast declines in real growth for 1982, LIFT forecasts about 1.5% real growth for 1982. Further, relative to the paths of unemployment rate for the other three models, the LIFT model unemployment rate path appears low for the 1983-87 period. Since the point of this exercise is to compare how the models react to similar monetary policy scenarios, it seem unnecessary to try and duplicate any of the more commercial models' output. Instead, we will find it instructive to compare the results of each scenario for each model with

the base forecast for that model. Table 6.1 provides a comparison of results for selected macroeconomic variables for the base scenarios.

Scenario 1

In this scenario the effect of a sudden deceleration of M1 or M2 growth to 0 or 4% per year is investigated. No gradual decline to the slower growth path is allowed, so that the 1982-83 growth rate is 0 for M1 and 4% for M2, which are the rates maintained through 1991. In this scenario, only one model, LIFT, completed the forecast through 1991. The three other models stopped running before 1991, indicating some very nonsensical result was obtained which did not allow the model to continue. It must be made clear that the results are not reported because no results are available for those years, not because they are nonsensical. The Chase model must be considered to have broken before the end of the forecast period because the requirements of the simulation were violated by the model operators. Chase refused to let the level of non-borrowed reserves become negative and so was forced to let M1 grow faster than 0% after 1987. While it is unclear whether the model itself would have continued beyond this point, the violation of simulation requirements must count as a breakdown. The model that broke down first was the Wharton model, which stopped after 1986. The Chase and DRI models lasted only one more year. Table 6.2 shows some macroeconomic results for each model using this scenario.

Of the models that broke down, the Chase model appears to have the most reasonable results. Slower money growth reduces the rate of inflation slightly, from 7.29% for 1981-82 to 5.5% from 1986-87. This reduction is associated with slightly lower interest rates, which

Table 6.1

Base scenarios for four models

Year	82	83	84	85	86	87	88	89	90	91
M2										
Chase	9.98	10.37	10.08	9.21	9.27	9.48	9.56	9.42	9.22	9.11
DRI	8.30	8.90	9.20	10.80	9.50	9.80	9.10	8.20	8.00	7.70
Wharton	8.82	8.56	9.23	10.91	10.80	10.49	9.22	10.02	9.42	10.01
LIFT	12.33	13.72	3.23	6.26	7.52	8.12	6.99	9.26	8.00	7.37
Nominal GNP										
Chase	6.57	11.43	10.94	10.61	10.42	10.02	9.65	9.45	9.16	8.84
DRI	6.00	11.20	11.40	11.60	11.00	10.10	10.30	9.70	9.10	9.00
Wharton	6.81	11.42	10.83	11.20	9.44	10.86	9.64	9.80	9.41	9.27
LIFT	7.87	12.25	8.59	7.79	7.33	7.51	6.74	7.68	7.91	7.41
Real GNP										
Chase	-0.73	3.99	3.90	3.33	3.41	3.22	3.05	3.01	2.85	2.75
DRI	-1.40	3.60	4.00	4.00	3.50	3.00	3.40	3.10	2.50	2.70
Wharton	-1.40	3.85	3.89	3.75	1.97	3.40	2.76	3.10	2.82	2.91
LIFT	1.46	6.63	2.99	2.36	2.15	2.43	1.64	3.05	2.35	1.79
GNP Deflator										
Chase	7.33	7.15	6.78	7.05	6.77	6.58	6.41	6.24	6.14	5.93
DRI	7.40	7.40	7.10	7.30	7.30	6.90	6.60	6.40	6.50	6.20
Wharton	8.32	7.28	6.68	7.18	7.32	7.21	6.69	6.50	6.41	6.18
LIFT	6.41	5.61	5.60	5.44	5.19	5.08	5.10	4.63	5.57	5.62
Wage rate										
Chase	7.02	7.30	6.87	7.67	7.62	7.78	7.90	7.87	7.56	7.35
DRI	7.40	7.20	7.70	7.80	7.90	8.00	8.00	7.90	7.80	7.80
Wharton	9.52	7.39	6.95	9.46	9.32	8.64	8.34	8.48	8.16	7.52
LIFT	10.78	7.11	5.81	5.27	5.62	5.81	5.21	5.30	6.10	6.43
Unemployment rate										
Chase	8.94	8.05	7.33	6.62	6.26	5.62	5.49	5.31	5.15	4.98
DRI	9.20	8.80	8.00	7.50	7.10	6.90	6.70	6.50	6.50	6.50
Wharton	9.21	8.60	7.74	7.11	7.10	6.53	6.54	6.35	6.32	6.09
LIFT	8.59	5.55	5.23	5.46	5.33	5.01	5.31	4.50	4.20	4.52
3 month Treas. rate										
Chase	12.68	12.22	10.99	9.77	8.90	8.09	7.82	7.60	7.48	7.25
DRI	11.94	12.35	11.23	10.27	11.27	10.73	9.71	9.31	8.77	8.63
Wharton	12.67	14.00	12.04	10.79	9.59	9.44	9.21	8.80	8.58	8.23
LIFT	10.97	9.44	9.50	8.40	7.97	7.60	7.38	6.67	7.06	6.88
Corporate bond rate										
Chase	15.98	14.45	12.98	12.29	11.35	10.47	10.19	9.97	9.87	9.64
DRI	14.27	13.38	12.16	11.66	11.81	11.78	11.62	11.43	11.13	10.88
Wharton	16.02	15.86	14.51	14.23	13.59	13.08	12.65	12.12	11.91	11.67
LIFT	13.07	11.34	9.80	9.03	8.71	8.45	8.22	7.85	7.86	7.85
Mortgage rate										
Chase	15.62	14.72	13.72	12.58	11.63	10.74	10.44	10.21	10.11	9.88
DRI	16.51	15.75	15.01	14.67	14.73	14.34	14.04	13.77	13.42	13.07
Wharton	15.75	14.88	12.60	12.29	11.62	11.06	10.60	10.04	9.82	9.56
LIFT	12.82	11.45	10.04	9.46	9.20	8.98	8.77	8.46	8.50	8.50

Table 6.2

First scenario: Rapid deceleration of money growth to low rates
4% for M2 and 0% for M1

Year	82	83	84	85	86	87	88	89	90	91
M2										
Chase	7.22	7.71	7.62	6.82	6.90	7.08	-	-	-	-
DRI	6.70	4.30	1.80	3.90	8.20	12.30	-	-	-	-
Wharton	8.82	4.00	4.00	4.00	4.00	-	-	-	-	-
LIFT	8.80	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00
Nominal GNP										
Chase	6.35	10.64	10.03	9.72	9.49	8.91	-	-	-	-
DRI	5.10	9.30	9.40	12.70	15.80	16.00	-	-	-	-
Wharton	6.81	11.42	9.36	7.74	9.81	-	-	-	-	-
LIFT	7.82	10.31	7.41	7.20	6.09	6.30	5.51	6.17	6.17	6.09
Real GNP										
Chase	-0.90	3.67	3.59	3.37	3.36	3.15	-	-	-	-
DRI	-2.10	2.00	2.50	5.10	7.00	5.90	-	-	-	-
Wharton	-1.40	3.85	2.48	0.41	2.07	-	-	-	-	-
LIFT	1.83	6.01	3.76	2.84	1.81	2.75	2.18	2.53	2.32	2.29
GNP Deflator										
Chase	7.29	6.73	6.22	6.15	5.93	5.58	-	-	-	-
DRI	7.30	7.20	6.80	7.20	8.30	9.50	-	-	-	-
Wharton	8.32	7.28	6.71	7.30	7.58	-	-	-	-	-
LIFT	5.99	4.30	3.65	4.36	4.28	3.55	3.33	3.64	3.85	3.81
Wage rate										
Chase	6.20	5.56	5.00	5.73	5.51	5.37	-	-	-	-
DRI	7.40	7.10	7.60	7.80	8.70	10.00	-	-	-	-
Wharton	9.52	7.39	7.02	9.61	9.29	-	-	-	-	-
LIFT	10.09	4.45	3.59	3.97	4.25	3.52	3.07	3.68	3.87	3.96
Unemployment rate										
Chase	9.39	8.82	8.47	8.07	8.17	8.18	-	-	-	-
DRI	9.40	9.70	9.50	8.70	6.90	5.20	-	-	-	-
Wharton	9.21	8.60	8.44	9.78	10.53	-	-	-	-	-
LIFT	8.28	5.70	4.79	4.61	4.78	4.25	4.11	3.71	3.47	3.39
3 month Treas. rate										
Chase	14.18	13.41	12.27	11.34	11.06	10.33	-	-	-	-
DRI	14.87	23.16	37.09	52.09	56.89	75.82	-	-	-	-
Wharton	12.67	17.22	18.15	19.64	24.11	-	-	-	-	-
LIFT	11.97	12.42	11.11	10.63	10.72	11.05	11.39	11.58	12.23	12.73
Corporate bond rate										
Chase	16.56	14.79	13.07	12.18	11.14	9.87	-	-	-	-
DRI	15.17	17.40	22.38	31.85	40.74	50.86	-	-	-	-
Wharton	16.02	15.86	17.45	19.96	23.32	-	-	-	-	-
LIFT	13.36	12.24	10.32	9.44	9.38	9.50	9.57	9.58	9.82	10.10
Mortgage rate										
Chase	16.21	15.40	14.44	13.33	12.61	12.05	-	-	-	-
DRI	17.31	19.32	24.11	32.64	40.49	49.14	-	-	-	-
Wharton	15.75	15.87	15.73	18.42	22.00	-	-	-	-	-
LIFT	13.19	12.49	10.52	9.91	9.90	10.10	10.10	10.13	10.38	10.66

Real GNP growth from 1983 to 1987 averages a healthy 3.43% a year, while the growth in the wage rate remains nearly constant and the unemployment rate shows a very small decline (8.82% to 8.18% 1983-1987).

The Wharton and DRI models produce results which are unbelievable. The DRI model translates 0% a year M1 growth into over 12% M2 growth by 1987. To the model's credit, these high rates of M2 growth are associated with higher inflation rates and rates of nominal wage growth. The rate of real GNP growth is quite large, however, averaging 4.5% per year for the period 1983-87. The unemployment rate declines in the face of this real growth, but the strength of real growth appears absurd when coupled with the extremely high levels of interest rates produced by the model.

The Wharton model links 4% M2 growth with an average rate of inflation of 7.22% and wage growth that averages nearly one percentage point higher than the inflation rate. The growth in real unemployment rate reflects the slow growth. In contrast to the DRI model, Wharton links low growth and high interest rates.

LIFT links the 4% annual average M2 growth rate with an average rate of inflation of 3.64% from 1987 to 1991. Nominal wage growth is nearly identical to the average inflation rate at 3.62%. Real growth averages 2.41% a year from 1987-91, and the average unemployment rate for the period is 3.79%. M2 velocity is increasing, which accounts for the relative high interest rates in the LIFT forecast. Relative to the base run, real GNP growth is higher with lower M2 growth, while the inflation rate tends to be lower. The unemployment rate is lower with lower M2 growth, which is in line with the higher real growth. Interest rates are higher in the low M2 growth than in the base run, which

reduces interest sensitive components of final demand. The lower inflation rate increases real disposable income, which increases consumption expenditures, causing the faster real growth.

Scenario 2

This scenario is a companion scenario to the sudden deceleration of M1 to 0% or M2 to 4% per year by allowing M1 or M2 to decelerate to 0% slowly. The targets are reached in 1987, so that the 1987-91 periods represent 0 M1 growth or 4% M2 growth. The results are presented in Table 6.3. In this scenario, only one model, the Wharton model, broke down before 1991. The other two models performed more reasonably with a slowly declining money growth rate than with a quick deceleration of money growth. The DRI model shows extremely high interest rates, in a pattern much like the pattern it displayed prior to breaking down in the first money growth scenario. These high rates apparently do not reduce real growth very much, since real growth averages over 3.25% per year over the 1987-91 period. From 1987 to 1991, the unemployment rate declines approximately three percentage points. The inflation rates remain in the 7% range, while 0 M1 growth leads to increasing M2 growth over the 1987-91 period. M2 velocity grows substantially in the 1987 to 1991 period.

The Chase model again behaves the most reasonably of the three models examined in the Joint Economic Committee study. An M1 growth rate of 0% leads to over 7% M2 growth for the 1987-91 period. Inflation averages about 5.5% over the 1987-91 period. The short term interest rate rises considerably faster than long term rates, which remain in the 9.5% range for 1987-91. In constrast to the DRI model, in which high

Table 6.3

Second scenario: Slow deceleration of money growth to low rates
4% for M2 and 0% for M1

Year	82	83	84	85	86	87	88	89	90	91
M2										
Chase	9.31	9.23	8.60	7.29	6.86	7.01	7.18	7.01	6.95	7.97
DRI	8.30	7.70	6.90	5.70	5.20	6.70	4.50	6.40	8.80	9.80
Wharton	8.82	7.80	6.80	5.80	4.80	4.00	4.00	-	-	-
LIFT	8.80	7.80	6.80	5.80	4.80	4.00	4.00	4.00	4.00	4.00
Nominal GNP										
Chase	6.52	11.20	10.54	10.07	9.68	8.98	8.40	8.01	7.62	7.33
DRI	6.00	10.60	10.60	9.30	10.60	9.30	11.30	11.60	11.10	11.00
Wharton	6.80	11.42	10.42	9.06	8.32	11.18	8.66	-	-	-
LIFT	7.82	10.78	8.18	7.94	6.60	6.62	5.84	6.44	5.86	6.45
Real GNP										
Chase	-0.77	3.89	3.74	3.26	3.28	3.02	2.80	2.72	2.52	2.80
DRI	-1.40	3.00	3.40	2.30	3.50	2.60	4.40	4.40	3.40	3.10
Wharton	-1.40	3.85	3.49	1.72	0.74	3.61	1.98	-	-	-
LIFT	1.83	6.20	3.61	2.63	1.53	2.67	2.13	2.77	2.15	2.50
GNP Deflator										
Chase	7.32	7.04	6.56	6.60	6.20	5.78	5.44	5.14	4.98	4.42
DRI	7.40	7.30	7.00	6.90	7.00	6.60	6.60	6.90	7.50	7.70
Wharton	8.32	7.28	6.69	7.21	7.53	7.31	6.55	-	-	-
LIFT	5.99	4.58	4.56	5.31	5.07	3.95	3.70	3.69	3.71	3.95
Wage rate										
Chase	6.82	6.74	5.97	6.38	5.82	5.53	5.40	5.20	4.92	5.00
DRI	7.40	7.20	7.60	7.50	7.60	7.70	8.00	8.30	8.70	8.90
Wharton	9.52	7.39	6.97	9.54	9.40	8.54	8.33	-	-	-
LIFT	10.09	5.15	4.94	5.37	5.15	4.06	3.32	3.71	3.80	3.75
Unemployment rate										
Chase	9.04	8.29	7.78	7.30	7.31	7.13	7.59	8.18	9.54	10.45
DRI	9.20	9.00	8.50	8.50	8.30	8.10	7.40	6.40	5.70	5.30
Wharton	9.21	8.60	7.94	8.41	9.47	9.23	9.69	-	-	-
LIFT	8.28	5.56	4.76	4.73	5.12	4.66	4.58	3.95	3.81	3.58
3 month Treas. rate										
Chase	13.04	12.76	11.72	10.84	10.56	10.22	10.44	9.97	15.60	15.44
DRI	11.94	14.64	15.00	22.32	23.20	30.31	36.37	36.41	35.71	34.32
Wharton	12.67	14.52	13.99	14.96	17.35	22.60	25.90	-	-	-
LIFT	11.97	11.55	9.93	9.35	9.51	9.86	10.17	10.36	10.86	11.27
Corporate bond rate										
Chase	16.12	14.63	13.13	12.41	11.45	10.39	9.81	8.86	10.38	9.42
DRI	14.27	14.08	13.22	15.21	17.33	21.81	26.95	29.90	28.70	24.66
Wharton	16.02	15.86	15.26	16.28	17.99	21.23	25.20	-	-	-
LIFT	13.36	11.98	9.93	9.10	9.15	9.26	9.17	9.11	9.18	9.32
Mortgage rate										
Chase	15.76	14.96	14.06	13.04	12.30	11.57	11.45	11.41	12.67	12.95
DRI	16.51	16.37	15.95	17.83	19.65	23.27	27.69	30.22	29.07	25.35
Wharton	15.75	15.04	13.40	14.48	16.32	19.77	24.02	-	-	-
LIFT	13.17	12.17	10.10	9.56	9.66	9.85	9.73	9.68	9.78	9.98

interest rates are associated with a declining unemployment rate, the Chase model forecasts the unemployment rate to increase by three percentage points from 1987 to 1991. M2 velocity increases, but not as quickly as in the DRI model.

The LIFT model displays results that are very similar to the results of the first scenario. The inflation rate averages just under 4.0% per year after 1987, very close to the rate of M2 growth. Nominal GNP grows at about 6.0% per year after 1987, which means that velocity is increasing, at approximately 2.0% per year. This tends to increase interest rates, from 1987 to 1991 the 90-day bill rate rises by about two percentage points. Longer term rates remain relatively constant. While the Chase model shows a slowly rising unemployment rate, the LIFT model shows a declining unemployment rate. This effect is observed even when the path of the unemployment rates are compared with the path of the unemployment rates from the base run. With respect to the base run, the Chase model produces an average unemployment rate 3.3 percentage points higher with slow money growth, while the LIFT model averages a .6 percentage point lower with low money growth.

An interesting question is how the difference between a slow decline in money growth affects the 1987-91 path. Since only LIFT completed the forecast in both instances, the comparison can only be done with LIFT. For each scenario, the growth of M2 is the same for the 1987-91 period. Nominal GNP in the sudden deceleration run averages 6.05% growth, while in the gradual deceleration run nominal GNP averages 6.25%. Virtually no difference can be found in real growth (2.41% with quick, first deceleration and 2.44% with gradual deceleration), so the remaining .2 percentage point difference comes only in inflation. The

average unemployment rate is .25 percentage points lower with quick deceleration than with gradual deceleration. Interest rates are lower by about one percentage point, with a gradual deceleration of money growth than with fast deceleration.

Scenario 3

In the third scenario, the money supply (M1 or M2) is fixed to grow at some moderate rate. M1 is set to grow at 3% from 1981 to 1991, while M2 growth is 7% for the same period. The results are shown in Table 6.4. As in the second scenario, only one model, the Wharton model, failed to complete the forecast. The model stopped after 1988. Only the interest rates seem somewhat unreasonable in the Wharton model, so the reasons for the breakdown are somewhat mysterious.

The DRI model produces some very curious results for interest rates. From 1990 to 1991, interest rates fall precipitously from 13.4 to 2.5 for Treasury bills, although real growth, inflation on the unemployment rate seem virtually unaffected by whatever caused the decline in interest rates. M1 growth of 3% leads to an average M2 growth of 9.2% and an average inflation rate of 6.9% over the 1987-91 period. Real growth averages 3% from 1987 to 1991, while the average unemployment rate is 6.5%. Relative to the base DRI scenario averages over the 1987-91 period, M2 grows an average of .64 percentage points faster while the average inflation rate is .32 percentage points faster. Real growth is only very slightly faster for this period, at .06 percentage points.

As with the first two scenarios, the Chase model displays the most reasonable results of the three models used in the Joint Economic

Table 6.4

Third scenario: Moderate money growth maintained through forecast
7% for M2 and 3% for M1

Year	82	83	84	85	86	87	88	89	90	91
M2										
Chase	8.53	8.97	8.83	7.96	7.96	8.09	8.36	8.22	8.16	7.99
DRI	5.60	5.10	7.80	8.80	9.50	11.90	8.30	7.60	9.00	9.20
Wharton	8.82	7.00	7.00	7.00	7.00	7.00	7.00	-	-	-
LIFT	8.80	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00
Nominal GNP										
Chase	6.46	11.02	10.47	10.15	9.89	9.34	8.87	8.60	8.24	7.89
DRI	4.40	10.40	11.40	11.00	11.80	10.40	10.50	10.20	9.50	9.80
Wharton	6.80	11.42	10.26	9.01	8.90	11.64	8.61	-	-	-
LIFT	7.82	10.68	8.10	8.10	7.03	7.32	6.72	7.34	6.91	7.49
Real GNP										
Chase	-0.82	3.83	3.75	3.34	3.34	3.10	2.91	2.86	2.70	2.63
DRI	-2.70	2.90	4.00	3.50	4.20	3.10	3.50	3.20	2.40	2.80
Wharton	-1.40	3.85	3.34	1.66	1.28	4.12	1.98	-	-	-
LIFT	1.83	6.17	3.65	2.72	1.53	2.57	1.99	2.60	2.02	2.26
GNP Deflator										
Chase	7.31	7.93	6.48	6.60	6.34	6.05	5.79	5.58	5.40	5.14
DRI	7.30	7.30	7.10	7.20	7.30	7.00	6.80	6.70	6.90	6.80
Wharton	8.32	7.28	6.69	7.23	7.53	7.22	6.50	-	-	-
LIFT	5.99	4.51	4.45	5.38	5.50	4.74	4.73	4.75	4.89	5.23
Wage rate										
Chase	6.59	6.40	5.91	6.69	6.49	6.44	6.45	6.36	5.97	5.65
DRI	7.40	7.20	7.70	7.70	7.80	8.00	8.00	8.10	8.10	8.10
Wharton	9.52	7.39	6.97	9.54	9.36	8.48	8.34	-	-	-
LIFT	10.09	5.00	4.80	5.57	5.87	5.28	4.84	5.40	5.43	5.44
Unemployment rate										
Chase	9.17	8.43	7.86	7.26	7.09	6.70	6.81	6.94	7.08	7.29
DRI	9.60	9.60	8.90	8.30	7.60	7.10	6.70	6.40	6.20	6.10
Wharton	9.21	8.60	8.01	8.55	9.36	8.77	9.09	-	-	-
LIFT	8.28	5.58	4.76	4.65	5.03	4.65	4.68	4.18	4.15	4.09
3 month Treas. rate										
Chase	13.47	12.80	11.53	10.44	9.81	9.30	9.15	9.27	9.42	10.26
DRI	17.47	20.42	17.99	20.71	16.96	15.68	16.72	15.39	13.42	2.49
Wharton	12.67	15.07	14.31	14.32	15.50	18.53	19.19	-	-	-
LIFT	11.97	11.73	10.00	9.16	8.96	8.88	8.83	8.64	8.73	8.73
Corporate bond rate										
Chase	16.28	14.61	12.97	12.17	11.15	10.16	9.61	9.16	8.69	8.36
DRI	15.96	17.33	15.87	15.48	15.16	14.19	15.21	14.94	13.94	3.36
Wharton	16.02	15.86	15.55	16.39	17.42	19.25	21.23	-	-	-
LIFT	13.36	12.03	9.95	9.03	8.97	9.00	8.87	8.73	8.68	8.64
Mortgage rate										
Chase	15.93	15.05	14.01	12.84	11.93	11.09	10.76	10.52	10.35	10.16
DRI	18.02	19.27	18.31	18.07	17.71	16.48	17.25	16.90	15.93	5.29
Wharton	15.75	15.21	13.71	14.60	15.70	17.66	19.67	-	-	-
LIFT	13.17	12.24	10.12	9.47	9.45	9.55	9.39	9.25	9.23	9.26

Committee study. Focussing on the average 1987-91 growth rates and levels, real growth is 2.84% while the unemployment rate is 6.96%. Average M2 growth is 8.16% and the rate of growth of the GNP deflator is 5.6%. Relative to the Chase base scenario, M2 growth is lower, as is inflation. Real growth is also slightly lower.

One somewhat unreasonable result of the Chase model is that the Treasury bill rate for the last three years of the scenario is higher than both the corporate bond rate. This suggests that some liquidity variable in the determination of the bill rate operates in a fashion similar to the one described above for the LIFT model.

The results of the third scenario for the LIFT model are very similar to the base LIFT forecast. Average M2 growth over the 1987-91 period for this scenario is .95 percentage points lower than the base. Average real GNP growth is nearly identical between the base and this scenario. All of the difference in M2 growth rates between this scenario and the base end up in the average rate of inflation, which differs by .75 percentage points. For 1990 and 1991, LIFT also displays the phenomenon that the short term interest rate is higher than the long term rate, although the difference is not as large as in the Chase model.

Scenario 4

This scenario investigates the effect of very rapid money growth on the model results. M1 growth is allowed to accelerate to 10% by 1987 and remain at that rate from 1987 to 1991. M2 growth is allowed to accelerate to 14% by 1987 and remain at that rate through 1991. Results for this scenario are shown in Table 6.5. The Wharton model failed to

Table 6.5

Fourth scenario: Increasing money growth to a high rate
14% for M2 and 10% for M1

Year	82	83	84	85	86	87	88	89	90	91
M2										
Chase	10.19	10.91	11.06	10.46	10.73	10.88	11.08	10.86	10.86	10.59
DRI	8.30	11.10	14.40	15.20	16.50	19.00	14.70	13.60	14.20	13.20
Wharton	8.82	9.90	11.00	12.00	13.00	14.00	-	-	-	-
LIFT	8.80	9.90	11.00	12.00	13.00	14.00	14.00	14.00	14.00	14.00
Nominal GNP										
Chase	6.58	11.51	11.13	10.93	10.87	10.60	10.32	10.21	10.01	9.77
DRI	6.00	12.50	13.80	14.50	16.40	15.40	15.90	14.70	12.80	12.20
Wharton	6.80	11.42	11.81	11.94	10.61	12.40	-	-	-	-
LIFT	7.82	11.05	9.00	9.42	8.82	9.74	9.04	10.42	9.42	10.70
Real GNP										
Chase	-0.72	4.03	3.97	3.40	3.54	3.41	3.27	3.26	3.12	3.02
DRI	-1.40	4.60	5.70	5.60	6.00	4.30	4.10	3.30	2.20	2.50
Wharton	-1.40	3.85	4.81	4.54	3.00	4.92	-	-	-	-
LIFT	1.83	6.31	3.65	2.49	1.34	2.28	1.36	2.30	1.74	2.04
GNP Deflator										
Chase	7.33	7.19	6.89	7.29	7.08	6.96	6.83	6.73	6.69	6.57
DRI	7.40	7.50	7.60	8.40	9.90	10.60	11.30	11.10	10.30	9.40
Wharton	8.32	7.28	6.68	7.08	7.24	7.13	-	-	-	-
LIFT	5.99	4.73	5.35	6.93	7.48	7.46	7.68	8.12	8.20	8.65
Wage rate										
Chase	7.08	7.54	7.38	8.45	8.60	8.87	9.06	9.12	8.96	8.89
DRI	7.40	7.30	8.00	8.50	9.70	10.80	11.60	11.70	11.00	10.30
Wharton	9.52	7.39	6.91	9.43	9.31	8.66	-	-	-	-
LIFT	10.09	5.55	6.23	7.83	8.77	8.85	9.16	9.60	9.81	9.92
Unemployment rate										
Chase	8.90	7.98	7.20	6.43	6.00	5.27	5.00	4.67	4.31	3.91
DRI	9.20	8.50	7.10	6.00	4.80	4.20	3.90	3.90	4.30	4.80
Wharton	9.21	8.60	7.28	6.06	5.19	3.05	-	-	-	-
LIFT	8.28	5.46	4.60	4.68	5.21	5.04	5.55	5.30	5.47	4.94
3 month Treas. rate										
Chase	12.51	11.96	10.52	9.16	8.17	7.31	6.86	6.51	6.02	5.48
DRI	11.94	9.13	6.08	5.95	4.23	3.90	4.94	4.99	5.10	5.27
Wharton	12.67	13.10	10.59	9.07	7.24	5.83	-	-	-	-
LIFT	11.97	11.05	8.65	7.03	5.90	4.78	3.42	2.09	0.98	-0.28
Corporate bond rate										
Chase	15.93	14.36	12.86	12.20	11.58	10.69	10.59	10.65	10.81	11.01
DRI	14.27	12.41	10.85	10.62	9.62	10.05	11.03	11.91	12.21	11.66
Wharton	16.02	15.86	13.77	12.94	11.72	10.45	-	-	-	-
LIFT	13.36	11.82	9.52	8.45	8.22	8.01	7.50	6.93	6.40	5.87
Mortgage rate										
Chase	13.64	12.77	11.11	9.72	8.75	8.07	7.85	7.85	7.79	7.80
DRI	16.51	14.88	13.84	13.74	12.79	12.80	13.52	14.20	14.38	13.77
Wharton	15.75	14.60	11.80	10.91	9.62	8.25	-	-	-	-
LIFT	13.17	11.99	9.63	8.81	8.61	8.44	7.89	7.39	6.90	6.43

complete the forecast, breaking down after 1987. The only result that may lend some insight into the reason for the breakdown is the unemployment rate of just over 3% in 1987. It appears likely that the Wharton model forecast this variable to fall even further in 1988, judging from the pattern of real growth in 1982-1987.

The DRI model associates 10% M1 growth with an average M2 growth from 1987-91 of nearly 15%. Most of this money growth shows up in inflation, with an average rate over 1987-91 of 10.5%. Real growth accelerates with the M2 acceleration, but averages 3.28% over the 1987-91 period. The interest rate forecast is especially interesting. The 90-day Treasury rate declines precipitously as M2 accelerates, then rises as the growth stabilizes. Long term rates appear to be affected only by the inflation rate, which is fairly high throughout the forecast. Thus, there is a widening difference between the long and short term rates until M2 stabilizes and a slight reduction in that difference after 1987. Relative to the DRI base, M2 growth is approximately 6 percentage points higher in this scenario over the 1987-91 period, while inflation is four percentage points higher. Real growth averages .32 percentage points higher with the faster money growth, while the average unemployment rate from 1987 is 2.4 percentage points lower with faster money growth.

The Chase model links 10% M1 growth to an average M2 growth of 10.85% over the 1987-91 period, which is associated with an average inflation rate of 6.76% over the same period. Real growth remains above 3.0% through the entire forecast and averages 3.22% over the 1987-1991 period. The Chase model displays the same pattern as the DRI model, with the short term rate falling continuously, while the corporate bond

rate remains high. One twist to the pattern is that the mortgage rate has declined to a level substantially below the corporate bond rate. Relative to the base Chase scenario, M2 averages 1.5 percentage points faster growth with 10% M1 growth, while inflation is .5 percentage points higher. The average unemployment rate for the 1987-91 period is .68 percentage points lower with faster M1 growth.

The LIFT model, which is using M2 as the exogenous monetary policy variable, translates the 14% average growth in M2 over the 1987-91 period into an average inflation rate of 8.02%. Real growth for the same period averages 1.94%, while the average unemployment rate is 5.26%. The most unreasonable facet of the LIFT forecast is the interest rate forecast. The 90-day Treasury bill rate declines continuously until 1991 when the rate actually becomes negative. Longer term rates remain at more reasonable levels, but also decline to rates that are low relative to those forecasted by the other models. Relative to the LIFT base, the average rate for the 1987-91 period of M2 growth is six percentage points higher, while the inflation rate is 2.5 percentage points higher. Average real growth over the period is actually lower by .31 percentage points. The average unemployment rate for the period is .55 percentage ponts higher with faster money growth.

Analysis and Conclusion

Several interesting points are apparent from an analysis of the four scenarios and bases for the four models. First, it is clear that the Wharton model is not very robust with respect to deviations of monetary policy assumptions from the base assumptions. None of the Wharton model pure simulations finished the forecast through 1991.

Since the "managed" simulations appeared quite reasonable for the Wharton model, this suggests that results which supposedly come from the Wharton model actually stem from the preconceptions of its operators expressed in fixes applied to the model. Thus, for the Wharton model at least, judgment of the operator appears to be a more important factor than the actual structure and working of the model. Particularly suspect relations are the interest rate equations which translate 4% M2 growth into phenomenally large interest rates, real and nominal. Even with 7% M2 growth, the interest rate equations seem to produce high real and nominal rates. Judgment seems to outweigh modelling in the Wharton case.

The DRI model appears to be more robust with respect to monetary policy changes. Only in the case of a quick deceleration of M1 growth to 0% per year does the model not finish the forecast. In the case of gradual deceleration to 0% M1 growth, M2 growth tends to slow, but then begins to rise very quickly, so that the 1991 M2 growth rate is nearly 10%. The implication is that over the 1987-91 period, M2 velocity is increasing at nearly 3% per year which is not consistent with the long run post-1950 behavior of M2 velocity. The interest rate equations in the DRI model appear suspicious, since gradually slowing money growth is linked to very high interest rates, both real and nominal. With moderate M1 growth, M2 velocity over the 1987-91 period is nearly constant and real growth for the period is .5 percentage points higher than the base. This provides some evidence that the DRI model associates slow money growth with higher real growth. The conclusion is very weak however. Constant, moderate M1 growth results in M2 growth over the 1987-91 period which averages about .5 percentage points faster

than the base and slightly higher real growth for the 1987-91 period. High rates of M1 growth results in high rates of M2 growth and higher rates of real growth. Thus, it is difficult to conclude how different rates of money growth affect real growth. For DRI, higher-than-base money growth and lower-than-base money growth both result in higher-than-base real growth. The DRI model, for both the moderate-M1-growth and fast-M1-growth scenarios, manages to keep M2 velocity nearly constant over the 1987-91 period. The behavior of interest rates in the moderate M1 growth scenarios (scenario 3) suggests some quirk in the DRI model that makes it suspect as a tool for analysis.

Of the three models discussed in the Joint Economic Committee study, the Chase model appears to be the most robust with respect to the monetary policy changes. Although the Chase model broke down in the rapid deceleration to 0% M1 growth, the macroeconomic results for the other three scenarios are fairly reasonable. Average rates of M2 velocity growth for the 1987-91 period for all scenarios is close to 0%, which is consistent with the post-1950 behavior of M2 velocity. Looking across scenarios, higher rates for M2 growth seems to be associated with higher rates of real growth, as evidenced in Table 6.6. A few puzzling results are apparent in the scenarios. One problem seems to be the link between M1 and M2. For example, in the 1987-91 period, scenario 2 links 0% M1 growth with 7.22% M2 growth and scenario 4 links 10% M1 growth with 10.85% M2 growth. This implies large movements in the non-M1 components of M2 that offset the M1 movements. The near constancy of M2 velocity may be due more to the lack of movement in M2 and inflation than due to their varying together in an economically meaningful

TABLE 6.6
Average growth rates or levels for 1987-91 period

M2	BASE	Scenario 1	Scenario 2	Scenario 3	Scenario 4
Chase	9.36	-	7.22	8.16	10.85
DRI	8.56	-	7.24	9.20	14.94
Wharton	9.83	-	-	-	-
LIFT	7.95	4.00	4.00	7.00	14.00
GNP Deflators					
CHASE	6.26	-	5.15	5.59	6.76
DRI	6.52	-	7.06	6.84	10.54
Wharton	6.60	-	-	-	-
LIFT	5.62	3.64	3.80	4.87	8.02
Real GNP					
Chase	2.98	-	2.77	2.84	3.22
DRI	2.94	-	3.58	3.00	3.28
Wharton	3.00	-	-	-	-
LIFT	2.25	2.41	2.44	2.29	1.94
Unemployment rate					
Chase	5.31	-	8.58	6.96	4.63
DRI	6.62		6.58	6.50	4.22
Wharton	6.37	-	-	-	-
LIFT	4.71	3.79	4.12	4.35	5.26

fashion. The rate of inflation seems curiously stable in the face of the radically different money supply growth rates.

The LIFT model appears to be able to hold its own against the other three models. The LIFT model managed to complete all of the scenarios, something that none of the other models were capable of doing. Thus, the model seems quite robust with respect to monetary policy changes. Looking across scenarios, LIFT seems to associate higher rates of M2 growth with lower rates of real growth, which is in direct contrast to the Chase model. M2 velocity remains constant in the base scenario and scenario 3 (which is very close to the base run) but increases at about 2.2% for scenarios 1 and 2, and decreases at about 5% per year for scenario 4. These latter two results tend to run counter to the relative constancy of M2 velocity that could reasonably be expected. The scenario in which the LIFT model performs most poorly is scenario 4, which is the fast M2 growth scenario. Decreasing velocity is the cause of the decline in interest rate. This decline in velocity more than offsets the tendency of interest rates to rise via the higher inflation rates associated with faster M2 growth.

LIFT Model: More Detailed Results

No industry detail or even aggregate final demand breakdown was available for the Chase, Wharton or DRI models for these particular scenarios. Naturally, far more detail is available for the LIFT model. Two tables present more detailed macroeconomic results and industry outputs for all four scenarios. Table 6.7 highlights the macroeconomic differences of the four scenarios. Large differences are found in the interest rates in 1991. The savings rate in 1991 for the slow money

growth scenarios (1 and 2) are nearly double the savings rate for the fast money growth scenarios. This is because interest rates are lower and the unemployment rate tends to be higher with fast money growth. As we have seen in Chapter 5, the rate of inflation and the rate of PCE growth move in opposite directions. Thus, scenario 4, with the highest rate of inflation shows the slowest rate of growth of PCE. Sectoral equipment investment is more influenced by sectoral outputs than interest rates, thus equipment investment grows more slowly with faster money growth and low interest rates than with slow money growth and higher interest rates. It is interesting to see that labor productivity is lowest with faster money growth. This is primarily because of the slower rate of industry output growth, on which productivity at the sectoral level depends.

Looking at the disaggregated sectoral employment growth rates, fast money growth shows faster employment growth for only two sectors, Agriculture, mining and structures, and Business, repair and other services. The fast growth for Agriculture, mining and sructures comes primarily from the increase in the output of Construction. Business, repair and other services tend to increase because the output of Business services is rising more quickly with fast money growth than in any of the other scenarios. Employment for this sector is also stimulated by the unbelievably rapid growth in the output of Movies and amusements with fast money growth. This very rapid output growth is due to positive own price elasticities for Movies and spectator events and Other recreation services which came from the estimation of the PCE equation system. All other employment sectors show considerably slower growth rates with faster money growth.

Turning to examine directly the long term growth rates for industry outputs (Table 6.8), we can see that faster money growth results in absolutely faster growth for Construction, Air transport, Water and sanitation, and Movies and amusements. The last three of these sectors are surprising and, as is the case above, due to unreasonable elasticities in estimated equations. In terms of growth rates relative to real GNP growth, sectors associated with residential structures show an increase. These are Lumber and Stone, clay and glass. Other sectors show relative declines with fast money growth. One sector of major importance, because it is a major user of machinery other durable equipment, is Motor vehicles. As was pointed out in the previous chapter, Metal products, Metal-working machinery, Ferrous metals and Iron ore mining are all closely related to the Motor vehicles sector. High inflation associated with faster M2 growth reduces real income and reduces PCE expenditures on New autos and trucks. Equipment investment is also lower with higher money growth, which further reduces the demand for Motor vehicles.

Conclusion

In this chapter, the LIFT model has been compared with three other models designed for long-term forecasting. The results of the comparison indicates that the LIFT model compares favorably with these other models and does so even though the model is much larger and more complex than any of the other three. One conclusion that emerges very strongly from these scenarios with the LIFT model is that fast money growth is counter-productive. This is true even when interest rates are unbelievably low, which should have had the effect of propping the level

of economic activity. Had the ratio of M2 to nominal GNP remained at levels more consistent with historical levels, interest rates would have been higher and the conclusion that faster money growth hurts the real economy would have been strengthened. The chapter has exposed some further problems with some specific sectors. It should be noted, however, that the chapter has shown the viability and competitiveness of the LIFT model relative to three other major models often used for policy analysis.

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JEC M2 SCENARIOS

TABLE 6.7. SUMMARY OF RESULTS

	(SCEN 2) 1981	(SCEN 2) 1987	(SCEN 3) 1987	(SCEN 1) 1987	(SCEN 4) 1987	(SCEN 2) 1991	(SCEN 3) 1991	(SCEN 1) 1991	(SCEN 4) 1991
Gross National Product, (cu. $)	2984.43	4819.84	4873.73	4686.06	5216.77	6163.27	6478.70	5933.65	7790.08
Labor compensation	1771.40	2923.93	2961.10	2831.39	3195.97	3722.96	3938.96	3591.02	4824.68
Indirect business taxes	251.76	362.85	366.28	353.84	388.68	451.61	472.86	437.42	561.81
Return to capital	900.07	1443.44	1455.64	1413.96	1534.22	1880.64	1952.23	1821.56	2261.92
Net interest	245.45	358.15	358.15	358.15	358.15	460.75	460.75	460.75	460.75
Corporate profits	249.06	449.36	467.86	419.82	560.44	572.94	650.34	522.25	962.77
Proprietor income	147.38	272.69	272.75	274.25	271.85	400.04	397.71	400.23	391.64
Gross National Product Deflator	1.99	2.67	2.70	2.59	2.91	3.11	3.29	2.99	4.03
Hourly labor comp. index (manuf.)	144.40	204.44	208.24	194.66	231.78	236.52	257.19	225.23	340.59
Labor productivity (GNP/JOBS)	20.10	21.20	21.19	21.22	21.16	21.88	21.83	21.89	21.59
Financial variables									
Treasury bill rate	14.76	9.86	8.88	11.05	4.78	11.27	8.73	12.73	-0.28
Treasury bonds , 10 year	13.91	8.82	8.49	9.11	7.25	8.97	8.17	9.72	5.03
AAA Corporate bond rate	14.17	9.26	9.00	9.50	8.01	9.32	8.64	10.10	5.87
Commercial paper rate	14.76	10.13	9.18	11.21	5.33	11.35	8.99	12.80	0.59
Mortgage rate	14.17	9.85	9.55	10.10	8.44	9.98	9.26	10.66	6.43
M2 (billions of currents)	1743.75	2349.85	2702.12	2325.74	3466.12	2992.28	3575.25	2729.27	6068.04
Non-borrowed reserve base	163.50	264.23	264.23	264.23	264.23	363.88	363.88	363.88	363.88
Ratio of M2 to nominal GNP	0.58	0.53	0.55	0.50	0.66	0.49	0.55	0.46	0.78
Savings rate	6.42	8.23	8.11	8.94	7.03	10.16	8.97	11.05	5.36
Gross National Product (77$)	2095.23	2520.38	2520.27	2533.39	2506.13	2773.14	2753.92	2780.67	2699.70
Personal Consumption	1313.09	1625.35	1624.54	1627.82	1621.01	1770.56	1769.08	1774.90	1757.54
Residential Structures	68.86	97.80	100.26	94.32	111.48	104.65	112.69	99.20	141.76
Non-residential structures	82.83	101.73	101.19	103.84	97.29	115.31	112.51	115.19	105.68
Producers' durable equipment	172.33	234.00	234.66	237.23	233.22	251.78	247.33	251.82	241.29
Inventory change	9.39	15.53	15.81	16.02	16.33	16.63	16.35	16.60	15.13
Exports	254.48	255.33	252.83	262.64	237.06	313.73	297.88	322.71	247.21
Imports	221.38	280.08	279.76	279.21	281.00	304.21	306.61	304.43	313.59
Other variables									
Disp. income per capita (1972$)	4537.61	5398.53	5385.45	5454.64	5297.17	5820.00	5729.44	5902.57	5431.22
Return to capital scaler	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Foreign demand scaler	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Trade balance (cu. $)	0.00	-131.47	-131.47	-131.47	-131.47	-144.54	-144.54	-144.54	-144.54
Merchandise exports (cu. $)	218.89	289.04	291.16	286.75	299.42	415.97	419.06	406.66	440.95
Merchandise imports (cu. $)	261.71	414.57	416.03	411.29	425.43	549.85	559.69	519.92	616.89
Exchange rate scaler	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.94	1.06
Unemployment rate	7.71	4.66	4.65	4.25	5.04	3.58	4.09	3.39	4.94
Civilian jobs (millions)	104.22	118.91	118.92	119.40	118.46	126.76	126.13	127.00	125.07
Private sector jobs	88.01	101.87	101.88	102.36	101.41	109.18	108.55	109.42	107.48
Agric,Mining,Structures	9.99	11.07	11.10	11.09	11.18	11.68	11.72	11.60	11.94
Durable goods manufacturing	12.20	13.56	13.56	13.71	13.41	14.26	14.03	14.38	13.27
Non-durable goods mfg	8.13	7.98	7.98	8.02	7.94	7.86	7.81	7.88	7.60
Transp,Communic,Utilities	5.43	5.75	5.75	5.79	5.71	5.87	5.82	5.89	5.78
Trade	22.88	27.93	27.94	28.01	27.87	30.34	30.25	30.41	29.38
Finance,Insurance,Real Estate	5.88	6.95	6.95	6.96	6.96	7.41	7.42	7.41	7.35
Medicine & Education	10.51	12.35	12.32	12.45	12.13	13.55	13.39	13.62	13.12
Domestic servants	1.88	1.79	1.79	1.79	1.79	1.76	1.76	1.76	1.76
Business,Repair,Oth services	11.16	14.51	14.51	14.56	14.44	16.45	16.37	16.48	17.50

JEC M2 SCENARIOS

TABLE 6.7. SUMMARY OF RESULTS
SUMMARY OF EXPONENTIAL ANNUAL GROWTH RATES

	(SCEN 2) 81- 87	(SCEN 3) 81- 87	(SCEN 1) 81- 87	(SCEN 4) 81- 87	(SCEN 2) 87- 91	(SCEN 3) 87- 91	(SCEN 1) 87- 91	(SCEN 4) 87- 91
Gross National Product, (cu. $)	7.99	8.17	7.52	9.31	6.15	7.12	5.99	10.02
Labor compensation	8.35	8.56	7.82	9.84	6.04	7.13	5.94	10.30
Indirect business taxes	6.09	6.25	5.67	7.24	5.47	6.38	5.30	9.21
Return to capital	7.87	8.01	7.53	8.89	6.61	7.34	6.33	9.70
Net interest	6.30	6.30	6.30	6.30	6.30	6.30	6.30	6.30
Corporate profits	9.84	10.51	8.70	13.52	6.07	8.23	5.46	13.53
Proprietor income	10.26	10.26	10.35	10.20	9.58	9.43	9.45	9.13
Gross National Product Deflator	4.91	5.10	4.35	6.32	3.76	4.90	3.66	8.16
Hourly labor comp. index (manuf.)	5.79	6.10	4.98	7.89	3.64	5.28	3.65	9.62
Labor productivity (GNP/JOBS)	0.88	0.88	0.90	0.85	0.79	0.74	0.78	0.50
Financial variables								
Treasury bill rate	-6.72	-8.47	-4.82	-18.80	3.34	-0.40	3.54	0.00
Treasury bonds , 10 year	-7.58	-8.23	-7.06	-10.87	0.40	-0.96	1.62	-9.13
AAA Corporate bond rate	-7.10	-7.56	-6.66	-9.51	0.15	-1.02	1.51	-7.75
Commercial paper rate	-6.26	-7.91	-4.58	-16.97	2.84	-0.53	3.32	-55.14
Mortgage rate	-6.06	-6.57	-5.64	-8.63	0.33	-0.76	1.34	-6.79
M2 (billions of current$)	6.33	7.30	4.80	11.45	4.00	7.00	4.00	14.00
Non-borrowed reserve base	8.00	8.00	8.00	8.00	8.00	8.00	8.00	8.00
Ratio of M2 to nominal GNP	-1.66	-0.87	-2.72	2.14	-2.15	-0.12	-1.99	3.98
Savings rate	4.14	3.90	5.53	1.53	5.27	2.51	5.31	-6.79
Gross National Product (77$)	3.08	3.08	3.16	2.98	2.39	2.22	2.33	1.86
Personal Consumption	3.56	3.55	3.58	3.51	2.14	2.13	2.16	2.02
Residential Structures	5.85	6.26	5.24	8.03	1.69	2.92	1.26	6.01
Non-residential structures	3.42	3.34	3.77	2.68	3.13	2.65	2.59	2.07
Producers' durable equipment	5.10	5.15	5.33	5.04	1.83	1.31	1.49	0.85
Inventory change	8.38	8.69	8.90	9.22	1.71	0.83	0.89	-1.92
Exports	0.06	-0.11	0.93	-1.18	5.15	4.10	5.15	1.05
Imports	3.92	3.90	3.87	3.97	2.07	2.29	2.16	2.74
Other variables								
Disp. income per capita (1972$)	2.90	2.86	3.07	2.58	1.88	1.55	1.97	0.62
Return to capital scaler								
Foreign demand scaler								
Trade balance (cu. $)	0.00	0.00	0.00	0.00	2.37	2.37	2.37	2.37
Merchandise exports (cu. $)	4.63	4.76	4.50	5.22	9.10	9.12	8.73	9.68
Merchandise imports (cu. $)	7.67	7.73	7.53	8.10	7.06	7.42	5.86	9.29
Exchange rate scaler	0.00	0.00	0.00	0.00	0.00	0.00	-1.57	1.49
Unemployment rate	-8.40	-8.44	-9.94	-7.09	-6.57	-3.20	-5.64	-0.48
Civilian jobs (millions)	2.20	2.20	2.27	2.13	1.60	1.47	1.54	1.36
Private sector jobs	2.44	2.44	2.52	2.36	1.73	1.58	1.67	1.45
Agric.,Mining,Structures	1.78	1.83	1.81	1.94	1.35	1.34	1.13	1.65
Durable goods manufacturing	1.76	1.77	1.95	1.58	1.27	0.85	1.19	-0.27
Non-durable goods mfg	-0.31	-0.31	-0.23	-0.41	-0.38	-0.54	-0.43	-1.09
Transp.,Communic.,Utilities	0.96	0.96	1.06	0.85	0.49	0.29	0.43	0.29
Trade	3.32	3.32	3.37	3.29	2.07	1.99	2.05	1.32
Finance,Insurance,Real Estate	2.79	2.80	2.80	2.81	1.63	1.62	1.59	1.35
Medicine & Education	2.68	2.64	2.81	2.38	2.33	2.08	2.26	1.97
Domestic servants	-0.81	-0.81	-0.81	-0.81	-0.36	-0.36	-0.35	-0.36
Business,Repair,Oth services	4.38	4.37	4.44	4.30	3.14	3.03	3.10	4.52

JEC M2 SCENARIOS

TABLE 6 B. OUTPUT BY PRODUCING SECTOR (1977$)

		(SCEN 2) 1981	(SCEN 2) 1987	(SCEN 3) 1987	(SCEN 1) 1987	(SCEN 4) 1987	(SCEN 2) 1991	(SCEN 3) 1991	(SCEN 1) 1991	(SCEN 4) 1991
1	AGRICULTURE, FORESTRY, FISHERY	143.71	159.24	159.05	160.29	157.26	172.95	171.02	173.03	165.39
	MINING	80.86	89.65	89.68	90.27	89.02	94.01	93.15	94.33	90.66
2	IRON ORE MINING	2.46	2.91	2.90	2.99	2.78	3.03	2.88	3.09	2.43
3	NONFERROUS METALS MINING	3.11	3.69	3.69	3.76	3.60	4.04	3.93	4.07	3.61
4	COAL MINING	20.57	24.99	24.97	25.18	24.68	28.38	28.03	28.54	27.07
5	NATURAL GAS EXTRACTION	19.63	19.80	19.80	19.95	19.60	20.30	20.09	20.44	19.55
6	CRUDE PETROLEUM	28.17	29.72	29.78	29.80	29.85	28.82	28.81	28.75	28.81
7	NON-METALLIC MINING	6.92	8.54	8.55	8.59	8.51	9.44	9.38	9.44	9.19
8	CONSTRUCTION	99.90	121.50	122.16	121.27	124.39	133.12	134.60	131.23	141.68
	NON-DURABLES	671.99	790.53	790.36	794.40	785.51	865.43	859.42	867.38	833.64
9	FOOD & TOBACCO	218.11	242.19	242.13	242.95	241.14	257.67	256.39	258.28	249.59
10	TEXTILES, EXC. KNITS	34.87	44.59	44.56	44.95	44.06	49.75	49.24	49.85	46.90
11	KNITTING	9.17	11.52	11.50	11.54	11.43	12.68	12.66	12.71	12.27
12	APPAREL, HOUSEHOLD TEXTILES	41.60	53.84	53.79	54.03	53.32	60.21	59.91	60.40	57.56
13	PAPER	51.19	61.30	61.24	61.88	60.43	68.17	67.21	68.44	64.01
14	PRINTING & PUBLISHING	50.43	59.49	59.42	59.89	58.78	64.88	64.31	65.04	63.54
15	AGRICULTURAL FERTILIZERS	13.52	14.83	14.80	14.98	14.53	16.85	16.55	16.90	15.66
16	OTHER CHEMICALS	109.19	134.67	134.63	135.71	133.30	155.17	153.33	155.77	145.92
17	PETROLEUM REFINING	96.81	107.26	107.33	107.39	107.40	110.79	110.75	110.68	110.65
	18 FUEL OIL	24.33	26.25	26.24	26.40	26.04	27.47	27.24	27.57	26.70
19	RUBBER PRODUCTS	15.39	19.85	19.93	19.88	20.11	22.15	22.20	22.11	22.00
20	PLASTIC PRODUCTS	25.30	32.43	32.43	32.71	32.12	38.16	37.68	38.32	35.89
21	SHOES AND LEATHER	6.42	8.57	8.63	8.48	8.89	8.95	9.20	8.87	9.66
	DURABLES	723.11	942.47	942.62	953.93	930.40	1071.52	1052.14	1080.32	984.88
22	LUMBER	39.84	47.66	47.90	47.71	48.50	50.84	50.99	50.54	51.33
23	FURNITURE	16.42	21.41	21.43	21.57	21.32	22.85	22.68	23.03	21.80
24	STONE, CLAY, GLASS	32.80	41.73	41.90	41.84	42.29	46.93	47.03	46.70	47.54
25	FERROUS METALS	54.06	63.61	63.44	65.54	60.30	67.73	64.34	68.56	53.41
26	COPPER	8.64	9.88	9.88	10.06	9.66	10.66	10.38	10.81	9.44
27	OTHER NONFERROUS METALS	33.10	42.67	42.67	43.42	41.76	49.59	48.30	50.03	44.31
28	METAL PRODUCTS	86.39	108.94	108.44	109.84	106.76	121.88	119.94	122.39	112.90
	NON-ELEC MACHINERY	144.57	184.16	184.33	187.22	181.56	211.03	206.01	213.36	190.74
29	ENGINES AND TURBINES	11.05	14.29	14.30	14.52	14.04	17.01	16.58	17.33	15.06
30	AGRICULTURAL MACHINERY	11.26	13.04	13.06	13.23	12.90	14.54	14.28	14.54	13.59
31	CONSTR, MINING, OILFIELD EQ	18.37	19.53	19.60	19.73	19.53	21.98	21.60	22.39	20.32
32	METALWORKING MACHINERY	15.32	18.55	18.58	19.07	18.30	18.49	17.91	18.76	16.11
33	SPECIAL INDUSTRY MACHINERY	9.12	9.92	9.94	10.07	9.82	10.10	9.68	10.32	9.02
34	MISC NON-ELECTRICAL MACH.	36.71	44.41	44.38	45.23	43.43	49.13	47.80	49.61	43.88
35	COMPUTERS	27.65	44.82	44.84	45.61	44.02	57.91	56.31	58.48	51.88
36	OTHER OFFICE EQUIPMENT	3.04	3.74	3.74	3.81	3.66	4.21	4.09	4.31	3.68
37	SERVICE INDUSTRY MACHINERY	12.06	15.87	15.89	15.95	15.87	17.68	17.56	17.63	17.21
	ELECTRICAL MACHINERY	116.63	147.31	147.19	149.36	144.52	174.78	170.76	177.68	158.14
38	COMMUNIC EQ, ELECTRONIC COMP	63.19	83.36	83.24	84.62	81.49	102.98	100.27	104.89	92.22
39	ELEC INDL APP & DISTRIB EQ	20.64	23.98	23.97	24.39	23.47	26.91	26.16	27.35	23.93
40	HOUSEHOLD APPLIANCES	10.58	12.24	12.24	12.36	12.10	13.37	13.22	13.47	12.62
41	ELEC LIGHTING & WIRING EQ	16.08	20.08	20.09	20.26	19.93	22.75	22.46	23.11	21.19
42	TV SETS, RADIOS, PHONOGRAPHS	6.14	7.66	7.65	7.73	7.54	8.76	8.65	8.86	8.18
	TRANSPORTATION EQ	144.33	214.55	214.52	215.85	213.60	243.79	241.40	245.42	230.38
43	MOTOR VEHICLES	87.33	137.72	137.96	137.80	139.16	155.11	155.26	156.26	151.37
44	AEROSPACE	38.61	50.16	49.93	51.09	48.21	58.04	55.95	58.27	52.39
45	SHIPS, BOATS	9.28	14.17	14.17	14.21	14.11	16.31	16.21	16.40	15.10
46	OTHER TRANSP. EQUIP.	9.11	12.50	12.47	12.74	12.11	14.33	13.09	14.50	11.53

JEC M2 SCENARIOS

TABLE 6.8. OUTPUT BY PRODUCING SECTOR (1977$)

		(SCEN 2) 1981	(SCEN 2) 1987	(SCEN 3) 1987	(SCEN 1) 1987	(SCEN 4) 1987	(SCEN 2) 1991	(SCEN 3) 1991	(SCEN 1) 1991	(SCEN 4) 1991
47	INSTRUMENTS	28.54	37.69	37.67	38.19	37.05	44.74	43.81	45.01	40.48
48	MISC. MANUFACTURING	17.81	23.24	23.23	23.35	23.06	26.69	26.50	26.80	24.39
	TRANSPORTATION	136.14	166.05	166.03	167.06	164.89	186.09	184.42	186.83	188.74
49	RAILROADS	22.72	25.94	25.95	26.15	25.73	28.00	27.67	28.13	26.48
50	TRUCKING, HWY PASS TRANSIT	63.57	77.73	77.74	78.09	77.41	86.34	85.82	86.53	85.02
51	WATER TRANSPORT	15.44	17.52	17.49	17.75	17.13	20.46	20.00	20.68	19.20
52	AIR TRANSPORT	28.23	37.80	37.78	38.00	37.56	43.73	43.39	43.92	50.72
53	PIPELINE	3.58	4.05	4.05	4.05	4.05	4.26	4.26	4.26	4.25
54	TRANSPORTAION SERVICES	2.61	3.02	3.01	3.03	2.99	3.30	3.27	3.30	3.06
	UTILITIES	223.80	279.30	279.25	280.90	277.32	314.97	312.64	315.93	305.18
55	COMMUNICATIONS SERVICES	83.10	111.97	112.00	112.53	111.51	131.91	131.09	132.07	127.62
56	ELECTRIC UTILILITIES	78.35	93.73	93.62	94.47	92.45	103.10	101.93	103.71	98.88
57	GAS UTILITY	51.31	59.59	59.55	60.01	58.93	64.27	63.64	64.70	62.15
58	WATER AND SANITATION	11.04	14.01	14.08	13.90	14.43	15.70	15.98	15.46	16.52
59	WHOLESALE TRADE	187.85	233.73	233.83	235.03	232.72	261.29	259.37	262.03	250.90
60	RETAIL TRADE	193.65	244.09	244.12	244.20	244.27	266.43	266.83	266.85	258.72
61	EATING & DRINKING PLACES	89.33	113.80	113.73	114.17	113.23	126.18	125.66	126.54	122.57
62	FINANCE & INSURANCE	130.86	160.83	160.83	161.01	160.76	176.42	176.41	176.47	173.25
63	REAL ESTATE	158.83	188.17	188.52	188.30	189.48	200.15	200.56	199.74	203.10
64	OWNER-OCCUPIED HOUSING	154.89	193.37	193.27	193.68	192.82	211.25	211.06	211.77	209.45
	SERVICES	488.44	631.22	630.65	634.47	625.69	720.42	715.30	722.69	726.90
65	HOTELS: REPAIRS EXC AUTO	44.31	52.60	52.56	52.77	52.27	56.30	56.06	56.40	58.26
66	BUSINESS SERVICES	202.75	282.62	282.67	283.83	281.56	334.41	332.59	335.06	330.26
67	AUTOMOBILE REPAIRS	42.60	55.78	55.72	55.87	55.50	61.84	61.71	62.10	60.07
68	MOVIES AND AMUSEMENTS	23.87	32.36	32.32	32.43	32.14	37.84	37.72	37.95	35.62
69	MEDICINE, EDUCATION, NPO	174.92	207.88	207.39	209.56	204.21	230.04	227.22	231.19	222.70
70	FED & S&L GOVT ENTERPRISES	28.22	33.66	33.72	33.60	34.02	36.15	36.34	35.98	37.29
71	NON COMPETITIVE IMPORTS									
72	DOMESTIC SERVANTS	5.09	6.05	6.00	6.13	5.81	6.26	6.09	6.39	5.18
73	UNIMPORTANT INDUSTRY	8.50	10.67	10.66	10.77	10.53	12.02	11.85	12.08	11.37
74	SCRAP AND USED	2.65	4.90	4.86	5.09	4.47	6.51	6.11	6.65	4.91
75	REST OF THE WORLD INDUSTRY	36.07	27.19	26.65	28.86	23.07	35.98	32.37	37.83	19.40
76	GOVERNMENT INDUSTRY	213.73	223.64	223.64	223.64	223.64	229.74	229.74	229.74	229.74
77	INFORUM STAT. DISCREPANCY	16.08	19.49	19.54	19.69	19.45	20.86	20.63	20.77	19.74
78	NIPA STAT. DISCREPANCY	1.22	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

JEC M2 SCENARIOS

TABLE 6.8. OUTPUT BY PRODUCING SECTOR (1977$)
SUMMARY OF EXPONENTIAL ANNUAL GROWTH RATES

		(SCEN 2) 81- 87	(SCEN 3) 81- 87	(SCEN 1) 81- 87	(SCEN 4) 81- 87	(SCEN 2) 87- 91	(SCEN 3) 87- 91	(SCEN 1) 87- 91	(SCEN 4) 87- 91
1	AGRICULTURE, FORESTRY, FISHERY	1.71	1.69	1.82	1.50	2.06	1.81	1.91	1.26
	MINING	1.72	1.73	1.84	1.60	1.19	0.95	1.10	0.46
2	IRON ORE MINING	2.80	2.77	3.27	2.02	0.99	-0.16	0.78	-3.32
3	NONFERROUS METALS MINING	2.86	2.85	3.15	2.44	2.23	1.56	1.99	0.06
4	COAL MINING	3.25	3.24	3.38	3.04	3.18	2.90	3.13	2.31
5	NATURAL GAS EXTRACTION	0.14	0.14	0.27	-0.02	0.63	0.37	0.61	-0.07
6	CRUDE PETROLEUM	0.89	0.92	0.93	0.96	-0.77	-0.82	-0.89	-0.89
7	NON-METALLIC MINING	3.51	3.53	3.61	3.46	2.52	2.33	2.37	1.92
8	CONSTRUCTION	3.26	3.39	3.23	3.65	2.28	2.42	1.97	3.25
	NON-DURABLES	2.71	2.70	2.79	2.60	2.26	2.09	2.20	1.49
9	FOOD & TOBACCO	1.75	1.74	1.80	1.67	1.55	1.43	1.53	0.86
10	TEXTILES, EXC. KNITS	4.10	4.09	4.23	3.90	2.74	2.49	2.59	1.56
11	KNITTING	3.80	3.78	3.84	3.68	2.40	2.40	2.41	1.77
12	APPAREL, HOUSEHOLD TEXTILES	4.30	4.27	4.36	4.14	2.80	2.71	2.79	1.91
13	PAPER	3.00	2.99	3.16	2.77	2.66	2.32	2.52	1.44
14	PRINTING & PUBLISHING	2.75	2.73	2.86	2.55	2.17	1.98	2.07	1.95
15	AGRICULTURAL FERTILIZERS	1.53	1.50	1.71	1.19	3.21	2.80	3.02	1.88
16	OTHER CHEMICALS	3.49	3.49	3.62	3.33	3.54	3.25	3.45	2.26
17	PETROLEUM REFINING	1.71	1.72	1.73	1.73	0.81	0.78	0.75	0.74
18	FUEL OIL	1.26	1.26	1.36	1.13	1.13	0.94	1.08	0.62
19	RUBBER PRODUCTS	4.25	4.31	4.27	4.46	2.74	2.70	2.66	2.24
20	PLASTIC PRODUCTS	4.14	4.14	4.28	3.98	4.07	3.75	3.96	2.77
21	SHOES AND LEATHER	4.82	4.94	4.64	5.44	1.08	1.61	1.14	2.06
	DURABLES	4.42	4.42	4.62	4.20	3.21	2.75	3.11	1.42
22	LUMBER	2.99	3.07	3.00	3.28	1.61	1.56	1.44	1.42
23	FURNITURE	4.42	4.44	4.54	4.35	1.62	1.41	1.64	0.56
24	STONE, CLAY, GLASS	4.01	4.08	4.06	4.23	2.94	2.89	2.75	2.93
25	FERROUS METALS	2.71	2.67	3.21	1.82	1.57	0.35	1.13	-3.04
26	COPPER	2.23	2.22	2.53	1.86	1.91	1.25	1.79	-0.58
27	OTHER NONFERROUS METALS	4.23	4.23	4.52	3.87	3.75	3.10	3.55	1.48
28	METAL PRODUCTS	3.81	3.80	4.01	3.54	2.90	2.52	2.70	1.40
	NON-ELEC MACHINERY	4.03	4.05	4.31	3.80	3.40	2.78	3.27	1.23
29	ENGINES AND TURBINES	4.29	4.30	4.56	3.99	4.35	3.70	4.42	1.75
30	AGRICULTURAL MACHINERY	2.45	2.48	2.68	2.26	2.72	2.23	2.36	1.30
31	CONSTR, MINING, OILFIELD EQ	1.02	1.08	1.19	1.02	2.96	2.43	3.16	0.99
32	METALWORKING MACHINERY	3.20	3.22	3.65	2.97	-0.09	-0.93	-0.42	-3.19
33	SPECIAL INDUSTRY MACHINERY	1.41	1.45	1.65	1.23	0.46	-0.14	0.61	-2.10
34	MISC NON-ELECTRICAL MACH.	3.17	3.16	3.48	2.80	2.53	1.86	2.31	0.26
35	COMPUTERS	8.05	8.06	8.34	7.75	6.41	5.69	6.21	4.11
36	OTHER OFFICE EQUIPMENT	3.47	3.47	3.77	3.12	2.93	2.22	3.08	0.15
37	SERVICE INDUSTRY MACHINERY	4.58	4.60	4.67	4.58	2.69	2.50	2.49	2.02
	ELECTRICAL MACHINERY	3.89	3.88	4.12	3.57	4.27	3.71	4.34	2.25
38	COMMUNIC EQ, ELECTRONIC COMP	4.62	4.59	4.87	4.24	5.28	4.65	5.37	3.09
39	ELEC INDL APP & DISTRIB EQ	2.49	2.49	2.78	2.14	2.89	2.18	2.86	0.49
40	HOUSEHOLD APPLIANCES	2.42	2.42	2.58	2.23	2.22	1.93	2.17	1.05
41	ELEC LIGHTING & WIRING EQ	3.70	3.71	3.85	3.57	3.12	2.79	3.29	1.54
42	TV SETS, RADIOS, PHONOGRAPHS	3.70	3.68	3.85	3.43	3.36	3.07	3.40	2.04
	TRANSPORTATION EQ	6.61	6.60	6.71	6.53	3.19	2.95	3.21	1.89
43	MOTOR VEHICLES	7.59	7.62	7.60	7.77	2.97	2.97	3.14	2.10
44	AEROSPACE	4.36	4.28	4.67	3.70	3.65	2.85	3.29	2.08
45	SHIPS, BOATS	7.05	7.04	7.10	6.98	3.51	3.36	3.57	1.68
46	OTHER TRANSP. EQUIP.	5.28	5.24	5.60	4.75	3.41	2.69	3.22	-1.24

JEC M2 SCENARIOS

TABLE 6.8. OUTPUT BY PRODUCING SECTOR (1977$)
SUMMARY OF EXPONENTIAL ANNUAL GROWTH RATES

		(SCEN 2) 81- 87	(SCEN 3) 81- 87	(SCEN 1) 81- 87	(SCEN 4) 81- 87	(SCEN 2) 87- 91	(SCEN 3) 87- 91	(SCEN 1) 87- 91	(SCEN 4) 87- 91
47	INSTRUMENTS	4.64	4.63	4.85	4.35	4.29	3.77	4.11	2.21
48	MISC. MANUFACTURING	4.43	4.42	4.52	4.30	3.46	3.29	3.44	1.40
	TRANSPORTATION	3.31	3.31	3.41	3.19	2.85	2.63	2.80	3.38
49	RAILROADS	2.21	2.22	2.34	2.07	1.91	1.61	1.83	0.72
50	TRUCKING, HWY PASS TRANSIT	3.35	3.35	3.43	3.28	2.63	2.47	2.57	2.34
51	WATER TRANSPORT	2.11	2.08	2.32	1.74	3.87	3.35	3.83	2.85
52	AIR TRANSPORT	4.87	4.86	4.95	4.76	3.65	3.46	3.62	7.51
53	PIPELINE	2.05	2.06	2.07	2.08	1.28	1.25	1.23	1.19
54	TRANSPORTAION SERVICES	2.39	2.39	2.48	2.28	2.22	2.03	2.15	0.57
	UTILITIES	3.69	3.69	3.79	3.57	3.01	2.82	2.94	2.39
55	COMMUNICATIONS SERVICES	4.97	4.97	5.05	4.90	4.10	3.94	4.00	3.38
56	ELECTRIC UTILILITIES	2.99	2.97	3.12	2.76	2.38	2.12	2.33	1.68
57	GAS UTILITY	2.49	2.48	2.61	2.31	1.89	1.66	1.88	1.33
58	WATER AND SANITATION	3.97	4.05	3.84	4.46	2.84	3.16	2.65	3.38
59	WHOLESALE TRADE	3.64	3.65	3.73	3.57	2.79	2.59	2.72	1.88
60	RETAIL TRADE	3.86	3.86	3.87	3.87	2.19	2.22	2.22	1.44
61	EATING & DRINKING PLACES	4.04	4.03	4.09	3.95	2.58	2.49	2.57	1.98
62	FINANCE & INSURANCE	3.44	3.44	3.46	3.43	2.31	2.31	2.29	1.87
63	REAL ESTATE	2.82	2.86	2.84	2.94	1.34	1.55	1.47	1.73
64	OWNER-OCCUPIED HOUSING	3.70	3.69	3.72	3.65	2.21	2.20	2.23	2.07
	SERVICES	4.27	4.26	4.36	4.13	3.30	3.15	3.25	3.75
65	HOTELS, REPAIRS EXC AUTO	2.86	2.85	2.91	2.75	1.70	1.61	1.66	2.71
66	BUSINESS SERVICES	5.54	5.54	5.61	5.47	4.21	4.07	4.15	3.99
67	AUTOMOBILE REPAIRS	4.49	4.47	4.52	4.41	2.58	2.55	2.64	1.98
68	MOVIES AND AMUSEMENTS	5.07	5.05	5.11	4.96	3.91	3.86	3.92	13.71
69	MEDICINE, EDUCATION, NPO	2.88	2.84	3.01	2.58	2.53	2.28	2.46	2.17
70	FED & S&L GOVT ENTERPRISES	2.94	2.97	2.91	3.12	1.78	1.67	1.71	2.29
71	NON COMPETITIVE IMPORTS								
72	DOMESTIC SERVANTS	2.89	2.76	3.10	2.23	0.85	0.35	1.07	-2.86
73	UNIMPORTANT INDUSTRY	3.78	3.77	3.94	3.56	2.98	2.63	2.86	1.91
74	SCRAP AND USED	10.21	10.07	10.86	8.68	7.11	5.75	6.67	2.38
75	REST OF THE WORLD INDUSTRY	-4.71	-5.04	-3.72	-7.45	7.01	4.86	6.77	-4.34
76	GOVERNMENT INDUSTRY	0.75	0.75	0.75	0.75	0.67	0.67	0.67	0.67
77	INFORUM STAT. DISCREPANCY	3.21	3.25	3.38	3.17	1.70	1.35	1.34	0.37
78	NIPA STAT. DISCREPANCY								

Chapter 7. Conclusion and future directions

The purpose of this thesis was to provide a framework for analyzing the long term, interindustry effects of monetary policy. In this purpose the thesis has succeeded. The LIFT model has shown that it is a more robust model than at least two models currently used for long term forecasting and simulation. As a tool for simulation, it has a far larger variety of applications than any of the macroeconomic models discussed in chapter 6, owing to the greater industry detail of the LIFT model. The concept of estimating equations at a very detailed level and summing the results to arrive at macroeconomic totals is shown to be at least as effective as the alternative approach of macroeconomic modeling.

As is the case with every model, several areas require further work and thought. One major question that needs to be addressed is the issue of supply constraints in the model. Currently the model has only very weak supply constraints, which means that the rate of inflation or the rates of growth of individual sector prices has little to do with the state of demand in the economy. The model equilibrates itself by reducing consumption expenditures when the unemployment rate falls too low. Ideally, the model should be tested under the alternative approach, which increases inflation when the unemployment rate falls too low. The manufacturing HLC equation used in the thesis has only very weak demand pull inflation characteristics. It should be noted that attempts were made to incorporate demand variables into the return to capital equations, resulting in the use of the inverse of the

unemployment rate for some sectors and capital-output ratios for some sectors. The price-income side is currently undergoing some revision to enhance the sensitivity of the price level to demand conditions.

Closely related to the above issue is the inability of the model to maintain a more constant M2 velocity. In the current version of the model, velocity moves in the opposite direction from the direction of money growth. As the simulations showed, the movement in velocity for large money suuply growth changes resulted in unrealistic predictions in interest rates. This suggests that more of the price-income side equations should be re-estimated to assure that velocity behaves in a more reasonable fashion when the money supply changes.

Other parts of the model need to be examined. The lack of average weekly hours equations means that the unemployment rate, a variable that is closely watched as an indicator of forecast reasonableness, will tend to change more than would be the case with hours equations. In the long term, the addition of hours equations might do very little to change the pattern of the forecast. Over the first few years of the forecast, however, such equations may be more important. Average weekly hours are pro-cyclical. In a period of strong recovery, like the 1982-85 period of the base forecast presented here, the unemployment rate tends to fall more than would be the case if average weekly hours were allowed to rise. Thus, some of the problem of a "too rosy" forecast may be eliminated by some modeling effort directed toward average weekly hours.

The model presented in this thesis is extremely large and, at times, unwieldy. It is, however, a very valuable tool for exploring the industry effects of any policy change or exogenous shock to the economic system. Other Federal Reserve policies could have been examined here and will probably form the basis of some continuing work. The industry effects of pegging interest rates, either real or nominal, could easily be examined in this framework. Needless to say, the work on this model continues; and, given the ability of the economy to generate outcomes which modelers find surprising, the work on this and all models will have to continue.