DOE/EIA-M065(2004)

MODEL DOCUMENTATION REPORT: MACROECONOMIC ACTIVITY MODULE (MAM) OF THE NATIONAL ENERGY MODELING SYSTEM

February 2004

Office of Integrated Analysis and Forecasting
Energy Information Administration
U.S. Department of Energy
Washington, DC

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Appendix A: Structural Models Underlying MAM

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Purpose of This Report

The National Energy Modeling System (NEMS) is a comprehensive mid-term energy forecasting and policy analysis tool used by EIA. NEMS projects energy supply, demand, prices, and environmental emissions, by region, given assumptions about the state of the economy, international markets, and energy policies. The Macroeconomic Activity Module (MAM) links NEMS to the rest of the economy by providing projections of economic driver variables for use by the supply, demand, and conversion modules of NEMS. The derivation of the baseline macroeconomic forecast lays a foundation for the determination of the energy demand and supply forecast. MAM is used to present alternative macroeconomic growth cases to provide a range of uncertainty about the growth potential for the economy and its like consequences for the energy system. MAM is also able to address the macroeconomic impacts associated with changing energy market conditions, such as alternative world oil price assumptions. Outside of the AEO setting, MAM represents a system of linked modules which assess the potential impacts on the economy of changes in energy events or policy proposals specified by a non-EIA requestor. These economic impacts then feed back into NEMS for an integrated solution.

This report documents the objectives and analytical approach of the Macroeconomic Activity Module (MAM) used to develop the Annual Energy Outlook for 2004(AEO2004). It serves as a reference document providing a description of the MAM used for the AEO2004 production runs for model analysts, users, and the public. It also facilitates continuity in model development by providing documentation from which energy analysts can undertake model enhancement and modifications. This documentation report is divided into two separate components.

Part A presents the structural models comprising MAM. These include:

- Global Insight Model of the U.S. Economy
- Global Insight Industry Model
- Global Insight Employment Model
- Global Insight Regional Model
- Energy Information Administration Commercial Floorspace Model

Part B focuses on the MAM interface with NEMS. This section identifies the set of model levers and simulation rules used to operate the system, and provides a discussion of four types of integrated simulations carried out with NEMS. This section also views MAM from the perspective of a programmer, and focuses on the ties which link the various models together to form MAM, and how MAM communicates with NEMS.

Appendices A and B provide detailed information on variable listings and sectoral definitions.

Part A
STRUCTURAL MODELS COMPRISING MAM

1. Modeling System Overview

Economy activity driving the National Energy Modeling System (NEMS) is determined by an Economic Modeling System comprised of five models:

- Global Insight Model of the U.S. Economy
- Global Insight Industry Model
- Global Insight Employment Model
- Global Insight Regional Model
- Energy Information Administration (EIA) Commercial Floorspace Model

The Global Insight Model of the U.S. Economy (Macroeconomic Model) is the same model used by Global Insight Inc. to generate the economic forecasts behind the company's monthly assessment of the U.S. economy. The Industry, Employment, and Regional Models are derivatives of Global Insight's industry, employment, and regional models. The models have been tailored in order to provide the industry and regional detail required by the NEMS modeling system. The Commercial Floorspace Model was developed by EIA to complement the set of Global Insight Models.

This system of models provides a fully integrated approach to forecasting economic activity at the national, industry and regional levels. The modeling system is designed to provide a consistent set of macroeconomic and industry and regional forecasts. Global Insight's Macroeconomic Model determines the national economy's growth path and final demand mix. The Industry Model insures that supply by industry is consistent with the final demands (consumption, investment, government spending, exports and imports) generated in the Macroeconomic Model. Industry output is the key driver of employment by industry in the Employment Model. The employment forecasts also incorporate the aggregate hours per week and productivity trends established in the Macroeconomic Model, providing industry employment forecasts that are in line with the aggregate employment forecast generated in the Macroeconomic Model. National output forecasts by industry from the Industry Model, employment forecasts by industry from the Employment Model, and population, national income and housing activity forecasts from the Macroeconomic Model are the key inputs to the Regional Model. The Regional Model determines the level of industry output and employment, population, incomes, and housing activity in each of nine Census regions. The sum of each of these concepts across the nine regions is constrained to sum to the national totals projected by the supporting models.

Global Insight Model of the U.S. Economy

Key Inputs: National demographics by age cohort, federal tax rates and expenditures, money supply, prices and quantities of energy demand and supply, GDP of major trading partners.
Key Outputs: Final demands (consumption, investment, government purchases, exports, imports), inflation, exchange and interest rates, incomes, employment, Federal and state/local government budgets.

Global Insight Industry Model

Key Inputs: Final demands, prices from the Global Insight Model of the U.S. Economy and input-output coefficient matrix.
Key Outputs: Industry output (real and nominal) and prices for 160 industry sectors and aggregates.

Global Insight Employment Model

Key Inputs: Industry outputs and prices from the Industry Model, industry wage costs from the Global Insight Cost Forecasting Service, capital service cost determinants, productivity measures and total employment from the Global Insight Model of the U.S. Economy.
Key Outputs: Industry employment for 45 industry sectors.

Global Insight Regional Model

Key Inputs: National industry output, prices and employment from the Industry and Employment Models. National wages, incomes, population, housing activity, and prices from the Global Insight Quarterly Model of the U.S. Economy.
Key Outputs: Regional output and employment for 45 industries. Regional wages and salaries, farm income, personal income, disposable income, population, housing activity.

Energy Information Administration Commercial Floorspace Model

Key Inputs: Interest rates, real disposable income per capita and population.
Key Outputs: Commercial floorspace in million square feet for 13 commercial floorspace types in each of 9 Census Divisions

Each of these models is discussed below, with further detail presented in the Appendixes to this documentation.

2. Global Insight Model of the U.S. Economy

The Model's Theoretical Position

Econometric models built in the 1950s and 1960s were largely Keynesian income-expenditure systems that assumed a closed domestic economy. High computation costs during estimation and manipulation, along with the underdeveloped state of macroeconomic theory, limited the size of the models and the richness of the linkages of spending to financial conditions, inflation, and international developments. Since that time, however, computer costs have fallen spectacularly; theory has also benefited from five decades of postwar data observation and from the intellectual attention of many eminent economists.

An Econometric Dynamic Equilibrium Growth Model: The Global Insight Macroeconomic Model strives to incorporate the best insights of many theoretical approaches to the business cycle: Keynesian, neoclassical, monetarist, supply-side, and rational expectations. In addition, the Global Insight Macroeconomic Model embodies the major properties of the *long-term* growth models presented by James Tobin, Robert Solow, Edmund Phelps, and others. This structure guarantees that short-run cyclical developments will converge to robust long-run equilibria.

In growth models, the expansion rate of technical progress, the labor force, and the capital stock determine the productive potential of an economy. Both technical progress and the capital stock are governed by investment, which in turn must be in balance with post-tax capital costs, available savings, and the capacity requirements of current spending. As a result, monetary and fiscal policies will influence both the short- and the long-term characteristics of such an economy through their impacts on national saving and investment.

A modern model of output, prices, and financial conditions is melded with the growth model to present the detailed, short-run dynamics of the economy. In specific goods markets, the interactions of a set of supply and demand relations jointly determine spending, production, and price levels. Typically, the level of inflation-adjusted demand is driven by prices, income, wealth, expectations, and financial conditions. The capacity to supply goods and services is keyed to a production function combining the basic inputs of labor hours, energy usage, and the capital stocks of business equipment and structures, and government infrastructure. The "total factor productivity" of this composite of tangible inputs is driven by expenditures on research and development that produce technological progress.

Prices adjust in response to gaps between current production and supply potential and to changes in the cost of inputs. Wages adjust to labor supply-demand gaps (indicated by a demographically-adjusted unemployment rate), current and expected inflation (with a unit long-run elasticity), productivity, tax rates, and minimum wage legislation. The supply of labor positively responds to the perceived availability of jobs, to the after-tax wage level, and to the

growth and age-sex mix of the population. Demand for labor is keyed to the level of output in the economy and the productivity of labor, capital, and energy. Because the capital stock is largely fixed in the short run, a higher level of output requires more employment and energy inputs. Such increases are not necessarily equal to the percentage increase in output because of the improved efficiencies typically achieved during an upturn. Tempering the whole process of wage and price determination is the exchange rate; a rise signals prospective losses of jobs and markets unless costs and prices are reduced.

For financial markets, the model predicts exchange rates, interest rates, stock prices, loans, and investments interactively with the preceding GDP and inflation variables. The Federal Reserve sets the supply of reserves in the banking system and the fractional reserve requirements for deposits. Private sector demands to hold deposits are driven by national income, expected inflation, and by the deposit interest yield relative to the yields offered on alternative investments. Banks and other thrift institutions, in turn, set deposit yields based on the market yields of their investment opportunities with comparable maturities and on the intensity of their need to expand reserves to meet legal requirements. In other words, the contrast between the supply and demand for reserves sets the critical short-term interest rate for interbank transactions, the federal funds rate. Other interest rates are keyed to this rate, plus expected inflation, Treasury borrowing requirements, and sectoral credit demand intensities.

The old tradition in macroeconomic model simulations of exogenous fiscal policy changes was to hold the Federal Reserve's supply of reserves constant at baseline levels. While this approach makes static analysis easier in the classroom, it sometimes creates unrealistic policy analyses when a dynamic model is appropriate. In the Global Insight Macroeconomic Model, "monetary policy" is defined by a set of targets, instruments, and regular behavioral linkages between targets and instruments. The model user can choose to define unchanged monetary policy as unchanged reserves, or as an unchanged reaction function in which interest rates or reserves are changed in response to changes in such policy concerns as the price level and the unemployment rate.

Monetarist Aspects: The model pays due attention to valid lessons of monetarism by carefully representing the diverse portfolio aspects of money demand and by capturing the central bank's role in long-term inflationary trends.

The private sector may demand money balances as one portfolio choice among transactions media (currency, checkable deposits), investment media (bonds, stocks, short-term securities), and durable assets (homes, cars, equipment, structures). Given this range of choices, each asset's implicit and explicit yield must therefore match expected inflation, offset perceived risk, and respond to the scarcity of real savings. Money balances provide benefits by facilitating spending transactions and can be expected to rise nearly proportionately with transactions requirements unless the yield of an alternative asset changes.

Now that even demand deposit yields can float to a limited extent in response to changes in Treasury bill rates, money demand no longer shifts quite as sharply when market rates change. Nevertheless, the velocity of circulation (the ratio of nominal spending to money demand) is still far from stable during a cycle of monetary expansion or contraction. Thus the simple monetarist link from money growth to price inflation or nominal spending is therefore considered invalid as a rigid short-run proposition.

Equally important, as long-run growth models demonstrate, induced changes in capital formation can also invalidate a naive long-run identity between monetary growth and price increases. Greater demand for physical capital investment can enhance the economy's supply potential in the event of more rapid money creation or new fiscal policies. If simultaneous, countervailing influences deny an expansion of the economy's real potential, the model *will* translate all money growth into a proportionate increase in prices rather than in physical output.

"**Supply-Side" Economics:** Since 1980, "supply-side" political economists have pointed out that the economy's growth potential is sensitive to the policy environment. They focused on potential labor supply, capital spending, and savings impacts of tax rate changes. The Global Insight Macroeconomic Model embodies supply-side hypotheses to the extent supportable by available data, and this is considerable in the many areas that supply-side hypotheses share with long-run growth models. These features, however, have been fundamental ingredients of the model since 1976.

Rational Expectations: As the rational expectations school has pointed out, much of economic decision-making is forward looking. For example, the decision to buy a car or a home is not only a question of current affordability but also one of timing. The delay of a purchase until interest rates or prices decline has become particularly common since the mid-1970s when both inflation and interest rates were very high and volatile. Consumer sentiment surveys, such as those conducted by the University of Michigan Survey Research Center, clearly confirm this speculative element in spending behavior.

However, households can be shown to base their expectations, to a large extent, on their past experiences: they believe that the best guide to the future is an extrapolation of recent economic conditions and the changes in those conditions. Consumer sentiment about whether this is a "good time to buy" can therefore be successfully modeled as a function of recent levels and changes in employment, interest rates, inflation, and inflation expectations. Similarly, inflation expectations (influencing financial conditions) and market strength expectations (influencing inventory and capital spending decisions) can be modeled as functions of recent rates of increase in prices and spending.

This largely retrospective approach is not, of course, wholly satisfactory to pure adherents of the rational expectations doctrine. In particular, this group argues that the announcement of macroeconomic policy changes would significantly influence expectations of inflation or growth prior to any realized change in prices or spending. If an increase in government expenditures is

announced, the argument goes, expectations of higher taxes to finance the spending might lead to lower consumer or business spending in spite of temporarily higher incomes from the initial government spending stimulus. A rational expectations theorist would thus argue that multiplier effects will tend to be smaller and more short-lived than a mainstream economist would expect.

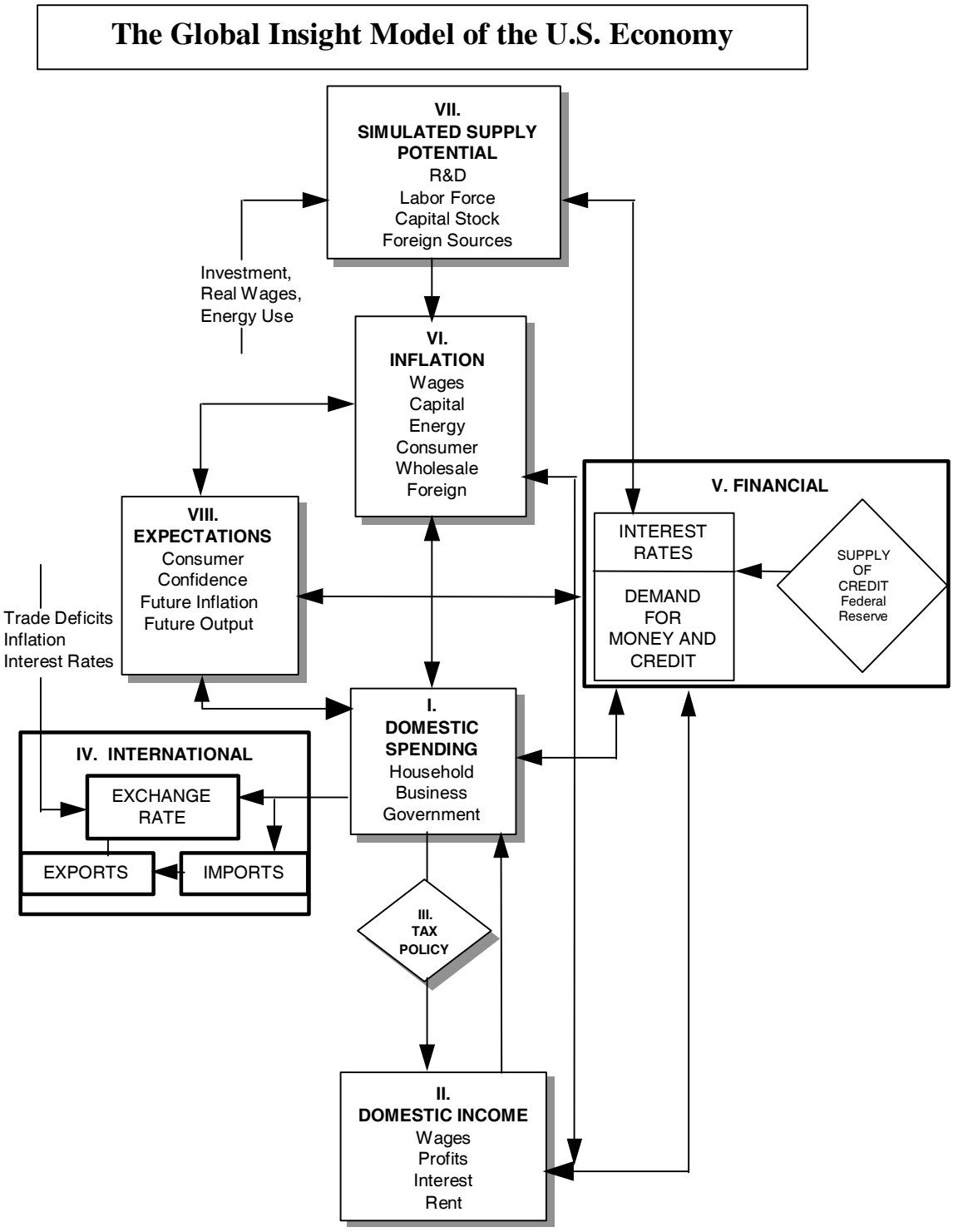
These propositions are subject to empirical evaluation. Global Insight's conclusions are that expectations do play a significant role in private sector spending and investment decisions; but, until change has occurred in the economy, there is very little room for significant changes in expectations in advance of an actual change in the variable about which the expectation is formed. The rational expectations school thus correctly emphasizes a previously understated element of decision-making, but exaggerates its significance for economic policy-making and model building.

The Global Insight Macroeconomic Model allows a choice in this matter. On the one hand, the user can simply accept Global Insight's judgments and let the model translate policy initiatives into initial changes in the economy, simultaneous or delayed changes in expectations, and subsequent changes in the economy. On the other hand, the user can manipulate the clearly identified expectations variables in the model, i.e., consumer sentiment, and inflation expectations. For example, if the user believes that fear of higher taxes would subdue spending, the user could reduce the consumer sentiment index.

Theory As a Constraint: The conceptual basis of each equation in the Global Insight Macroeconomic Model was thoroughly worked out before the regression analysis was initiated. The list of explanatory variables includes a carefully selected set of demographic and financial inputs. Each estimated coefficient was then thoroughly tested to be certain that it meets the tests of modern theory and business practice. This attention to equation specification and coefficient results has eliminated the “short circuits" that can occur in evaluating a derivative risk or an alternative policy scenario. Because each equation will stand up to a thorough inspection, the Global Insight Model is a reliable analytical tool and can be used without excessive iterations. The model is not a black box: it functions like a personal computer spreadsheet in which each interactive cell has a carefully computed, theoretically-consistent entry and thus performs logical computations simultaneously.

Major Sectors

The Global Insight Macroeconomic Model captures the full simultaneity of the U.S. economy, forecasting over 1600 concepts spanning final demands, aggregate supply, prices, incomes, international trade, industrial detail, interest rates, and financial flows. The chart below summarizes the structure of the eight interactive sectors (in Roman numerals). The following discussion presents the logic of each sector and significant interactions with other sectors.


The Global Insight Model of the U.S. Economy
VII.
SIMULATED SUPPLY
POTENTIAL
R&D
Labor Force
Capital Stock
Foreign Sources
Investment,
Real Wages,
Energy Use
VI.
INFLATION
Wages
Capital
Energy
Consumer
Wholesale
Foreign
V. FINANCIAL
INTEREST
RATES
DEMAND
FOR
MONEY AND
CREDIT
SUPPLY
OF
CREDIT
Federal
Reserve
VIII.
EXPECTATIONS
Consumer
Confidence
Future Inflation
Future Output
Trade Deficits
Inflation
Interest Rates
I.
DOMESTIC
SPENDING
Household
Business
Government
IV. INTERNATIONAL
EXCHANGE
RATE
EXPORTS
IMPORTS
III.
TAX
POLICY
II.
DOMESTIC INCOME
Wages
Profits
Interest
Rent

Spending - Consumer: The domestic spending (I), income (II), and tax policy (III) sectors model the central circular flow of behavior as measured by the national income and product accounts. If the rest of the model were "frozen," these blocks would produce a Keynesian system similar to the models pioneered by Tinbergen and Klein, except that neoclassical price factors have been imbedded in the investment and other primary demand equations.

Consumer spending on durable goods is divided into nine categories: light vehicles; used automobiles; motor-vehicle parts; other vehicles; computers; software; other household equipment and furnishings; ophthalmic and orthopedic products, and "other." Spending on nondurable goods is divided into nine categories: three food categories; clothing and shoes; gasoline and oil; fuel oil and coal; tobacco; drugs; and "other." Spending on services is divided into sixteen categories: housing; six household operation subcategories; four transportation categories; medical; recreation; two personal business service categories; and "other." (See Table A1.) In nearly all cases, real consumption expenditures are motivated by real income and the user price of a particular category relative to the prices of other consumer goods. Durable and semidurable goods are also especially sensitive to current financing costs, and consumer speculation on whether it is a "good time to buy." The University of Michigan Survey of Consumer Sentiment monitors this last influence, with the index itself modeled as a function of current and lagged values of inflation, unemployment, and the prime rate.

Spending - Business Investment: Business spending includes nine fixed investment categories for equipment and seven for construction: four information processing equipment categories; industrial equipment; three transportation equipment categories; other producers' durable equipment; four building categories; mines and wells; and two public utility structures. (See Table A2.) Equipment and business (non-utility, non-mining) structures spending components are determined by their specific effective post-tax capital costs, capacity utilization, and replacement needs. The cost terms are sophisticated blends of post-tax debt and equity financing costs (offset by expected capital gains) and the purchase price of the investment good (offset by possible tax credits and depreciation-related tax benefits). This updates the well-known work of Dale Jorgenson, Robert Hall, and Charles Bischoff.

Given any cost/financing environment, the need to expand capacity is monitored by recent growth in national goods output weighted by the capital intensity of such production. Public utility structure expenditures are motivated by similar concepts except that the output terms are restricted to utility output rather than total national goods output. Net investment in mining and petroleum structures responds to movements in real domestic oil prices and to oil and natural gas production.

Inventory demand is the most erratic component of GDP, reflecting the pro-cyclical, speculative nature of private sector accumulation during booms and decumulation during downturns. The forces that drive the five nonfarm inventory categories are changes in spending, short-term interest rates and expected inflation, surges in imports, and changes in capacity utilization or the speed of vendor deliveries. Unexpected increases in demand lead to an immediate drawdown of

stocks and then a rebuilding process over the next year; the reverse naturally holds for sudden reductions in final demand. Inventory demands are sensitive to the cost of holding the stock, measured by such terms as interest costs adjusted for expected price increases and by variables monitoring the presence of bottlenecks. The cost of a bottleneck that slows delivery times is lost sales: an inventory spiral can therefore be set in motion when all firms accelerate their accumulation during a period of strong growth but then try to deplete excessive inventories when the peak is past.

Spending - Residential Investment: The residential investment sector of the model includes two housing starts (single and multi-family starts) and three housing sales categories (new and existing single family sales, and new single family units for sale). Housing starts and sales, in turn, drive investment demand in six GDP account categories: single family housing; multi-family housing; manufactured homes; improvements; other residential structure; and residential equipment. (See Table A3.)

Residential construction is typically the first sector to contract in a recession and the first to rebound in a recovery. Moreover, the magnitude of the building cycle is often the key to that of the subsequent macroeconomic cycle. The housing sector of the Global Insight Macroeconomic Model explains new construction as a decision primarily based on the after-tax cost of home ownership relative to disposable income. This cost is estimated as the product of the average new home price adjusted for changes in quality, and the mortgage rate, plus operating costs, property taxes, and an amortized down payment. “Lever variables" allow the model user to specify the extent to which mortgage interest payments, property taxes, and depreciation allowances (for rental properties) produce tax deductions that reduce the effective cost.

The equations also include a careful specification of demographic forces. After estimating the changes in the propensity for specific age-sex groups to form independent households, the resulting “headship rates" were multiplied by corresponding population statistics to estimate the trend expansion of single- and multi-family households. The housing equations were then specified to explain current starts relative to the increase in trend households over the past year, plus pent-up demand and replacement needs. The basic phenomenon being scrutinized is therefore the proportion of the trend expansion in households whose housing needs are met by current construction. The primary determinants of this proportion are housing affordability, consumer confidence, and the weather. Actual construction spending in the GDP accounts is the value of construction “put-in-place" in each period after the start of construction (with a lag of up to six quarters in the case of multi-family units), plus residential improvements, and brokerage fees.

Spending - Government: The last sector of domestic demand for goods and services, that of the government, is largely exogenous (user-determined) at the federal level and endogenous (equation-determined) at the state and local level. The user sets the real level of federal nondefense and defense purchases (for compensation, consumption of fixed capital, Commodity Credit Corporation inventory change, other consumption, and gross investment), medical and

non-medical transfer payments, and medical and non-medical grants to state and local governments. The model calculates the nominal values through multiplication by the relevant estimated prices. Transfers to foreigners, wage accruals, and subsidies (agricultural, housing, and other) are also specified by the user, but in nominal dollars. One category of federal government spending – net interest payments – is determined within the model because of its dependence on the model's financial and tax sectors. Net federal interest payments are determined by the level of privately-held federal debt, short and long-term interest rates, and the maturity of the debt. (See Table A4.)

The presence of a large and growing deficit imposes no constraint on federal spending. This contrasts sharply with the state and local sector where legal requirements for balanced budgets mean that declining surpluses or emerging deficits produce both tax increases and reductions in spending growth. State and local purchases (for compensation, consumption of fixed capital, other consumption, and construction) are also driven by the level of federal grants (due to the matching requirements of many programs), population growth, and trend increases in personal income. (See Table A5.)

Income: Domestic spending, adjusted for trade flows, defines the economy's value-added or gross national product (GNP) and gross domestic product (GDP). Because all value-added must accrue to some sector of the economy, the expenditure measure of GNP (GDP plus net exports of factor services) also determines the nation's gross income. The distribution of income among households, business, and government is determined in sectors II and III of the model.

Pre-tax income categories include private and government wages, corporate profits, interest, rent, and entrepreneurial returns. Each pre-tax income category except corporate profits is determined by some combination of wages, prices, interest rates, debt levels, and capacity utilization or unemployment rates. In some cases such as wage income, these are identities based on previously calculated wage rates, employment, and hours per week.

Profits are logically the most volatile component of GNP on the income side. When national spending changes rapidly, the contractual arrangements for labor, borrowed funds, and energy imply that the return to equity holders is a residual that will soar in a boom and collapse in a recession. The model reflects this by calculating wage, interest and rental income as thoroughly reliable near-identities (e.g., wages equal average earnings multiplied by hours worked) and then subtracting each non-profit item from national income to solve for profits. (See Tables A6 and A7.)

Taxes: Since post-tax rather than pre-tax incomes drive expenditures, each income category must be taxed at an appropriate rate; the model therefore tracks personal, corporate, payroll, and excise taxes separately. Users may set federal tax rates; tax revenues are then simultaneously forecast as the product of the rate and the associated pre-tax income components. However, the model automatically adjusts the effective average personal tax rate for variations in inflation and income per household, and the effective average corporate rate for credits earned on equipment,

utility structures, and R&D. Substitutions or additions of "flat" taxes and value-added taxes for existing taxes are accomplished with specific tax rates and new definitions of tax bases. As appropriate, these are aggregated into personal, corporate or excise tax totals.

State and local corporate profits and social insurance (payroll) tax rates are exogenous in the model, while personal income and excise taxes are fully endogenous: the Macroeconomic Model makes reasonable adjustments automatically to press the sector toward the legally-required approximate budget balance. The average personal tax rate rises with income and falls with the government operating surplus. Property and sales taxes provide the bulk of state excise revenue and reflect changes in oil and natural gas production, gasoline purchases, and retail sales, as well as revenue requirements. The feedback from expenditures to taxes and taxes to expenditures works quite well in reproducing both the secular growth of the state and local sector and its cyclical volatility. (See Table A8.)

International: The international sector (IV) is a critical, fully simultaneous block that can either add or divert strength from the central circular flow of domestic income and spending. Depending on the prices of foreign output, the U.S. exchange rate, and competing domestic prices, imports capture varying shares of domestic demand.

Depending on similar variables and the level of world gross domestic product, exports can add to domestic spending on U.S. production. The exchange rate itself responds to international differences in inflation, interest rates, trade deficits, and capital flows between the U.S. and its competitors. In preparing forecasts, Global Insight's U.S. Economic Service and the World Service collaborate in determining internally consistent trade prices and volumes, interest rates, and financial flows.

Eight categories of goods and one services category are separately modeled for both imports and exports, with one additional goods category for oil imports. (See Table A9.) For example, export and import detail for business machines is included as a natural counterpart to the inclusion of the office equipment component of producers' durable equipment spending. The business machines detail allows more accurate analysis because computers are rapidly declining in effective quality-adjusted prices relative to all other goods, and because such equipment is rising so rapidly in prominence as businesses push ahead with new production and information processing technologies.

Investment income flows are also explicitly modeled. The stream of huge current account deficits incurred by the U.S. has important implications for the U.S. investment income balance. As current account deficits accumulate, the U.S. net international investment position and the U.S. investment income balance deteriorate. U.S. foreign assets and liabilities are therefore included in the model, with the current account deficit determining the path of the net investment position.

The reactions of overseas prices, interest rates and GDP to U.S. development are robust and

automatic. In the case of a dollar depreciation, for example, U.S. activity may expand at the expense of foreign activity and U.S. inflation may rise while the rate in other countries slows.

Financial: The use of a detailed financial sector (V) and of interest rate and wealth effects in the spending equations recognizes the importance of credit conditions on the business cycle and on the long-run growth prospects for the economy.

Interest rates, the key output of this sector, are modeled as a term structure, pivoting off the federal funds rate. As noted earlier, the model gives the user the flexibility of using the supply of reserves as the key monetary policy instrument, reflecting the Federal Reserve's open market purchases or sales of Treasury securities, or using a reaction function as the policy instruction. If the supply of reserves is chosen as the policy instrument, the federal funds rate depends upon the balance between the demand and supply of reserves to the banking system. Banks and other thrift institutions demand reserves to meet the reserve requirements on their deposits and the associated (exogenous) fractional reserve requirements. The private sector in turn demands deposits of various types, depending on current yields, income, and expected inflation.

If the reaction function is chosen as the monetary policy instrument, the federal funds rate is determined in response to changes in such policy concerns as inflation and unemployment. The reaction function recognizes that monetary policy seeks to stabilize prices (or to sustain a low inflation rate) and to keep the unemployment rate as close to the natural rate as is consistent with the price objective. A scenario designed to display the impact of a fiscal policy change in the context of “unchanged” monetary policy is arguably more realistic when “unchanged” or traditional reactions to economic cycles are recognized, than when the supply of reserves is left unchanged.

Longer-term interest rates are driven by shorter-term rates as well as factors affecting the slope of the yield curve. In the Global Insight Macroeconomic Model, such factors include inflation expectations, government borrowing requirements, and corporate financing needs. The expected real rate of return varies over time and across the spectrum of maturities. An important goal of the financial sector is to capture both the persistent elements of the term structure and to interpret changes in this structure. Twenty-four interest rates are covered in order to meet client needs regarding investment and financial allocation strategies. (See Table A10.)

Inflation: Inflation (VI) is modeled as a carefully-controlled, interactive process involving wages, prices, and market conditions. Equations embodying a near accelerationist point of view produce substantial secondary inflation effects from any initial impetus such as a change in wage demands or a rise in foreign oil prices. Unless the Federal Reserve expands the supply of credit, real liquidity is reduced by any such shock; given the real-financial interactions described above, this can significantly reduce growth. The process also works in reverse: a spending shock can significantly change wage-price prospects and then have important secondary impacts on financial conditions. Inspection of the simulation properties of the Global Insight Macroeconomic Model, including full interaction among real demands, inflation and financial

conditions, confirms that the model has moved toward central positions in the controversy between fiscalists and monetarists, and in the debates among neoclassicists, institutionalists, and "rational expectationists."

The principal domestic cost influences are labor compensation, nonfarm productivity (output per hour), and foreign input costs; the latter are driven by the exchange rate, the price of oil, and foreign wholesale price inflation. Excise taxes paid by the producer are an additional cost fully fed into the pricing decision. This set of cost influences drives *each* of the nineteen industry-specific producer price indexes, in combination with a demand pressure indicator and appropriately weighted composites of the other eighteen producer price indexes. In other words, the inflation rate of each industry price index is the reliably-weighted sum of the inflation rates of labor, energy, imported goods, and domestic intermediate goods, plus a variable markup reflecting the intensity of capacity utilization or the presence of bottlenecks. If the economy is in balance--with a unemployment rate near 5%, manufacturing capacity utilization steady near 80-85%, and foreign influences neutral--then prices will rise in line with costs and neither will show signs of acceleration or deceleration.

Supply: The first principle of the market economy is that prices and output are determined simultaneously by the factors underlying both demand and supply. As noted above, the "supply-siders" have not been neglected in the Global Insight Macroeconomic Model; indeed, substantial emphasis on this side of the economy (VII) was incorporated as early as 1976. In the Global Insight Macroeconomic Model, aggregate supply (or potential GDP excluding the energy sector) is estimated by a Cobb-Douglas production function that combines factor input growth and improvements in total factor productivity. Factor input equals a weighted average of labor, business fixed capital, public infrastructure, and energy provided by the energy sector. Based upon each factor's historical share of total input costs, the elasticity of potential output with respect to labor is 0.65 (i.e., a 1% increase in the labor supply increases potential GDP 0.65%); the business capital elasticity is 0.26; the infrastructure elasticity is 0.025; and the energy elasticity is 0.07. Factor supplies are defined by estimates of the full employment labor force, the full employment capital stock, end-use energy demand, and the stock of infrastructure. Total factor productivity depends upon the stock of research and development capital and trend technological change.

Taxation and other government policies influences labor supply and all investment decisions, thereby linking tax changes to changes in potential GDP. An expansion of potential first reduces prices and then credit costs, and thus spurs demand. Demand rises until it equilibrates with the potential output. Thus, the growth of aggregate supply is the fundamental constraint on the long-term growth of demand. Inflation, created by demand that exceeds potential GDP or by a supply-side shock or excise tax increase, raises credit costs and weakens consumer sentiment, thus putting the brakes on aggregate demand.

Expectations: The contributions to the Macroeconomic Model and its simulation properties of the rational expectations school are as rich as the data will support. Expectations (Sector VIII)

impact several expenditure categories in the Global Insight Macroeconomic Model, but the principal nuance relates to the entire spectrum of interest rates. Shifts in price expectations or the expected capital needs of the government are captured through price expectations and budget deficit terms, with the former impacting the level of rates throughout the maturity spectrum, and the latter impacting intermediate and long-term rates, and hence affecting the shape of the yield curve. On the expenditure side, inflationary expectations impact consumption via consumer sentiment, while growth expectations affect business investment.

3. Global Insight Industry Model

Overview

The Industry Model is a combination input–output/stochastic model of activity in 160 U.S. industries and industry aggregates. The model forecasts demand, real and nominal revenues, prices, productivity, average hourly earnings, and material costs for each U.S. industry. The output levels generated in the Industry Model reflect a level of domestic production that is consistent with the final demands generated in the Global Insight Macroeconomic Model. Table A11 identifies the final demand categories driving the Industry Model. Table A12 identifies the concept coverage of the model and the industry coverage of the model.

The industry detail follows the manufacturing industries reported by the Department of Commerce in its monthly Shipments, Orders, and Inventories release, basically a two-digit SIC aggregation with some dissaggregations beyond 2 digits for selected manufacturing sectors and a largely two-digit scheme for the nonmanufacturing industries.

The input–output block of the model translates macroeconomic forecasts from The Global Insight Macroeconomic Model into demand by industry. These I–O tables are used to calculate input cost by industry, prices by industry, and material costs. All other model concepts are projected by statistical equations and identities.

The model projections are at a quarterly frequency. Historical data supporting the model are, for the most part, monthly series released by various government agencies typically within two months of the observation. All data, unless otherwise specified, are seasonally adjusted at annual rates.

The Input/Output Block

Standard input–output analysis proceeds in two steps. First, the vector of economic expenditures from the macroeconomic model (the components of GDP) is converted into a vector of industrial deliveries to final demand. This conversion is represented for any time period as:

F = H * G
where:
F = vector of industrial deliveries to final demand
H = benchmark bridge matrix recording the industrial composition of each expenditure category
G = vector of real final expenditure components of GDP

A fixed bridge matrix, constructed from the 1992 input–output tables and workfiles, is used in this step. Once the final demand vector, F, has been calculated, standard input–output techniques

are used to derive estimates of the industrial output required to produce this bill of goods for final use. According to the basic input–output model, intermediate inputs, industrial deliveries to final demand, and gross output are related as follows:

A * X + F = X
where:
A = matrix of direct input coefficients describing the amount of each input industry's product required per unit of industry output.
X = vector of gross output by industry.

This equation can be considered an equilibrium condition that total demand equals total supply. The product A * X is equal to intermediate demand, and F is equal to final demand. The sum of the two is total demand, which, in equilibrium, is equal to total supply, or production.

Following standard input–output conventions, it is assumed that the technology of production as reflected by the matrix of direct input coefficients, A, remains relatively stable over time. In addition, production processes are assumed to be linear and exhibit constant returns to scale with no possibility for substitution among inputs. However, these restrictions apply for the calculation of demand by industry only — equations for actual shipments and production include factors that offset these restrictive assumptions statistically.

The basic input–output equation is then solved for output:

Inverse (I – A) * F = X

This equation describes the relationship between final demand and industrial output levels that would be required to deliver this bill of goods under the restrictive assumptions detailed above. The vector X should equal total demand and supply for each industry, in equilibrium.

Revenue / Output for Manufacturing Industries

Industry revenues are measured in billions of current and constant dollars and are available for each of the manufacturing industries in the model. The current–dollar historical series are quarterly averages of the Department of Commerce's value of shipments data from its monthly Shipments, Orders, and inventories release, which are then converted to annual rates. Constant–dollar historical values are the current–dollar series deflated using each industry's industry price index.

Constant–dollar revenue by industry is modeled as a function of total demand from the input–output analysis, cyclical variables, and a time trend. The functional form used imposes a unitary elasticity on the demand term, which embodies most of the explanatory power in the equations.

The additional, nondemand terms are included in the equation to explain the patterns not well accounted for by the input–output model and its demand indicators — cyclicality and technological change.

1. Macroeconomic variables feed down into the industry output equations through demand, but these weighted demand terms are in most cases smoother and less cyclical than industrial production indexes. Therefore, cyclical variables, such as capacity utilization, housing starts, or interest rates, are included in most equations. Cyclical variables were chosen with care to reflect the appropriate business cycle for each industry.

2. The use of constant 1992 input–output tables in the construction of total demand becomes less accurate the farther from the base year the estimates go. This is because shifts in relative prices for inputs, as well as other factor, can in the long run change the technological processes used to manufacture goods. To account for this slowly changing divergence between input–output coefficients and actual production processes, a simple time trend is used in many model equations that use input–output concepts.

LOG(GOOind_96/GOODind_96) = F(LOG(Cyclical variable), trend)
where:
GOOind_96 = constant–dollar revenue, industry ind
GOODind_96 = total input–output demand, industry ind
trend = time trend variable

Current–dollar forecasts are the constant dollar series inflated using industry price indexes.

GOOind = GOOind_96 * PGOOind /100
where:
GOOind = current–dollar revenue, industry ind
PGOOind = industry price index, industry ind

Revenue / Output for Nonmanufacturing Industries

For nonmanufacturing industries, revenue is the main activity indicator available, and historical data are derived from a number of different sources. The common criterion for the data, however, is that conceptually it should be as close as possible to the measure of value of production for the manufacturing industries — it always measures total gross output, rather than value added — and the current–dollar measure is roughly equivalent to revenue. The standard identity between current–dollar and constant–dollar output and the industry price index always holds.

Forecasts of nonmanufacturing revenue are calculated from equations of the same form as the manufacturing revenue equations:

LOG(GOOind_96/GOODind_96) = F(LOG(Cyclical variable), trend)
where:
GOOind_96 = revenue, nonmanufacturing industry ind
GOODind_96 = total input−output demand, industry ind
trend = time trend variable

Productivity

Productivity by industry is modeled with a simulation rule. The simulation rule changes each industry's productivity level in an alternative simulation from its baseline level in response to changes in nonfarm productivity generated in the corresponding alternative U.S. macroeconomic simulation.

RAOEMEind = RAOEMEindB * JQPCMHNF / JQPCMHNFB
where:
RAOEMEind = labor productivity, industry ind
RAOEMEindB = labor productivity in the baseline simulation, industry ind
JQPCMHNF = nonfarm productivity
JQPCMHNFB = nonfarm productivity in the baseline simulation

Average Hourly Earnings

Average hourly earnings are current−dollar hourly wages from the Bureau of Labor Statistics' monthly Employment and Earnings release. Average hourly earnings are projected for all two−digit manufacturing industries as well as some three−digit, and major industries in the nonmanufacturing area.

Average hourly earnings by industry is modeled with a simulation rule. The simulation rule changes each industry's hourly earnings in an alternative simulation from its baseline level in response to changes in the employment cost index generated in the corresponding alternative U.S. macroeconomic simulation.

WRHPind = WRHPindB * ECIWSP / ECIWSPB
where:
WRHPind = average hourly earnings, industry ind.
WRHPindB = average hourly earnings in the baseline simulation, industry ind.

ECIWSP = employment cost index
ECIWSPB = employment cost index in the baseline simulation

Industry Price Indexes

Industry price indexes are seasonally adjusted indexes that reflect changes in the prices charged for each industry's products. The manufacturing industry prices are constructed by Global Insight over history by aggregating commodity–based producer price indexes (from the Bureau of Labor Statistics' monthly release) to industry groupings and adjusting for seasonally. Nonmanufacturing industry prices come from various sources, but are constructed to be as similar as possible to the manufacturing price indexes in concept.

A key determinant of industry prices is industry cost trends. Material input prices are constructed using the input–output table of direct requirements – each industry's input price is a weighted average of output prices of all inputs used in its production process, using the I–O coefficients as the weights.

PMASind = Sum over i(A(i,ind) * PGOOi)
where:
PMASind = input price index, industry ind
A(i,ind) = coefficient of direct requirements, output of industry i used per unit of output of industry ind
PGOOi = industry price index, industry i

Industry price indexes are assumed to move in line with industry costs, subject to changes trends and cyclical factors. Hence industry prices relative to industry costs are modeled as a function of a time trend (to account for the fixed I–O table), capacity utilization, productivity, and other cyclical indicators.

LOG(PGOOind/PCOSind)
= F(LOG($PGOOind_{-1}$/$PCOSind_{-1}$, LOG(RAOEMEind/$RAOEMEind_{-1}$), cyclical indicators, trend)
where:
PGOOind = industry price index, industry ind
PCOSind = weighted cost term, derived from input price index, user cost of capital, and average hourly earnings, industry ind
$PGOOind_{-1}$ = PGOOind, lagged one quarter
$PCOSind_{-1}$ = PCOSind, lagged one quarter
RAOEMEind/$RAOEMEind_{-1}$ = labor productivity, industry ind, current quarter divided by prior quarter
cyclical indicator = shipments measure, industry ind
trend = time trend dummy variable

4. Global Insight Employment Model

Overview

The Employment Model determines employment in 49 industries and 11 industry aggregates (See Table A13), consistent with the projection nonfarm employment (EE) from the Macroeconomic Model. Industry output, relative factor prices, and productivity and average workweek trends are the key determinates of industry employment. Real outputs in the industries from the Industry Model are summed to the 49 sector levels of the Employment Model. National wage rates, capital service cost determinants, productivity trends and average workweek trends are determined in the Macroeconomic Model.

The basic behavioral equations in the Employment Model are the total manufacturing employment equation (EMEMFG) and unconstrained employment (XXX_EME) for each of the detailed industries. Employment is based upon production theory. Consistent with production theory, the key determinant of employment by industry is industry output. Both current and lagged output values enter in the employment specification, reflecting the tendency for hiring to lag output growth and layoffs to lag output declines. The labor-to-output ratio varies with changes in relative factor prices, productivity, the national average workweek, cyclical factors, and technological change. Relative factor prices are represented by wage rates, interest rates and equity prices. National productivity trends and industry-specific time trends are used to capture changes in the employment-to-output relationship due to technological advances. Change in the average length of the workweek also alters this relationship. Some industries' workweek tends to increase relative to the national average with declines in the cyclical unemployment rate and increases in manufacturing capacity utilization rates, as both factors cause the industries to increase their utilization of existing laborers.

Total Nonfarm, Private Nonfarm, and Government Employment

Projections for total nonfarm (EEA, or EE in the Macroeconomic Model) and government employment (EMEGGE) are established in the Macroeconomic Model. An alternative behavioral equation for government employment has been included in the model. This gives the model user the option of treating this variable as exogenous in the Employment Model and using the Macroeconomic Model projection, or using the Employment Model's projection. In the baseline projection provided to the DOE by Global Insight, the projections for government employment in the Macroeconomic Model and in the Employment Model are the same.

Private nonfarm employment (EEAPIO) is determined by substracting government employment from total nonfarm employment.

EEAPIO = EEA - EMEGGE

Manufacturing Employment

Changes in total manufacturing employment are directly proportional to current and lagged changes in manufacturing output and inversely proportional to increases in current and lagged manufacturing productivity and the average manufacturing workweek. Output is measured in 1996 dollars for all industries except one. Within the industrial machinery and equipment industry sector (SIC 35), rapid increases in computer technology in the last two decades have led to sharp declines in the industry's quality-adjusted price deflators. This in turn has resulted in steep increases in the industry's real dollar output measures. This makes the real output measure an inappropriate driver for the industrial machinery and equipment industry's employment demand. Consequently, nominal dollars rather than real dollars are use to drive employment requirements for the industrial machinery and equipment industry sector.

DLOG(EMEMFG * JQPCMHM * HPM) - DLOG(GOOMFG96 - GOO35_96 + GOO35) = 0.0007719970559 - 0.9619216159 * DLOG(@MOVAV(JQPCMHM(-1) * HPM(-1) , 15) / (JQPCMHM * HPM)) + 0.7910080362 * DLOG(@MOVAV((GOOMFG96(-1) - GOO35_96(-1) + GOO35(-1)) , 5) / (GOOMFG96 - GOO35_96 + GOO35))

Or alternatively,

EMEMFG = EMEMFG(-1) * EXP[(DLOG(GOOMFG96 - GOO35_96 + GOO35) - (JQPCMHM * HPM) + 0.0007719970559 - 0.9619216159 * DLOG(@MOVAV(JQPCMHM(-1) * HPM(-1) , 15) / (JQPCMHM * HPM)) + 0.7910080362 * DLOG(@MOVAV((GOOMFG96(-1) - GOO35_96(-1) + GOO35(-1)) , 5) / (GOOMFG96 - GOO35_96 + GOO35))]

where:
EMEMFG = manufacturing employment
GOOMFG96 = real dollar value of manufacturing output
GOO35_96 = real dollar value of industrial machinery and equipment (includes computers)
GOO35 = nominal dollar value of industrial machinery and equipment
JQPCMHM = productivity index for the manufacturing sector
HPM = average workweek in the manufacturing sector

Employment in each manufacturing industry is first estimated independent of total manufacturing employment. Unconstrained manufacturing industry employment (XXX_EMEind) is modeled as a function of current and lagged output, manufacturing productivity and average workweek, relative factor prices, and such cyclical variables as the unemployment rate and capacity utilization rates (with the sum of the elasticities on current and lagged equal to 1.0).

DLOG(XXX_EMEind / (GOOind_96 / (JQPCMHM * HPM))) = @COEF(1) + @COEF(2) * DLOG(@MOVAV(JQPCMHM(-1) * HPM(-1) , lags) / (JQPCMHM * HPM)) + @COEF(3) * DLOG(@MOVAV(GOO14_96(-1) , lags) / GOO14_96) + @COEF(4) * D(CYCLICAL VARIABLE) +@COEF(5)*D(RELATIVE FACTOR PRICES)

Unconstrained manufacturing employment (XXX_EMEMFG) is defined by summing unconstrained employment across the manufacturing industries.

XXX_EMEMFG = XXX_EME20 + XXX_EME21 + XXX_EME22 + XXX_EME23 + XXX_EME24 + XXX_EME25 + XXX_EME26 + XXX_EME27 + XXX_EME281A6 + XXX_EME28D + XXX_EME28OTH + XXX_EME29A + XXX_EME29B + XXX_EME30 + XXX_EME31 + XXX_EME32GLASS + XXX_EME32CEMENT + XXX_EME32OTH + XXX_EME33A + XXX_EME33B + XXX_EME33ALUM + XXX_EME33COTH + XXX_EME34 + XXX_EME35 + XXX_EME36 + XXX_EME37 + XXX_EME38 + XXX_EME39

The difference between the manufacturing employment total computed in the first step (EMEMFG) and this unconstrained total (XXX_EMEMFG) is defined as EMRESID. Employment in each manufacturing industry (EMEind) is set equal to its unconstrained employment plus a share of the EMRESID.

EMRESID = EMEMFG - XXX_EMEMFG

EMEind = XXX_EMEind + (XXX_EMEind / XXX_EMEMFG) * EMRESID

Nonmanufacturing Employment

Employment in each nonmanufacturing industry is modeled in a two-step process similar to that for manufacturing industry employment. That is, unconstrained nonmanufacturing industry employment (XXX_EMEind) is modeled as a function of current and lagged output, nonfarm productivity and average workweek, relative factor prices, and such cyclical variables as the unemployment rate and capacity utilization rates (with the sum of the elasticities on current and lagged equal to 1.0).

DLOG(XXX_EMEind / (GOOind_96 / (JQPCMHNF * HNF))) = @COEF(1) + @COEF(2) * DLOG(@MOVAV(JQPCMHNF(-1) * HNF(-1) , lags) / (JQPCMHNF * HNF)) + @COEF(3) * DLOG(@MOVAV(GOO14_96(-1) , lags) / GOO14_96) + @COEF(4) * D(CYCLICAL VARIABLE) +@COEF(5)*D(RELATIVE FACTOR PRICES)

where:
EMEind = nonmanufacturing employment, industry ind
GOOind96 = real dollar value of nonmanufacturing output, industry ind

JQPCMHNF = productivity index for the nonfarm sector
HNF = average workweek in the nonfarm sector

Unconstrained private nonfarm employment (XXX_EEAPIO) is defined by summing unconstrained nonmanufacturing employment by industry and total manufacturing employment.

XXX_EEAPIO = XXX_EME10 + XXX_EME12 + XXX_EME13 + XXX_EME14 + XXX_EMECON + XXX_EMETRN + XXX_EME48 + XXX_EME49A + XXX_EME49B + XXX_EME49C + XXX_EMEWST + XXX_EMERET + XXX_EMEFIR + XXX_EMESERX + XXX_EME75 + XXX_EME87 + EMEMFG

The difference between total private nonfarm employment and this unconstrained total (XXX_EEAPIO) is defined as EEAPRESID. Employment in each nonmanufacturing industry (EMEind) is set equal to its unconstrained employment plus a share of EEAPRESID.

EEAPRESID = EEAPIO - XXX_EEAPIO

EMEind = XXX_EMEind + EEAPRESID * (XXX_EMEind / (XXX_EEAPIO - EMEMFG))

Total nonfarm employment within the employment model (EEAIO) is defined as the sum of all industry employment. EEAIO should match the level of nonfarm employment derived in the Macroeconomic Model except for rounding errors.

EEAIO = EMEMIN + EMEMFG + EMECON + EMETRN + EME48 + EME49 + EMEWST + EMERET + EMEFIR + EMESER + EMEGGE

5. Global Insight Regional Model

Overview

Global Insight's Macroeconomic Model, the Industry Model, and the Employment Model determine the national economy's growth path and its national final demand, industry, employment, and income mix. Regions then compete with each other for available growth. The Regional Model forecasts over 100 concepts for each region. The principal indicators of sectoral economic activity are output and employment, which are modeled for 35 manufacturing and 12 non-manufacturing industries. Wage rates, production costs, consumer prices and major components of personal income are modeled, as well as home-building activity and population.

The Regional Model is solved for levels of activity in the nine Census regions: New England, Middle Atlantic, South Atlantic, East North Central, East South Central, West North Central, West South Central, Mountain and Pacific. The sum of regional economic activity is constrained to sum to the national totals projected by the Macroeconomic, Industry, and Employment Models.

The Regional Model is based on the premise of regional competition, rather than a simple allocation of national economic activity based on fixed relationships. Competition centers around factors influencing a firm's location decisions. The decision to move between regions is driven by:

1. proximity to markets and suppliers,
2. costs considerations such as wages, energy prices, housing prices and taxes,
3. quality of labor-education and degree of unionization,
4. climate, and
5. quality of life.

The Regional Model is an export base model. The principle underlying the export base structure is that regional growth is generated primarily when locally produced goods and services are sold to customers outside the region. The inflows of income produced by such inter-regional transactions will then generate a multiplier effect on the local economy. In contrast, intra-regional transactions only redistribute income. Industries that sell their products to markets outside the region constitute the export base. In the Regional Model, the export base is composed of manufacturing, mining, federal governments, and some portion of other service-related sectors.

Major Sectors

Output: The detailed national output forecasts projected by the Industry Model are aggregated into 29 manufacturing and 6 non-manufacturing industries. (See Table A14) The manufacturing sector is examined in detail because of its importance in each area's economic base. All of the industries are analyzed separately, in a pooled time-series cross-sectional framework. This technique makes possible the inclusion of a variety of cross-sectional concepts that could not be used in conventional time-series regression analyses. These include climate and attractiveness, which do not change over time, and other variables such as unionization, education, personal and business taxes, which change so rarely or so gradually that they are not distinguishable from a time trend in the absence of cross-sectional methods.

Each region's share of national output is determined based upon the region's relative advantage in three categories. The first category relates to the mix of activities within each region and the activities that each industry serves. A generated output variable is constructed for each industry i using input-output coefficients to weight the productions of the other industries in the region based upon their usage of industry i's output. This serves as an indicator of the relative growth that each industry can expect within each region simply on the basis of the region's industrial mix. Other economic activity indicators driving particular industry's location decisions include personal income, population, and housing starts.

Second, industry location is driven by relative costs of production. The model computes a cost index for each industry in each region. The index is a weighted average of regional wage rates (manufacturing or non-manufacturing), regional coal, oil, natural gas, electric utility and gas utility costs, capital costs, and material costs, with the weights reflecting the relative importance of each factor in each industry's factor mix. Firms' location decisions are influenced by this industry-specific cost measure in each region, relative to the cost in other U.S. regions.

Third, it is clear that a significant factor in many business and personal decisions is the underlying quality of life. The model looks at a general measure of attractiveness (the indicator used is the proportion of total employment dependent on tourism). Not all of these variables are significant in every industry or within every region, but in total they all have a substantial impact on the location of production.

Employment: The detailed employment forecasts projected by the Employment Model are aggregated into 20 manufacturing and 10 non-manufacturing industries. (See Table A15) Each region's share of Employment for each industry is typically determined by the region's share of national output in that industry. Regional manufacturing employment is also affected by relative manufacturing wage rates and the importance of wages in each industry's cost index, explaining variation in the employment-to-output ratios within any manufacturing industry by region.

Most non-manufacturing sectors, however, are principally driven by the local economy. For example, federal, state and local employment shares are largely determined by population shares. State and local government employment is further determined by tax revenues, which in turn is defined by disposable income. Finance, insurance, and real estate employment shares are dependent upon disposable income and construction activity. Transportation, communications, utilities and services employment shares are also dependent on the region's share of goods production.

Transportation, communications, and utilities, trade, finance, insurance, and real estate, and services are primarily driven by local needs, but each sector contains components that serve wider markets. International and national banking and insurance, many business services, and a wide variety of activities related to tourism, are all examples of economic-base elements within non-manufacturing. The proportion of each of these four sectors which is export-oriented has been estimated by means of a minimum-requirements test. For each sector, the proportion of total employment was calculated for every state and region, and the lowest proportion was used as an indicator of the amount of, for example, service employment which is "needed" by a region. Any employment above that proportion is treated as export-oriented, and is tied to demand in the rest of the region and the rest of the country.

Wages and Incomes: The largest component of personal income is wages and salaries; the model therefore focuses on wage rates, identifying separately hourly wages and average annual wages and salaries in manufacturing and in non-manufacturing. Average hourly manufacturing wage rates are forecast using a measure of national wages adjusted for each region's concentration of durable goods manufacturing. There is pressure for faster wage growth if total employment is growing faster than in the rest of the country, and employers are competing for scarcer labor. Non-manufacturing wages follow manufacturing and consumer price inflation.

Wages in the manufacturing and non-manufacturing sector are determined as the product of wage rates and total manufacturing and non-manufacturing employment. Finally, a constraining procedure is used to ensure that the total amount of wage and salary disbursements implied by the forecast wage rates is consistent with the national and regional forecasts.

Non-wage income is divided into farm proprietors' income and other personal income. Each region's share of farm proprietors' income is modeled as a function of the region's share of national crop and livestock production. Other personal income is largely dependent on the share of manufacturing and non-manufacturing wages and salaries going to the region.

Population: Population in the Regional Model is estimated using a pooled time-series cross-sectional technique, and forecasts are constrained to add up to the total given by the Global Insight macroeconomic model (actually, the Census Bureau's middle projection); all movements of population are therefore balanced.

The main determinant of differential population growth is employment. In the Regional Model, people move to find jobs, but they are discouraged by high housing prices. There are also non-economic components of migration due to climate and attractiveness; this reflects the increasing trend towards retirement in the sun-belt. In general people move towards fast-growing regions, rather than away from depressed ones, so that there is more movement when the overall economy performs more strongly. This effect is captured in the model by the particular coefficients on relative employment and wage rate growth.

Housing: Single and multi-family housing starts are estimated on the basis of the gap between a region's housing stock per capita and that of the nation. Housing activity is also stronger in regions with higher personal income and population growth, and dampened in regions with higher housing prices. Mobile home shipments fluctuate with aggregate housing and employment activity.

Historical housing stock estimates by region were created using the 1970, 1980 and 1990 Census, together with data on housing starts and mobile home shipments. The implied depreciation rate, which is affected by the actual history of conversions as a proportion of stock, is subject to the forecasters' judgment regarding likely future conversion rates. The stocks of single, multi-family, and mobile homes are equated to the lagged housing stock adjusted by these assumed depreciation rates, plus current housing completions and shipments. Housing starts are assumed to take one-to-three quarters to completion. Regional differences in housing prices, in turn, reflect differences in relative wage rates and income per capita levels, as well as variation in regional characteristics.

Consumer Prices: Consumer prices indices do not exist at the nine-region level, despite a widespread need for information on relative inflation in different parts of the country. Global Insight already forecasts those CPI's that exist for major metropolitan areas, and has now extended the coverage by using available data on consumer expenditure by region to construct state indices.
These are not based on local price information, but instead utilize information on typical household budgets in the four Census Regions, by size class of metropolitan area. This makes possible the calculation of different weights for the components of the CPI in each of the nine regions, depending on its Census Region and the sizes of the metropolitan areas in the region. These weights are applied to the national components of the CPI, except that regional home prices are used for housing costs. The indices also include the existing forecasts of the 28 published metropolitan CPIU's, weighted by the population of the area relative to its region. Consumer prices by region are modeled as a function of national prices, and regional housing prices, wage rates, and electricity costs relative to the national average.

6. Energy Information Administration Commercial Floorspace Model

Overview

The commercial floorspace forecast is done with a model independent of the Global Insight suite of models. The COMFLR submodule of MAM contains 140 equations of which 117 equations (13 commercial floorspace types in each of 9 Census Divisions) are estimated using historical data into the seventies. The remaining twenty-three equations are identities that aggregate floorspace by Division (9 Divisions), across region by floorspace type (13 types) and across all regions for a national total. The submodule forecasts thirteen floorspace types in each of the nine Census Division regions. The model forecasts thousand square feet of commercial floorspace at a quarterly interval. Since commercial floorspace is a stock measure, the fourth quarter solution is provided to the NEMS common block as the reported annual floorspace forecast.

Regional Commercial Floorpace

Regional level, commercial floorspace at time t is a function of a time trend and of lags of own floorspace; aggregate, regional, commercial floorspace; interest rates adjusted for regional inflation, regional real disposable income on a per capita basis and regional population. The general form of the estimated commercial floorspace equations is:

$$Commflrsp_{ij} = a_{ij} + b1_{ij} * Trend + \sum b2_{ijk} * Commflrsp_{ij}(-k) + b3_{ij} * Commflrsp_i(-1) + b4_{ij} * R1RMGBS3NS_i(-1) + b5_{ij} * PYD96C_i(-1) + b6_{ij} * NR16A_i(-1)$$

$$Commflrsp_i = \sum_j Commflrsp_{ij}$$

where:

i	= 1 to 9 Census Divisions
j	= 1 to 13 commercial floorspace types
(-k)	= time lag of k quarters, where k=1,2,…,5
a_{ij}	= estimated constant for commercial floorspace j in Census Division i equation
$b1_{ij}$, etc.	= estimated coefficients for the explanatory variables in the equation for commercial floorspace j in Census Division i
$Commflrsp_{ij}$	= commercial floorspace j in Census Division i
$Commflrsp_i$	= Aggregate commercial floorspace in Census Division i
Trend	= Time trend
$R1RMGBS3NS_i$	= short-term interest rate adjusted for regional inflation, Census Division i
$PYD96C_i$	= regional real disposable income on a per capita basis, Census Division i
$NR16A_i$	= regional population aged 16 and over, Census Division i

There is an estimated equation for each of the thirteen commercial floorspace types, k, in each of the nine Census Divisions, i. The thirteen commercial floorspace types are:

1. Stores - stores and restaurants
2. Warehouse - manufacturing and wholesale trade, public and federally-owned warehouses
3. Office - private, federal, and state and local offices
4. Automotive - auto service and parking garages
5. Manufacturing
6. Education - primary/secondary and higher education
7. Health - hospitals and nursing homes
8. Public - federal and state and local
9. Religious
10. Amusement
11. Miscellaneous, non-residential - transportation related and all other not elsewhere classified
12. Hotel - hotels and motels
13. Dormitories - educational and federally-owned (primarily military)

The nine Census Division regions are:

1. New England
2. Middle Atlantic
3. South Atlantic
4. East North Central
5. East South Central
6. West North Central
7. West South Central
8. Mountain
9. Pacific

Commercial floorspace data is supplied by F.W. Dodge Statistics and Forecasts Group and is drawn from their Building Stock Database. The historical stock data is at a quarterly interval beginning in 1970 and is supplied in thousand square feet for all commercial floorspace types in all Census Division regions.

Interest Rates

The real rate of interest is constructed using the nominal discount rate on 3-month Treasury bills and the all-urban consumer price index. The Macroeconomic Model supplies the data for both series. The 3-month Treasury bill rate is from the Macroeconomic Model and is quarterly beginning in 1970. Its model mnemonic is RMGBS3NS. This nominal interest rate is not a

measure of interest rates at the Census Division level. Regional measures of inflation are used to deflate the nominal interest rate and thereby construct a real rate of interest. Global Insight's regional measure of prices comes from their Regional Model. Its mnemonic is CPI. The historical, all-urban consumer price index is quarterly beginning in 1975 and is available for all Census Division regions.

The general specification for the real, short-term rate of interest is:

$R1RMGBS3NS_i = RMGBS3NS - ((CPI_i(-1)/CPI_i(-5))-1)*100$

where:

i	= 1 to 9 Census Divisions
$R1RMGBS3NS_i$	= rate of short-term interest adjusted for regional inflation
RMGBS3NS	= nominal discount rate on 3-month Treasury bills
$CPI_i(-1)$	= regional, all-urban consumer price index, lag 1 quarter
$CPI_i(-5)$	= regional, all-urban consumer price index, lag 5 quarters

Disposable Income

The regional, real disposable income per capita is constructed using regional, real disposable income and regional population (those aged 16 and over.) Their mnemonics are YD96C and NR16A. Real disposable income is measured in billions of chained 1996 dollars. It is available regionally beginning in 1975 for all Census Divisions but Mountain and Pacific. Real disposable income for the Mountain and Pacific Census Divisions begins in 1985. As mentioned, the measure of population used also comes from Global Insight's Regional model. The historical population for those aged 16 and over is quarterly beginning in 1971 for all Census Divisions except Mountain and Pacific. Population for the Mountain and Pacific Census Divisions begins in 1975. The general specification for the regional, real, disposable income per capita is:

$PYD96C_i = YD96C_i / NR16A_i$

where:

i	= 1 to 9 Census Divisions
$PYD96C_i$	= regional real disposable income per capita
$YD96C_i$	= regional real disposable income in billions of chained 1996 dollars
$NR16A_i$	= regional population aged 16 and over

As an EIA model, coefficients for the Commercial Floorspace Model are available by contacting Yvonne Taylor at yvonne.taylor@eia.doe.gov.

Part B
MAM INTERFACE WITH NEMS

7. Integrated Simulations Using MAM

This section first describes the types of integrated simulations of the Macroeconomic Activity Module (MAM) within the National Energy Modeling System (NEMS), followed by a discussion that briefly lays out the setup of the models constituting MAM and the aspects that are common to all the simulations. As indicated above, the set of models is designed to run in a recursive manner. The Global Insight Macroeconomic Model of the U.S. Economy (Macroeconomic Model) provides forecasts of over 1600 concepts spanning final demands, aggregate supply, prices, incomes, international trade, industrial detail, interest rates and financial flows. The Industry Model takes the final demand projections from the Macroeconomic Model as inputs to provide projections of output and other key indicators for 160 sectors, covering the entire economy, at the three and sometimes four-digit SIC code levels. The Employment Model takes the industry output projections from the Industry Model and national wage rates, productivity trends and average workweek trends from the Macroeconomic Model to project employment in 45 industries. The sum of nonfarm employment is constrained to sum to the national total projected by the Macroeconomic Model. The Regional Model shares the national results of output and employment to the nine Census Divisions. The Commercial Floorspace Model calculates regional floorspace for 13 types of use by Census Division.

Integrated Simulations of Alternative Energy Conditions or Events

Integrated forecasts of NEMS center around estimating state of the energy-economy system under a set of alternative energy conditions. Typically, the forecasts fall into the following four types of integrated NEMS simulations:

- Baseline Projection
- Alternative World Oil Prices
- Changes in or proposed Energy Fees or Emissions Permits
- Proposed Changes in Combined Average Fuel Economy (CAFE) Standards

In these integrated NEMS simulations, forecast period baseline values for over 240 macroeconomic and demographic variables from MAM are passed to NEMS which takes these values and, after making the requisite changes as required by the simulation, solves for demand, supply and prices of energy for the forecast period. These energy prices and quantities are passed back to MAM and a new simulation, Scenario 1, is solved in the Macroeconomic Model, the Industry Model and the Employment Model in the E-Views environment. The Regional Model

and the Commercial Floorspace Model and NEMS run in the FORTRAN environment. Details of each type of integrated simulation are discussed below.

Baseline Projection: In the Macroeconomic Model, the Global Insight baseline forecast is copied to Scenario 1. In this scenario the world oil price variable (PCOF) is made exogenous and is set equal to the forecast from NEMS. The two exchange rates are also made exogenous and are held at baseline values. The macroeconomic model is then solved. The solved values of the required macroeconomic variables are passed to the Industry Model which solves Scenario 1. The solved values of the variables from the Macroeconomic and Industry Models that are required by the Employment Model are then passed to the Employment Model which then solves Scenario 1. Regional detail is derived using shares derived from the Regional Model. The Commercial Floorspace Model derives the forecasts of floorspace by region by type. After the models are aligned in Scenario 1 the solved values of all the models that are required by NEMS are passed to NEMS. After NEMS is solved the changes in energy prices and quantities relative to their baseline values in NEMS are passed to MAM which re-solves Scenario 1 based on these changes. The final solution values for all the macroeconomic and demographic variables constitute the macroeconomic reference case which is reported in the Annual Energy Outlook.

Alternative World Oil Prices: Crude oil prices are determined largely by the international market and production in OPEC and non-OPEC nations. Two simulations are normally performed in conjunction with the baseline forecast for the Annual Energy Outlook. These are based on a high oil price scenario and a low world oil price scenario. These high and low prices are based on different assumptions for OPEC production. For each of these cases, MAM starts from the baseline case, as explained above, and passes the values of the required macro variables to NEMS. NEMS reacts to the alternative world oil prices. The energy variables are passed back to MAM which then solves for Scenario 1 in all its component models.

Changes in or Proposed Energy Taxes or Emission Permits: This class of simulations levies some kind of tax on the energy sector. It could be a unit tax (x-cents per gallon) or ad-valorem (x% of revenues). It could be a tax on a fuel by type or emissions by type. Since taxes are levied on an industry, prices are expected to rise proportionately to the tax. These taxes, if collected by the federal government will change the budget deficit relative to the baseline. Since these taxes are not levied for revenue raising purposes, although raising of revenue has also been considered in previous years, assumptions are made as to how these are returned to the economy. Generally, three alternative schemes are implemented. First, it can be assumed that taxes are retained within the business sector (grandfathered). Second, they can be returned to households. Third, a fraction can be returned to the households while the remaining fraction is retained within the business sector.

The grandfathered case is easiest to implement since the revenues stay in the business sector. Here, as in all simulations, baseline values for macroeconomic and demographic variables are passed to NEMS. With increases in or introduction of new energy taxes, energy prices rise and quantities fall in NEMS. These changes, relative to their baseline values, are passed to MAM .

The increase in federal revenues due to energy taxes are also passed to MAM. In this case the business sector retains tax revenues, either fully or to the extent that the full-employment federal NIPA budget surplus (SURGFFE) stays at baseline. In the former case, no change is required. In the latter case, Federal excise tax accruals other than for a VAT (TXGFOTH) are adjusted through a target search procedure where the add factor associated with it (TXGFOTH_A) is solved so that SURGFFE stays at baseline. After TXGFOTH_A has been determined Scenario 1 is solved.

In the case where revenues are returned to the consumers, either fully or to the extent that the federal government full employment budget surplus is kept at baseline, the increased revenues are subtracted from corporate profits before taxes (ZB) by increasing Federal excise tax accruals other than for a VAT (TXGFOTH) through the add factor associated with it (TXGFOTH_A). Second, the add factor associated with federal personal tax receipts (TPGF_A) is either reduced by the same amount as the increase in excise tax, or determined in a target search procedure so that the full-employment federal NIPA budget surplus (SURGFFE) stays at baseline. Essentially these two procedures imply that the federal government takes the energy tax revenues away from the business sector as a lump sum amount and then returns them to the consumers in the form of a lump sum. Sometimes the simulation may call for a reduction in personal income tax rates (RTPGF) to achieve the same objective. In that case the add factor associated with the personal average income tax rate (RTPGF_A) is target searched. After TXGFOTH_A and TPGF_A (or RTPGF_A) have been determined Scenario 1 is solved in MAM.

In the case where a portion of the tax revenue is allowed to stay in the business sector and the remaining amount is returned to consumers, the add factor for TXGFOTH is increased by the amount that has to be returned to the consumers. Then the add factor for TPGF is reduced by the same amount or by a target-searched amount that keeps SURGFFE at baseline. After these values have been determined Scenario 1 is rerun. In case the personal income tax rates are being reduced, RTPGF_A is target searched instead of than TPGF_A.

Proposed Changes in CAFE Standards: This class of simulations is based on changing (improving) the combined average fuel economy of new light vehicles relative to the baseline CAFE standards. Increases in the CAFE standards are associated with an increase in the cost of production of new light vehicles which are calculated by the Transportation Module of NEMS. This increased cost is passed to MAM. The increased cost is in constant dollars whereas most prices in MAM are indices. The assumption is made that the increased cost is due to increases in prices of factor inputs in transportation. The relevant factor input price index that feeds into the producer price index for transportation is T_WPI14. This index is adjusted upward by an amount that is equal to the percentage that the incremental cost represents in the baseline price for new light vehicles (JPLV).

MAM starts from the baseline case and passes to NEMS all baseline values for the required macroeconomic and demographic variables. NEMS reacts to the new CAFE standards that result in alternative prices and quantities for the energy variables and incremental cost for new light

vehicles. Changes in energy prices and quantities, relative to their baseline values, along with the incremental cost for new light vehicles, are passed to MAM, which then adjusts T_WPI14, energy prices, and quantities and solves for Scenario 1 in all the models.

Model Levers and Simulation Rules

In order to generate long-term alternatives and to assess alternative scenarios Global Insight provides a series of levers and simulation tools in the models that permit change in key assumptions. All these levers and simulation rules are presented below along with a discussion of how they are modified in MAM.

Energy Prices and Quantities: While energy prices and quantities are endogenously specified in the Global Insight Macroeconomic Model, in MAM these values are determined by NEMS and are considered to be exogenous inputs to the Macroeconomic Model. Similarly, movements in outputs of 5 energy industries and in two employment sectors are exogenously determined by NEMS. The projected movements in the following energy variables appearing in the Macroeconomic Model are determined in NEMS:

a. Production of Energy

ENGDOMPETANG = Domestic production of petroleum & natural gas
ENGDOMOTHER = Domestic production of energy excl. petroleum & natural gas

b. End-use Demand for Energy

DTFUELSALLB = Demand for all fuels
DENDUSE_COAL = End-use demand for coal (excludes electricity generation)
DENDUSE_ELC = Sales of electricity to ultimate consumers
DENDUSE_NG = End-use demand for natural gas
DENDUSE_PET = End-use demand for petroleum

c. Consumer Spending on Energy

CNFUEL96C = Real consumer spending on fuel oil & coal
CSHHOPG96C = Real consumer spending on natural gas
CSHHOPE96C = Real consumer spending on electricity
CNGAS96C = Real consumer spending on gasoline & motor oil
QGASASF = Highway consumption of gasoline & special fuels

d. Prices of Energy

PCWCNFUEL = Chained price index--consumer fuel oil & coal
PCWCSHHOPE = Chained price index--household electricity
PCWCSHHOPG = Chained price index--household natural gas
PCWCNGAS = Chained price index--consumer gasoline & oil
WPI051 = Producer price index--coal

WPI053 = Producer price index--gas fuels
WPI054 = Producer price index--electric power
WPI055 = Producer price index--utility natural gas
WPI0561 = Producer price index--crude petroleum
WPI057 = Producer price index--refined petroleum products
WPI0574 = Producer price index--residual petroleum fuels
PCOF = Weighted average price of imported crude received in refinery inventories

e. Industrial Production Indices

ISPN2121 = Industrial production index--coal mining
IPSG211A3 = Industrial production index--oil & gas extraction & support activities

f. Industry Output

The projected movements in the following industries' outputs, appearing in the Industry Model, are endogenous to the Global Insight Industry Model. These values are overwritten based on the growth in activity in these sectors as determined in NEMS:

GOO12_96 = Real Output of Coal Mining
GOO13_96 = Real Output of Oil and Gas Extraction
GOO29B96 = Real Output of Petroleum Refining
GOO49A96 = Real Output of Electric Utilities
GOO49B96 = Real Output of Gas Utilities

g. Employment

The projected employment in the following sectors are endogenous to the Global Insight Employment Model. These values are overwritten based on the growth in employment as determined in NEMS:

EME12 = Employment of Coal Mining Sector
EME13 = Employment of Oil & Gas Extraction Sector

Fiscal Policy Assumptions: Unless mentioned, MAM retains Global Insight's default settings for fiscal policy levers and assumptions.

a. Federal Purchases

Real federal government spending for each spending category is an exogenous input in the model. The price deflator associated with each of the goods categories reflects goods inflation in the private sector of the economy. Price deflators associated with the federal wage categories (PCWGFMLWSS and PCWGFOWSS) are closely tied to legislated pay increases; this pay increase concept explains 70-80% of the inflation in government wages while wage inflation in the private sector of the economy explains the remainder.

The determination of federal government pay increases (PAYGFML and PAYGFO) is controlled by model lever PAYGFLEV. If PAYGFLEV is set to 1, federal government pay increases are specified exogenously by the model user (supply values for exogenous variables PAYGFMLEXO and PAYGFOEXO). If PAYGFLEV is set to 0, federal government pay increases are modeled to rise with consumer price inflation (PCWC). The default value for PAYGFLEV is 1.0.

b. Federal Transfer Payments

The model lever SSLEV allows users to simulate Congressional decisions to trim (negative annual percentage rate) or augment (positive annual percentage rate) the cost-of-living adjustment (COLA) on social security payments (VGF_PERSS) based upon CPI inflation. For example, setting the lever value to 1 increases the social security COLA by 1%. The default value for SSLEV is 0.

c. Personal Income Tax Rates

Tax rates in the model are largely exogenous at the federal level and endogenous at the state and local level. However, the model lever TLEV allows the user to raise personal income tax rates if consumer prices rise. If TLEV is set to 0, changes in the federal personal income tax rate (RTPGF) are controlled through the add factor RTPGF_A. If TLEV is set to 1, the tax rate is indexed to CPI inflation. The default value for TLEV is 1. As mentioned above, RTPGF_A can be used to target search the full employment federal budget surplus (SURGFFE).

Monetary Policy Assumptions: The model lever RMFFLEV gives the user the flexibility of using the supply of reserves as the key monetary policy instrument, reflecting the Federal Reserve's open market purchases or sales of Treasury securities, or of using a reaction function as the policy instrument. If RMFFLEV is set to 0, the model uses non-borrowed reserves as the monetary policy instrument and the federal funds rate is determined by the balance between the demand and supply of reserves to the banking system (equation RMFF_RES). The Federal Reserve targets non-borrowed reserves and does not engage in an activist policy to stabilize the economy. The money market determines the federal funds rate. If the lever is set to 1, the model uses a Federal Reserve reaction function. This is an econometrically estimated equation which models the past behavior of the Federal Reserve in setting the federal funds rate in response to changes in inflation and unemployment (equation RMFF_RCT). This implies that the Federal Reserve targets interest rates trading off changes in inflation and the unemployment rate.

In the baseline forecast of the Global Insight Macroeconomic Model, both the RMFF_RES equation and the RMFF_RCT equation yield the same federal funds rate forecast, so that the lever can be set at any value before running a simulation. Any simulation run will have incorporated the monetary policy assumption set by RMFFLEV. In the MAM Macroeconomic Model, the lever is set at 0.9 to allow for a more activist monetary policy in simulations of energy events that have the potential to disrupt the economy significantly.

Foreign Assumptions: Global Insight default values are generally used, with exceptions discussed below.

a. Interest Rates

The long-term government bond yield in rest-of-world industrial economies (RMGBL_IND) is exogenous and equal to its baseline value RMGBL_INDB if model lever RMGBL_INDLEV is set to 0. When RMGBL_INDLEV is set to 1, however, this rate increases or decreases relative to baseline levels with the percentage point changes in the 10-year U.S. treasury notes. The default value for this lever is 0.5 for the forecast period.

b. Foreign Prices

Export and import demands are highly sensitive to changes in U.S. prices relative to foreign prices. While U.S. prices are modeled in considerable detail with a high level of sophistication, prices of our major trading partners are largely exogenous assumptions in the model. At times, policy or shock simulations can cause relative U.S./foreign prices to deviate significantly when foreign prices are fixed, causing trade volumes to respond strongly. In the case of a carbon tax that impacts our major trading partners to equal degrees, for example, relative prices should not be changing. Hence simple simulation rules have been added to the model to allow movements in the foreign prices relative to baseline levels

1. Producer Prices and Relative Prices. The model lever TRADEPLEV was introduced in order to negate any changes in relative prices on export and import demands. When TRADEPLEV is set to 1, export and import demands are determined by foreign output demand and relative U.S./trading partner prices. When TRADEPLEV is set to 0, relative prices are assumed to remain at baseline levels; export and import demands change from baseline levels only in response to changes in output, not relative prices. The default value for TRADEPLEV is 1.

The producer price index in the rest of the industrialized world (WPIW_IND) is both the key determinant of import prices and the key foreign price driving the U.S. exchange rate with industrialized countries. WPIW_IND is determined by one of two simulation rules based upon the value of the model lever WPIWLEV. If WPIWLEV is set to 0, foreign producer prices are changed relative to baseline levels with changes in imported oil prices (PCWMNIA00), U.S. merchandise export prices (PCWEXDAN_BM), exchange rates (EXCH_IND), and foreign economic activity (GDPR_IND and GDPR_DEV). If WPIWLEV is set to 1, foreign producer prices move in line with U.S. merchandise export prices. The default value for WPIWLEV is 0.

2. Exchange Rates. There are two exchange rates determined in the Global Insight Macroeconomic Model. These are EXCH_IND and EXCH_DEV and are defined as trade-weighted exchange rates (in U.S. $) for industrialized countries and developing countries, respectively. In MAM, these variables are set exogenously to their baseline values.

c. Foreign GDP

There are two foreign real GDP variables in the Macroeconomic Model. These are real GDP in the rest of the industrialized world (GDPR_IND) and real GDP in developing countries (GDPR_DEV). Both of these are exogenous in the Macroeconomic Models and reflect Global Insight's international forecasts.

Flowcharts of MAM

The following six flowcharts show the flow of information from NEMS to MAM and how the flows of energy and economic information are passed among the components of MAM. This set of flowcharts identifies the tasks performed by each of the MAM Submodules and may not necessarily follow the actual programming sequence. The latter will be discussed in the next section, along with another set of flowcharts presenting the programming steps and subroutines called.

Figure 1 summarizes the entire NEMS-MAM integrated system. The remaining five figures focus on the Macroeconomic, Industry, Employment, Regional and Commercial Floorspace Submodules of MAM, respectively. The process starts by generating a baseline economic forecast using the structural models described in Part A. This economic forecast is then provided to NEMS to initialize the system.

After the initial baseline is provided to NEMS, MAM is best described as a feedback system that modifies the baseline given changes in energy events or policies. To do this, alternative NEMS values of energy prices and quantities are first transformed into concepts recognized by the structural models. The alternative NEMS values are compared to the baseline values to compute a series of deviation ratios that are then applied to the appropriate Macroeconomic Model baseline concepts. The Macroeconomic Model is run with the new energy concepts, followed by the Industry and Employment Models. At each stage, a series of ratios are computed reflecting the ratio of the alternative value to the baseline value. These ratios are applied to the baseline values of key macroeconomic, industry and employment variables to be passed to NEMS. Selected variables at the national level are shared out to regions using time-varying regional shares (derived previously from the structural Regional Model). The Commercial Floorspace Submodule is also run to generate floorspace demand by region. This complete slate of national and regional economic forecast data is then passed back to NEMS for another cycle through the energy system.

Figure 1. Macroeconomic Activity Module Flow

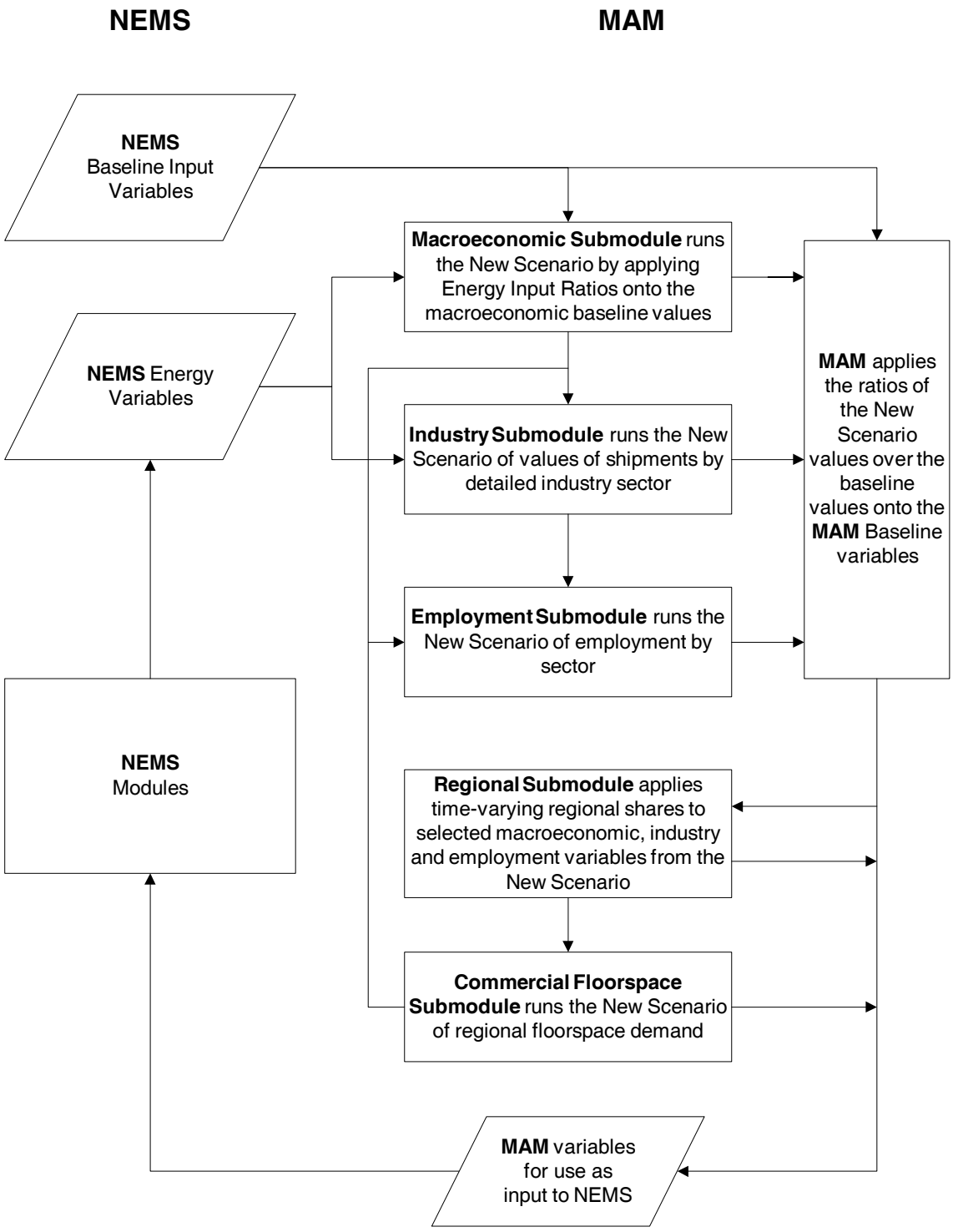


Figure 2. Macroeconomic Submodule Flow

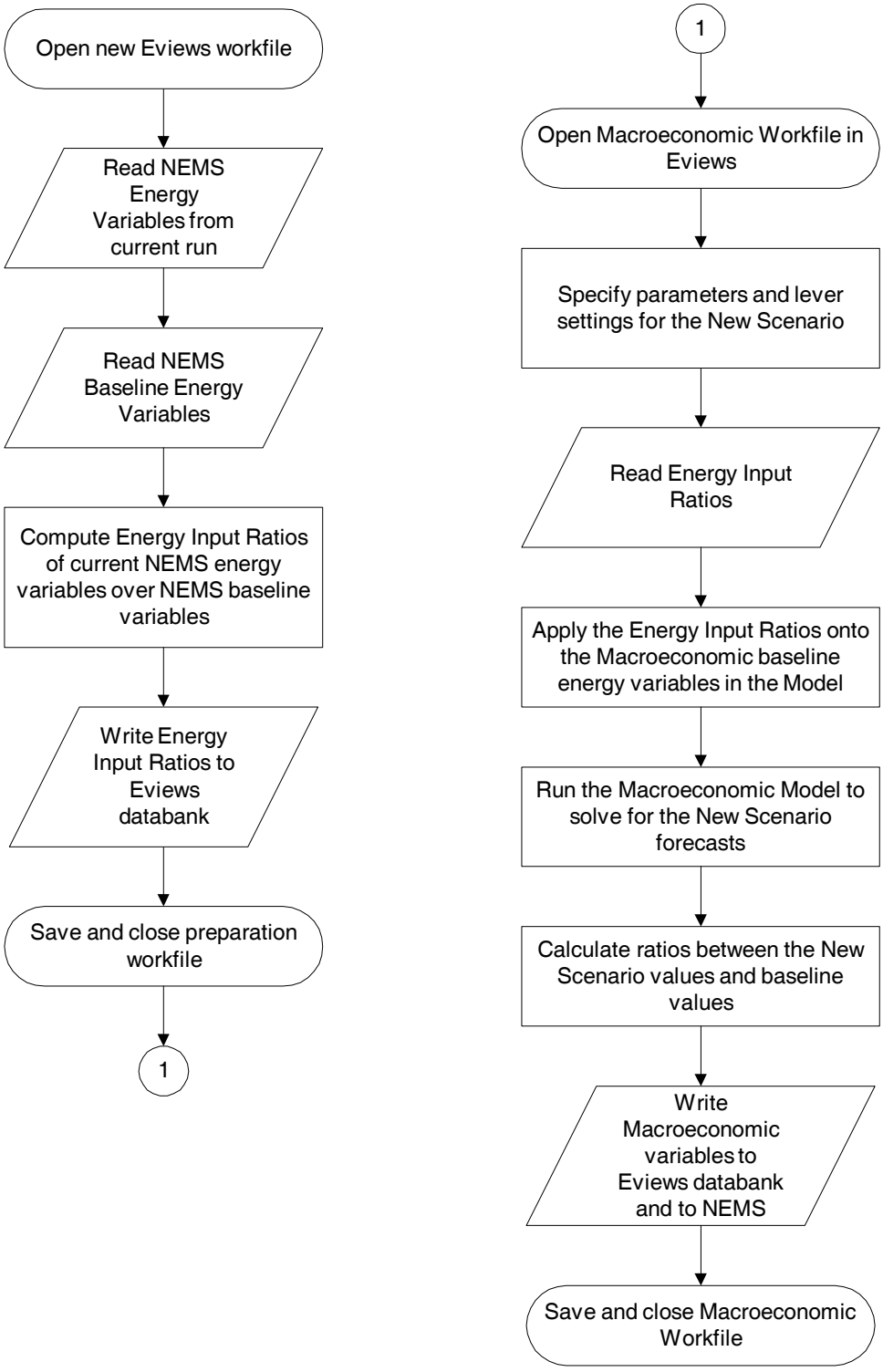
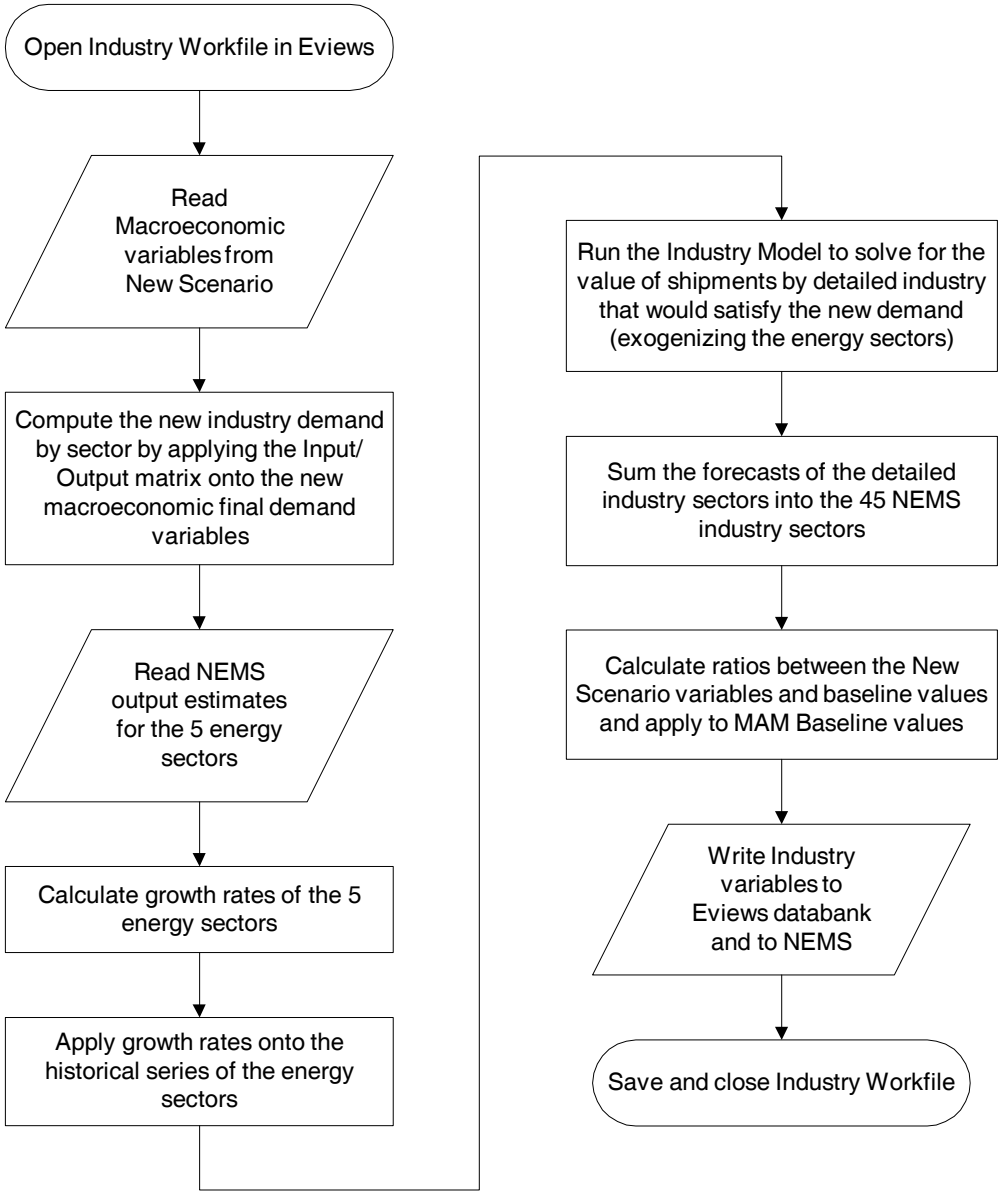


Figure 3. Industry Submodule Flow



Five energy sectors:
Coal Mining
Oil and Gas Extraction
Petroleum Refining
Electric Utilities
Gas Utilities

Figure 4. Employment Submodule Flow

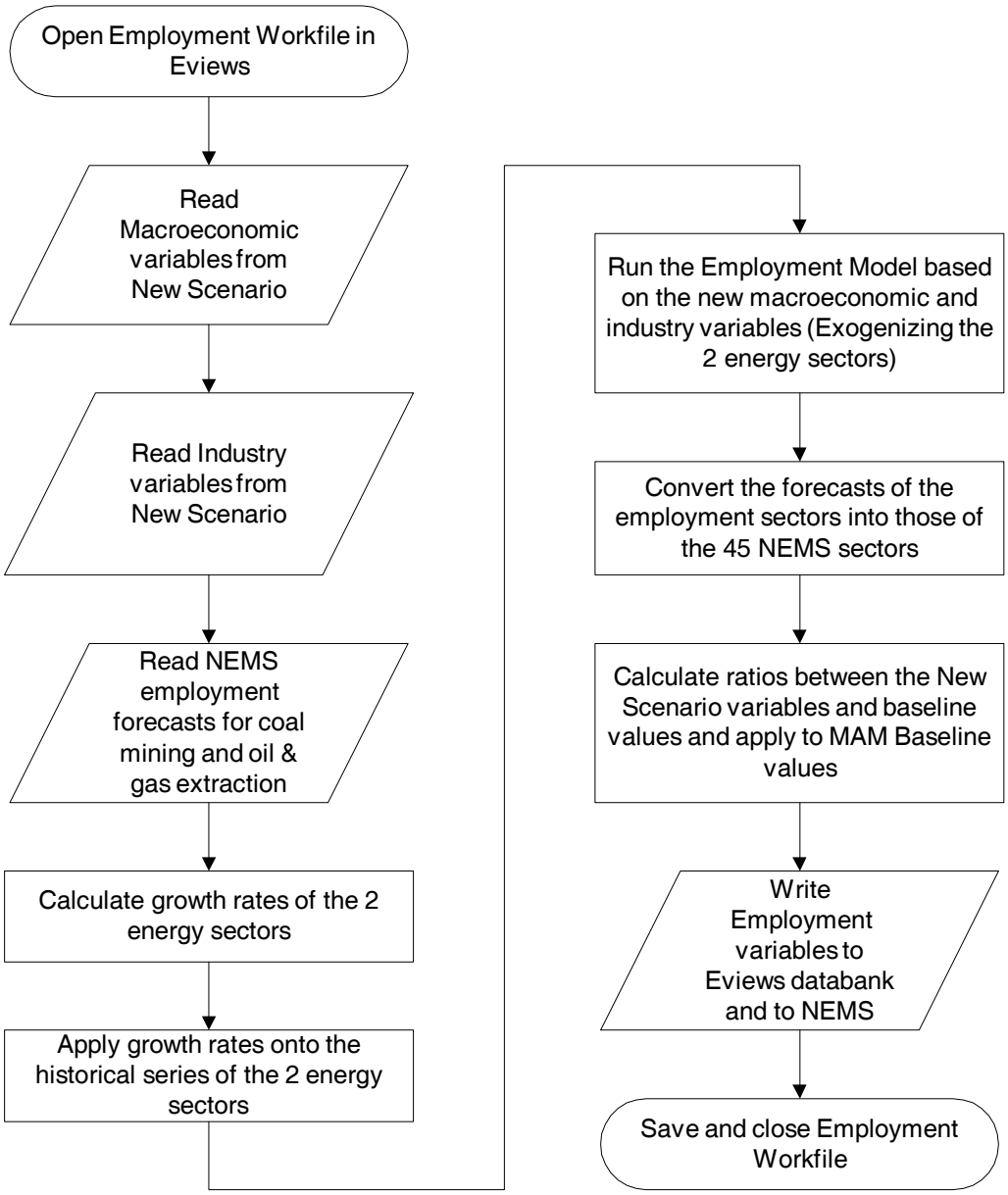


Figure 5. Regional Submodule Flow

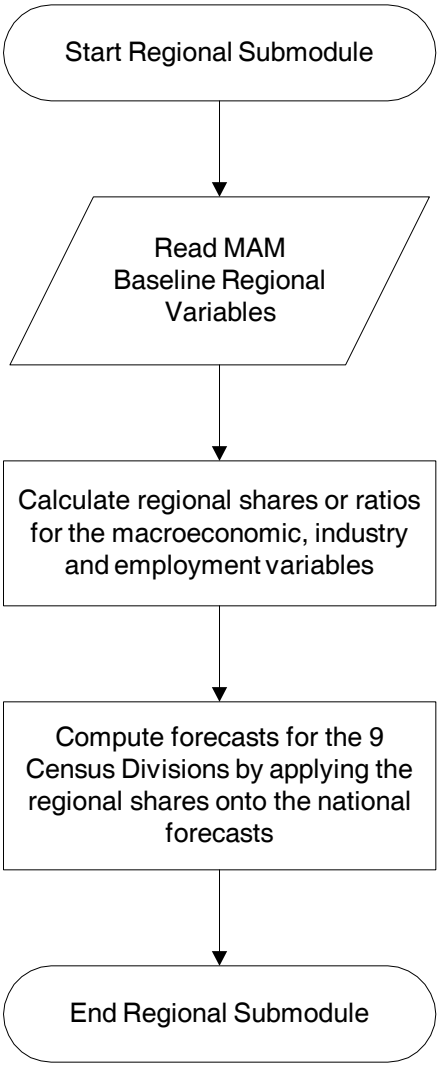
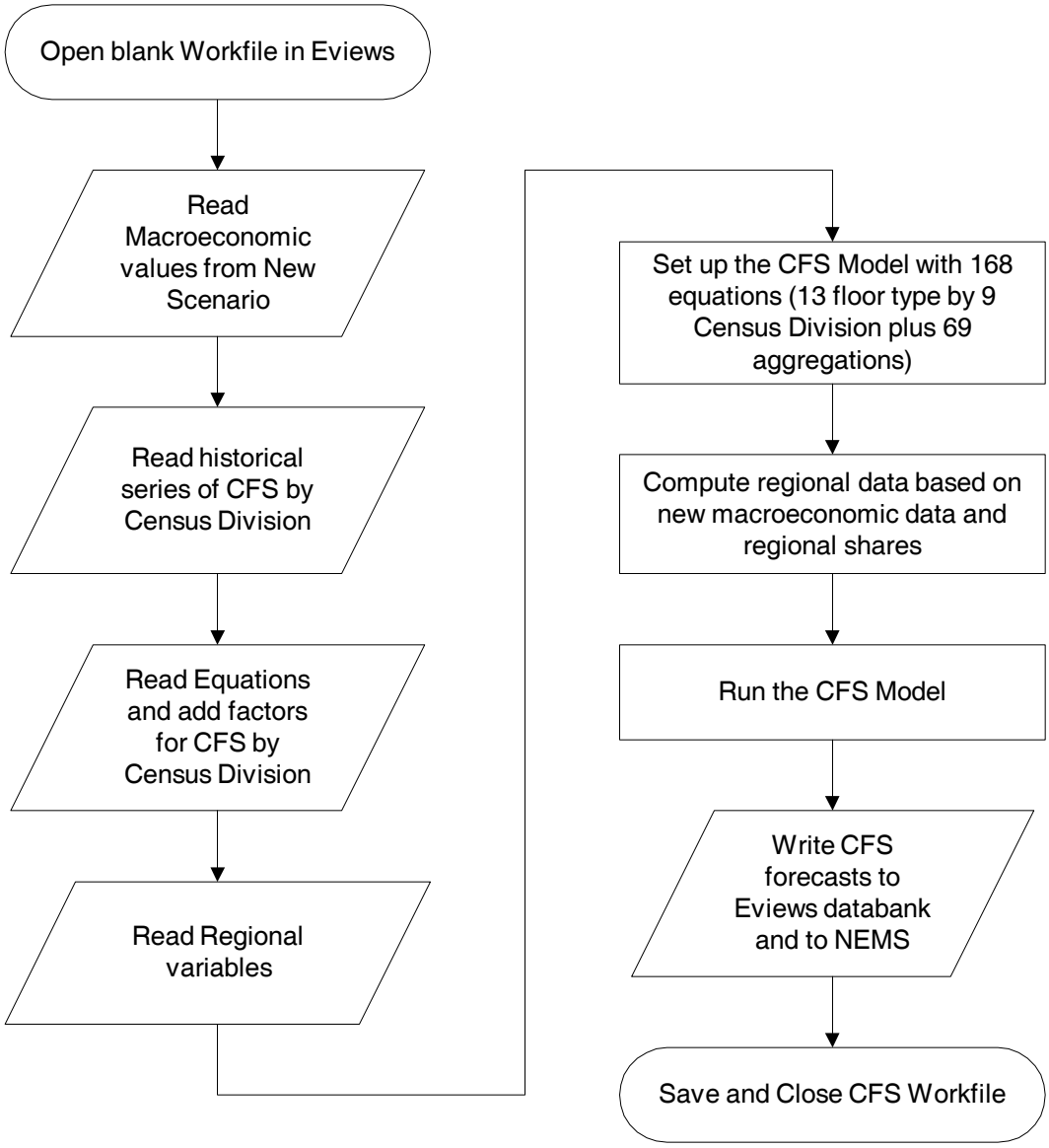


Figure 6. Commercial Floorspace (CFS) Submodule Flow



8. Operation of MAM within NEMS

The Macroeconomic Activity Module (MAM) is one of a number of FORTRAN source files (also known as modules) that, after compiled and linked, compose the National Energy Modeling System (NEMS) executable. MAM consists of nine subroutines used to read inputs, compute and apply shocks to the MAM models, simulate those models, complete and write out the resulting forecast. Figure 7 diagrams the flow of control within MAM.

MAC Subroutine

All of the activities in MAM are directed by the MAC subroutine. The MAC subroutine is the MAM driver. In addition to making calls on the remaining eight subroutines in MAM, the MAC subroutine has three tasks of its own. It writes the MC_ENERGY output[1] spreadsheet of NEMS energy prices and quantities that are the exogenous assumptions to the models in MAM. This spreadsheet includes aggregate assumptions and the components used to compute the assumptions. The values of the NEMS energy prices and quantities contained in the spreadsheet are read from the global data structure. All prices in the spreadsheet are reported in 1996 dollars. The second MAC subroutine task is to complete the economic forecast by applying forecasted percent changes to baseline values. Finally, the MAC subroutine supplies the remaining modules and the report writer of NEMS with the MAM results by writing model forecasts to the global data structure. Once this is done, the MAC subroutine returns program control to NEMS.

READMAC Subroutine

As mentioned, the MAC subroutine is the MAM driver and calls all the remaining subroutines in MAM. The first subroutine called is named READMAC. This subroutine is called just once per run in the first iteration of the first year of a NEMS run. The READMAC subroutine opens and reads the contents of three input files. The first of these is an input text file of MAM parameter settings named ***mcparms*** (Tables B1 and B2). The remaining two files are spreadsheets containing baseline values of MAM variables. The baselines are Global Insight model forecasts given assumptions about the path of world oil prices. The input MCBASE spreadsheet (Table B3) contains baseline values from the U.S. Macroeconomic, Industry and Employment models. These are the baseline values that forecasted percent changes are applied to compute the MAM forecast. The input MCRGBASE (Table B4) spreadsheet contains baseline values from the

[1] Files that are "output" files reside in the NEMS simulation's output directory. NEMS directory names begin with the character "d" which is followed by a date key and a letter identifying the particular run done that day. Files that are "input" files reside within the input subdirectory of the NEMS output directory.

Global Insight Regional model. These regional baseline values are used to compute shares. The shares are then applied to the forecast of national variables to produce a regional forecast.

DRTLINK Subroutine

The second subroutine called by MAC is named DRTLINK. This subroutine is responsible for executing the suite of Global Insight models. Like the READMAC subroutine, the DRTLINK subroutine executes only in the first iteration of the first year of a NEMS run. The DRTLINK subroutine, though, has an additional condition to satisfy. There are instances when the modeler does not want the forecast of the other NEMS modules affected by a change from MAM's baseline values. The presence of feedback is controlled with the NEMS parameter MACFDBK. When the feedback switch is set to zero, the DRTLINK subroutine is not called.

Much of what the DRTLINK subroutine does is preparation for executing the suite of Global Insight models housed within Quantitative Micro Software's EViews program. The subroutine begins by computing exogenous assumptions using NEMS energy prices and quantities read from the global data structure (Table B5). It then builds an EViews output program file called drivers. The drivers program file contains instructions written in the EViews programming language. The commands in this program file import exogenous assumptions, temporarily alter model structure, simulate the Global Insight suite of models and export forecast results in percent change from baseline values. Program control is temporarily transferred to EViews as it executes the commands in the output drivers program file.

The resulting model forecasts are written to an output spreadsheet named ***epmac***. The forecasted values stored in the epmac output spreadsheet are percent change from baseline values. The baseline in this case is that for each of the three Global Insight models within EViews. These percent changes are applied to the baselines contained in the MCBASE input spreadsheet to produce the U.S. economy, industrial shipments and employment forecasts. Every effort is made to ensure that the baseline values in the EViews models match that in the MCBASE input spreadsheet. Once EViews completes execution of the drivers output program, control is returned to the DRTLINK subroutine. The DRTLINK subroutine concludes by reading in the percent change forecast contained in the epmac output spreadsheet.

Before continuing, the MAC subroutine completes the economic forecast. It multiplies the economy baseline imported from the MCBASE input spreadsheet by the forecasted percent changes imported from the epmac output spreadsheet. The MAC subroutine then calls its third subroutine, INDUSTSUB.

INDUSTSUB Subroutine

The INDUSTSUB subroutine operates in a manner similar to the MAC subroutine. The forecasted percent changes from baseline values coming from the Industry Model and stored in

the ***epmac*** output spreadsheet are multiplied by the relevant baseline imported from the MCBASE input spreadsheet. The resulting forecast is for thirty-five categories of industrial output and ten categories of services.

Five energy industries in MAM are overwritten by calculated output based on NEMS activity:

1. Petroleum refining (SIC 291)
2. Coal mining (SIC 11, 12)
3. Oil and gas extraction (SIC 13)
4. Electric utilities (SIC 491) and
5. Gas utilities (SIC 492)

The MAM computes annual growth rates from the NEMS forecast of energy sector outputs (Table B6). Each of the growth rates is dynamically applied beginning with an initial historical value of the respective variable in Industry model. The resulting time series become the industrial output forecast for the five energy industries.

REGIONSUB Subroutine

The REGIONSUB subroutine is the fourth subroutine called by the MAC subroutine. This subroutine produces forecast at the nine Census Division level and operates a little different from the MAM modules. Even though there is a Global Insight Regional Model, it is not incorporated into the suite of models run inside of EViews. Instead, a regional baseline forecast run during a past Annual Energy Outlook cycle is used to share out the forecast from the U.S. Macroeconomic and Industry Models. Not all of the U.S. economy forecast is shared to the regional level; just a dozen variables along with employment at the 2-digit level. Industrial output for the thirty-five industries is shared to the regional level.

EMPLOYMENT Subroutine

The fifth subroutine called by the MAC subroutine is named EMPLOYMENT. This subroutine works just like the INDUSTSUB subroutine. It applies the forecasted percent changes in employment from baseline values coming from the Employment Model and stored in the ***epmac*** output spreadsheet to the relevant baseline imported from the MCBASE input spreadsheet. The resulting forecast is for thirty-five categories of industrial and ten categories of service employment.

NEMS forecasts employment for two of the five energy related industries. These two industries are coal mining and oil and gas extraction. Their forecast is constructed just as was done for those industries in the Industry Model. NEMS supplies the forecasts, and the MAM computes annual growth rates that are dynamically applied beginning with an initial historical value for the respective variable. Forecasts for the remaining three energy industries are computed like those for all the other employment variables. Since the Industry Model executes before the

Employment Model, the employment results for the remaining three energy sectors are affected by the NEMS industrial forecast. The five NEMS energy industries are:

1. Petroleum refining (SIC 291)
2. Coal mining (SIC 11, 12)
3. Oil and gas extraction (SIC 13)
4. Electric utilities (SIC 491) and
5. Gas utilities (SIC 492)

COMFLR Subroutine

The COMFLR subroutine is the sixth subroutine called by the MAC subroutine. This subroutine contains a 140 equation, structural model of the stock of commercial floorspace. It is a quarterly model that forecasts thirteen floorspace types (see Table A16) at the Census Division level. In this model, the stock of commercial floorspace is a function of lagged floorspace, interest rates, disposable income, population and a time trend. The regional model provides forecast values of the explanatory variables.

In the first iteration of the first NEMS model year, historical data and add factors are read from three input spreadsheets MCCOMFLR, MCCOMEX and MCCOMAF. The model begins to solve in the first forecast year. The forecasts of COMFLR are passed to the Commercial Demand Module of NEMS for further processing and calibration.

TRANC Subroutine

The TRANC subroutine is the seventh subroutine called by the MAC subroutine. This subroutine adds equations to the Macroeconomic model that share out total light truck sales by size class. Light trucks are vehicles with gross vehicle weight ratings of 14,000 pounds and less. Light truck sales are divided into the following size classes:

1. Unit Sales of Class 1 Light Trucks, 0 to 6000 lbs.
2. Unit Sales of Class 2 Light Trucks, 6001 to 10,000 lbs.
3. Unit Sales of Class 2a Light Trucks, 6001 to 8,500 lbs.
4. Unit Sales of Class 2b Light Trucks, 8,501 to 10,000 lbs.
5. Unit Sales of Class 3 Light Trucks, 10,001 to 14,000 lbs.

All unit sales of light trucks are measured in thousands of vehicles.

MACOUTPUT Subroutine

Once the commercial floorspace model has solved and program control is returned to the MAC subroutine from COMFLR, the MAC subroutine writes all of the MAM forecasts to the global

data structure so that the other modules in NEMS can use them including the report writer. The MAC subroutine then calls the final MAM subroutine, MACOUTPUT. The MACOUTPUT subroutine writes five output spreadsheets that record the activities of MAM for a NEMS run. The five output spreadsheets are:

1. MC_COMMON — Contains forecast values of MAM variables written to the global data structure from the Macroeconomic Model, the shared regional forecast produced in the REGIONSUB subroutine, plus commercial floorspace by region. Table B11 indicates the MAM variables used by other NEMS Modules.

2. MC_NATIONAL — Contains the forecast of macroeconomic variables as well as the baseline and percent change from baseline. The forecast is done using the Macroeconomic Model. The baseline is imported from the imported from the MCBASE input spreadsheet. (Table B7)

3. MC_INDUSTRIAL — Contains the forecast of industrial output for thirty-five manufacturing industries at the Census Division level as well as for the U.S. There is a U.S. forecast for the ten services. Baseline U.S. values are reported for manufacturing and services. The REGIONSUB subroutine shares this forecast across the Census Divisions. The baseline values are imported from the MCRGBASE input spreadsheet. (Table B8)

4. MC_EMPLOYMENT — Contains the forecast and baseline employment values of the forty-five manufacturing and service industries. The forecast is done using the Employment Model. The baseline is imported from the MCBASE input spreadsheet. (Table B9)

5. MC_REGIONAL — Contains the forecast and baseline values and the computed shares of the regional variables by Census Division as well as for the US. The regional forecast is done in the REGIONSUB subroutine using forecasts from the Macroeconomic and Industry Models. Baseline values originate from the MCRGBASE input spreadsheet. (Table B10)

Once the last spreadsheet is written, program control is returned to the MAC subroutine, which in turn returns program control to NEMS.

Figure 7. Flow of Control within MAM

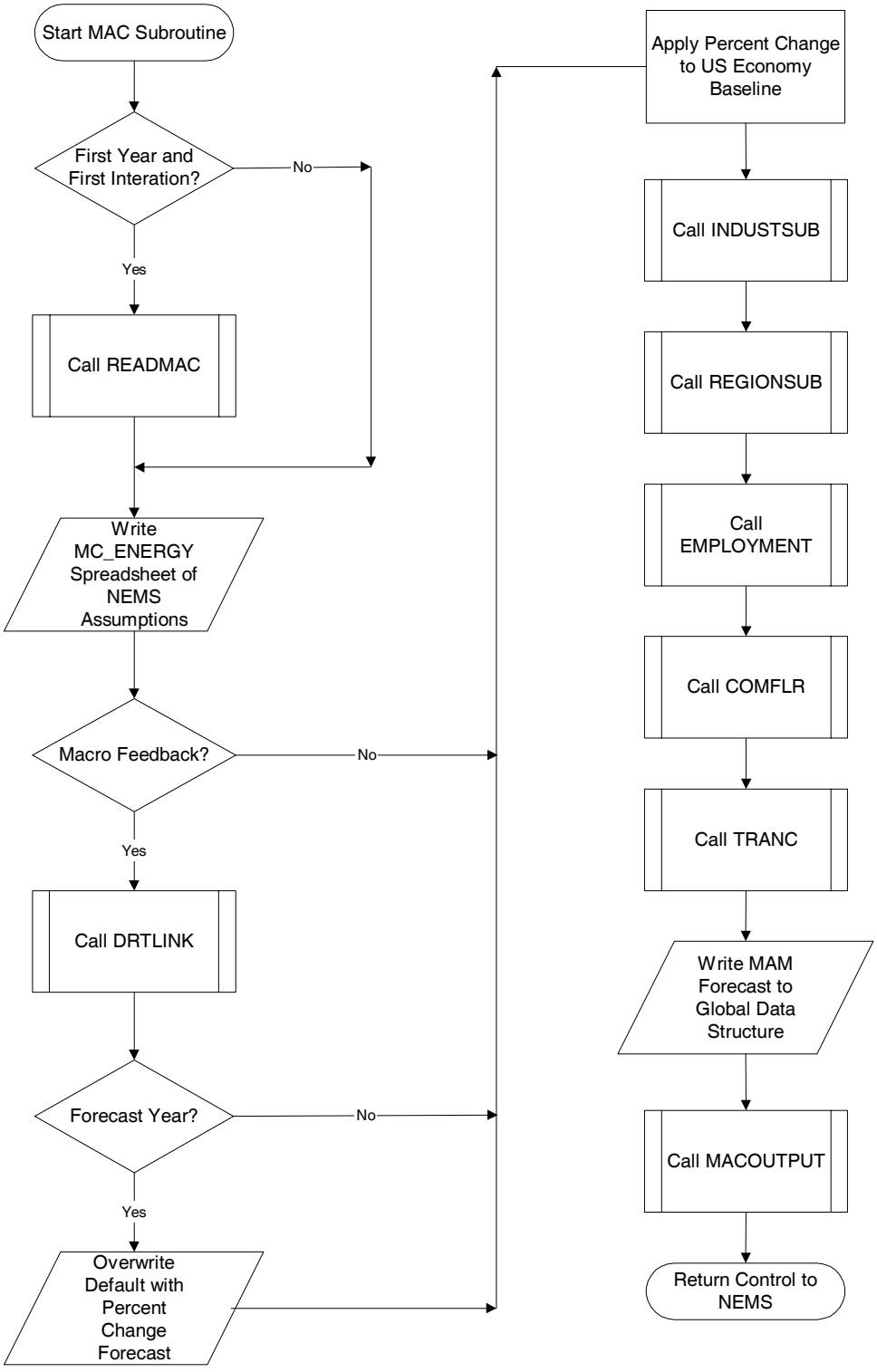


Figure 8. READMAC

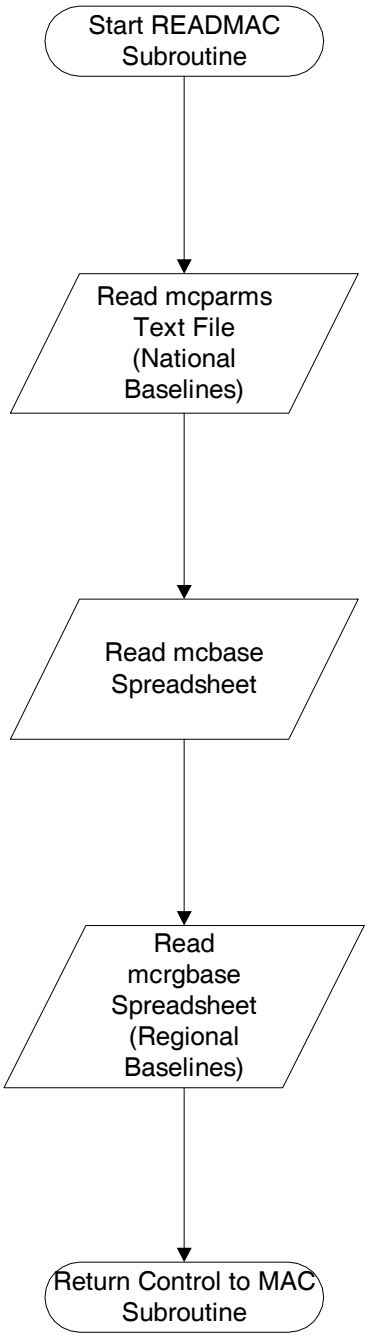


Figure 9. DRTLINK

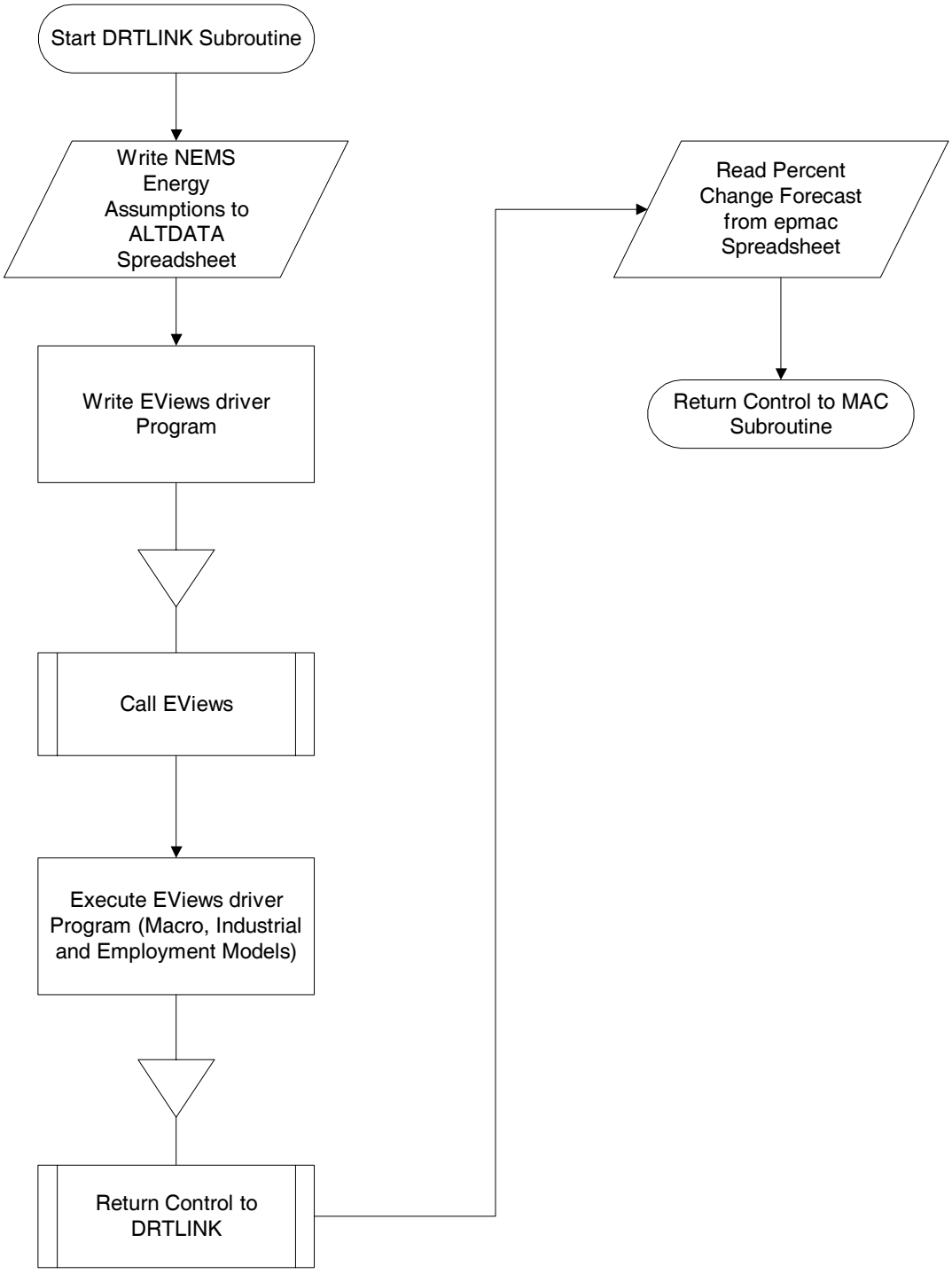


Figure 10. INDUSTSUB

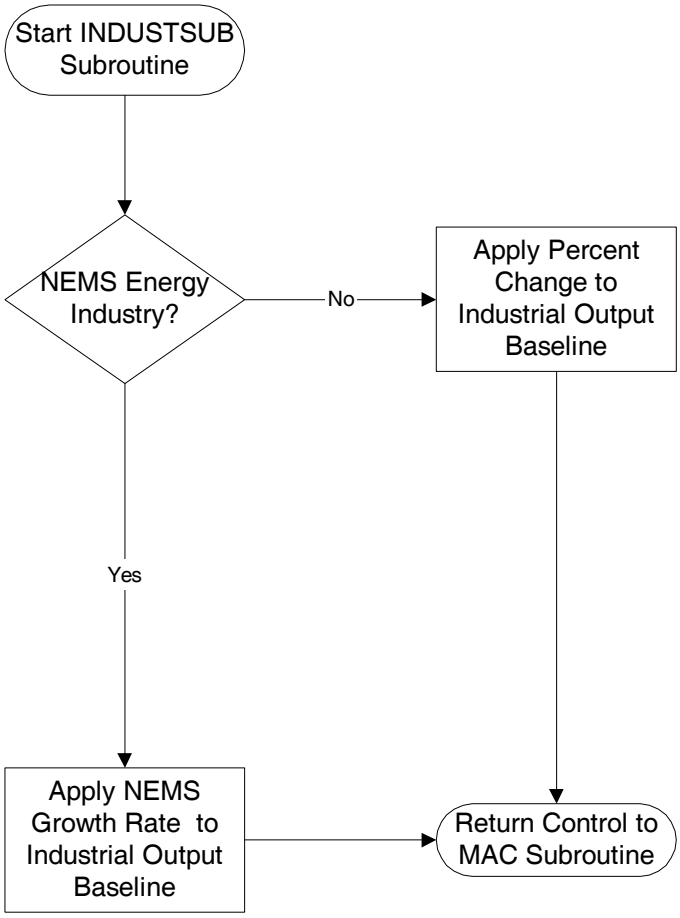


Figure 11. REGIONSUB

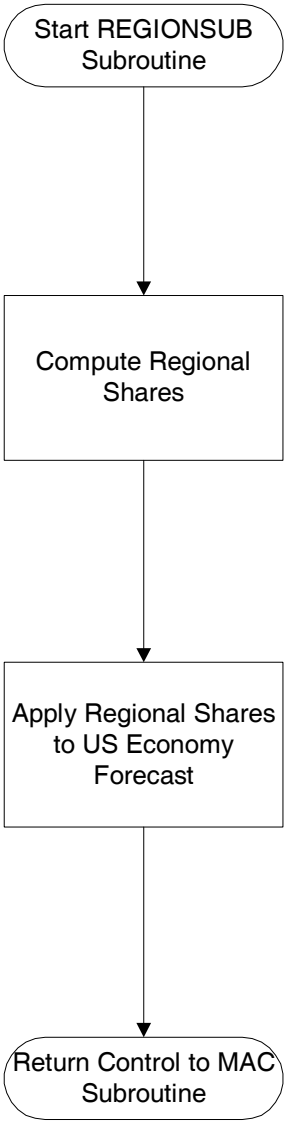


Figure 12. EMPLOYMENT

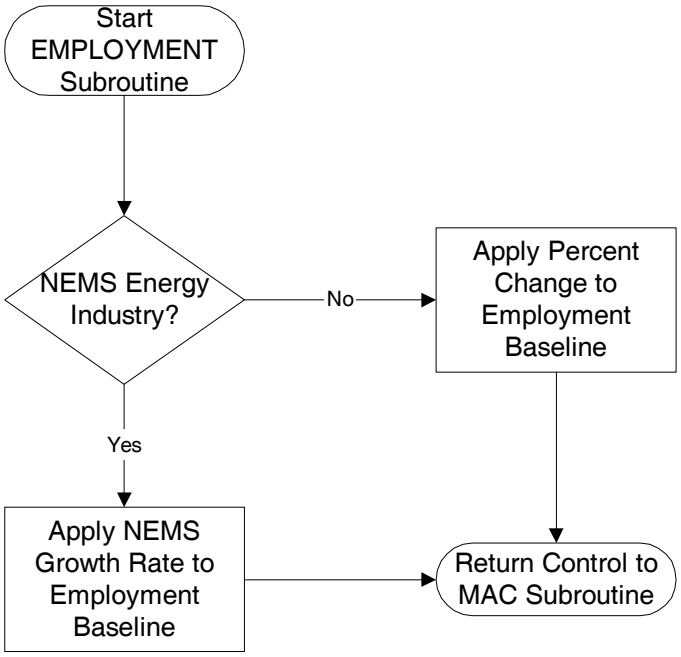


Figure 13. COMFLR

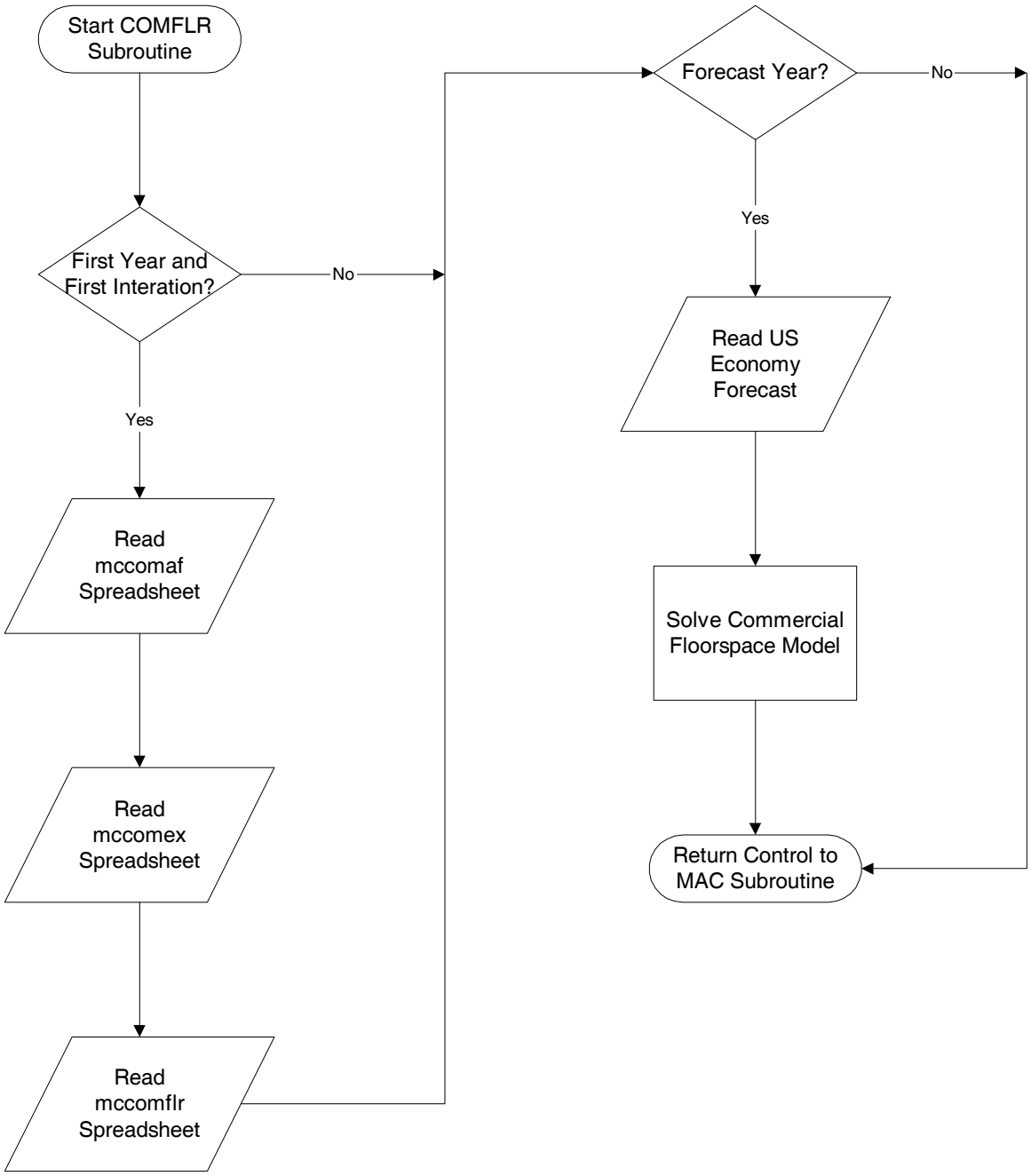


Figure 14. TRANC

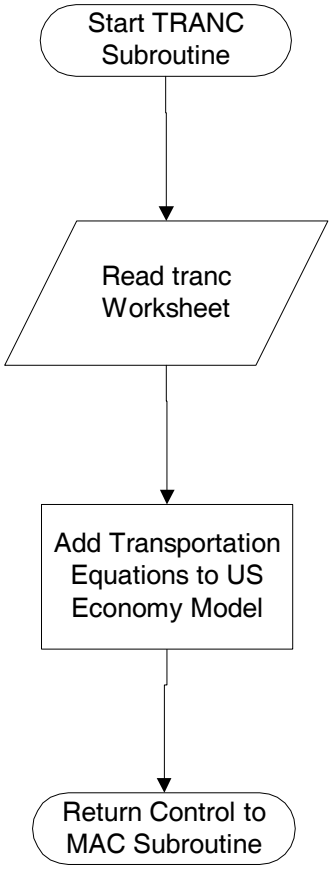
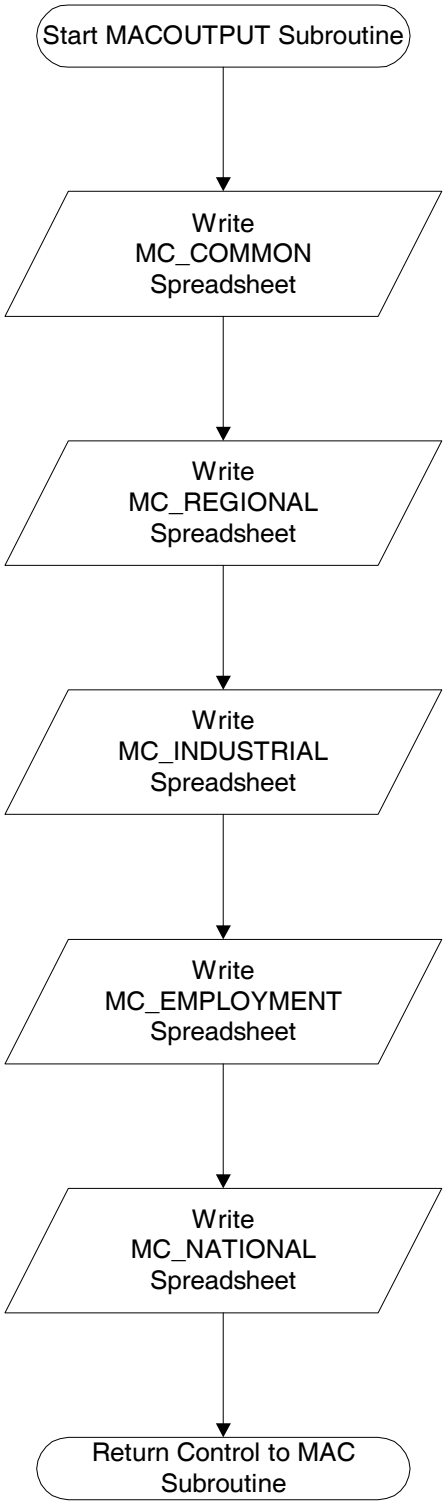


Figure 15. MACOUTPUT



Appendix A: STRUCTURAL MODELS

Macroeconomic Model Detail

Table A1. Real Personal Consumption Variables in the Global Insight Model of the U.S. Economy *

Personal consumption expenditures	**CONS96C**
Durables	**CD96C**
Motor vehicles & parts	**CDMVAP96C**
Light vehicles	CDLV96C
Tires, tubes, accessories & parts	CDTTAAP96C
Other motor vehicles & parts	CDMVOTHO96C
Used automobiles	CDAUTOUN96C
Furniture	**CDFURN96C**
Computers and Software	**CDCMPASW96C**
Computers	CDCMP96C
Software	CDSW96C
Furniture exc. computers & software	CDFURN_CSW96C
Other durable goods	**CDO96C**
Ophthalmic products	CDOOPHT96C
All other (1)	CDOTH96C
Nondurables	**CN96C**
Food	**CNFOOD96C**
Purchased meals & beverages	CNFOODPRCH96C
Food for off-premise consumption	CNFDOFF96C
Food on farms, furnished free	CNFOODFURNAAF96C
Clothing & shoes	CNCS96C
Gasoline & oil	CNGAS96C
Fuel oil & coal	CNFUEL96C
Other nondurables	**CNOO96C**
Tobacco products	CNTOB96C
Prescription & over-the-counter drugs	CNDRUG96C
All other (2)	CNOTH96C
Services	**CS96C**
Housing	CSHOUS96C
Household operation	**CSHHOP96C**
Gas	CSHHOPG96C
Electricity	CSHHOPE96C
Telephony	CSHHOPT96C
Water & sewer	CSHHOPW96C
Domestic service	CSHHOPDOM96C
Other household operation (3)	CSHHOPOTH96C
Transportation	**CSTRANS96C**

Motor vehicle leases	CSTRANSMVLEASE96C
Own Transportation exc. leases	CSTRANSUSEROTH96C
Purchased local transportation	CSTRANSPURCH96C
Purchased intercity transportation	CSTRANSCITY96C
Medical Care	CSMED96C
Recreation	CSREC96C
Personal business services	**CSPERBUS96C**
"Free" Financial services	CSOSVNP96C
Other personal business services	CSPERBUSOTH96C
Other services (4)	CSOTH96C

* Variables denoted in bold are defined by identities.

(1) – sports equipment, jewelry, boats, books, etc.
(2) – toilet articles, semidurable house furnishings, cleaning stuff, toys, magazines, flowers, net foreign remittances, etc.
(3) – insurance, postage, etc.
(4) – education, personal care, net foreign travel, etc.

Table A2. Real Business Investment Variables in the Global Insight Model of the U.S. Economy *

Real gross private fixed nonresidential investment	**IFIX96C**
Investment in nonresidential equipment and software	**IPDENR96C**
Information equipment	**IPDENRINFO96C**
Computer equipment	IPDENRMCP96C
Software	IPDENRSW96C
Communications equipment	IPDENREQC96C
Other information equipment (1)	IPDENRINFOOTH96C
Industrial equipment	IPDENRIND96C
Transportation equipment	**IPDENRTRANS96C**
Light vehicles	IPDENRLV96C
Aircraft	IPDENRAC96C
Other transportation equipment (2)	IPDENRTRANOTH96C
Other equipment (3)	IPDENROTHR96C
Investment in nonresidential construction	**ICNR96C**
Structures excluding public utility & mines	**ICNRBAO96C**
Nonfarm buildings	**ICNRB_F96C**
Industrial	ICNRBIND96C
Commercial	ICNRBCM96C
Other nonfarm buildings (4)	ICNRBOTH96C
Other buildings (5)	ICNROTH96C
Mines & wells	ICNRMIAPET96C
Public utilities	**ICNRPU96C**
Public utilities exc. telecommunications	ICNRPUO96C
Telecommunications infrastructure	ICNRTAT96C
Inventory investment (change in real stock of inventories)	**INV96CCH**
Nonfarm inventories	**INVNF96CCH**
Manufacturing	INVM96CCH
Wholesale trade	INVTW96CCH
Retail trade	**INVTR96CCH**
Motor vehicles	INVTRDMV96CCH
All other	INVTR_MV96CCH
Miscellanenous	**INVMISC96CCH**
Construction, mining & utilities	INVCM_U96CCH
Other business	INVO96CCH
Farm inventories	INVAF96CCH

* Variables denoted in bold are defined by identities.

(1) – copiers, instruments, office & accounting equipment
(2) – buses, railroad equipment, ships
(3) – furniture, farm equipment, electrical equipment, service industry machinery less sale of used stuff other than vehicles
(4)– religious, educational, medical
(5)– farm, brokers' commissions

Table A3. Real Residential Investment Variables in the Global Insight Model of the U.S. Economy *

Housing starts including mobile homes	**HAMHUSTS**
Housing starts	**HUSTS**
Single-family starts	HUSTS1
Multi-family starts	HUSTS2A
Mobile home shipments	SHUMBL
Housing sales	
New single-family homes sales	HU1NSOLD
New single-family homes for sale	HU1NOFFER
Sales of existing single-family home	HU1SOLD
Investment in residential construction	**ICR96C**
New housing construction	**ICRHU96C**
Single family housing	ICRHU196C
Multi-family housing	ICRHU2A96C
Manufactured homes	ICRMH96C
Improvements	ICRIMP96C
Other structure	ICROTH96C
Investment in residential equipment	IPDER96C
Costs of housing	
Average price of existing single-family homes	PAHU1ESOLDNS
Average price of constant-quality new home	PAHU1NSOLD96NS
Average price of new single-family homes	PAHU1NSOLDNS
Median price of new single-family homes	PMHU1NSOLDNS
30-year fixed mortgage rate	RMMTGCONNS

* Variables denoted in bold are defined by identities.

Table A4. Real Federal Government Expenditure Variables in the Global Insight Model of the U.S. Economy *

Federal purchases of goods & services	**GF96C**
Defense	G**FML96C**
Consumption	**GFMLC96C**
Personnel outlays	G*FMLWSS_FAC96C*
Consumption of fixed capital	GFMLCFC96C
All else	*GFMLCO96C*
Gross investment	*GFMLGI96C*
Nondefense	**GFO96C**
Consumption	**GFOC96C**
Personnel outlays	G*FOWSS_FAC96C*
Consumption of fixed capital	GFOCFC96C
CCC inventory change	*GFONINV96CCH*
All else	*GFOCO96C*
Gross investment	*GFOGI96C*
Interest, dividends, transfer payments, subsidies and accruals:	
Federal net interest payments	INTNETGF
Federal transfer payments	**VGF**
Transfers to individuals	**VGF_PER**
Cyclical component	VGF_PERO
Non-cyclical component	**VGF_PERHI**
Medical	VGF_PERMED
Social security payments	VGF_PERSS
Other	VGF_PERHIO
Transfers to foreigners	*VGF_FOR*
Grants-in aid to state & local governments	**VAIDGF_SL**
Medicaid	VAIDGF_SLMED
Other	VAIDGF_SLO
Subsidies less current surplus	**SUB_SRPGF**
Agricultural programs	*SUB_SRPGF_AG*
Housing programs	*SUB_SRPGF_HUD*
Other federal enterprises	*SUB_SRPGF_O*
Wage accruals less disbursements (1)	*WALDGF*

* Variables denoted in bold are defined by identities; variables denoted in italics are exogenous.

(1) Negative expenditure.

Table A5. Real State & Local Government Expenditure Variables in the Global Insight Model of the U.S. Economy *

State & local purchases of goods & services	**GSL96C**
Consumption	**GSLC96C**
Personnel outlays	GSLWSS_FAC96C
Consumption of fixed capital	GSLCFC96C
All else	GSLCO96C
Gross investment	**GSLGI96C**
Equipment	GSLGIEQ96C
Construction	GSLGIIC96C
Interest, dividends, transfer payments, subsidies and accruals:	
Net interest payments	INTNETGSL
Transfers to individuals	**VGSL_PER**
Medical	VGSL_PERMED
Non-medical	VGSL_PERO
Subsidies less current surplus	*SUB_SRPGSL*
Wage accruals less disbursements (1)	*WALDGSL*
Dividends received	*DIVGSL*

* Variables denoted in bold are defined by identities; variables denoted in italics are exogenous.

(1) Negative expenditure.

Table A6. Components of National Income (Nominal) in the Global Insight Model of the U.S. Economy *

GNP = WSD + TX + CCACORP + CCANCORP + CCAG + YRENTADJ + YENTNFADJ + YENTAFADJ + ZB + INTBUS + YOL + TWER - SUB_SRPG + VBUS + CCADJZB + IVACORP + WALD + STAT

Gross National Product	**GNP**
Wage and salary disbursements	**WSD**
Private sector	WSDP
Government	WSDG
Excise tax receipts	**TX**
Federal	**TXGF**
State & local	TXGSL
Capital consumption allowances w/ adjustment	
Private	**CCAP**
Corporate	CCACORP
Non-corporate	CCANCORP
Government	**CCAG**
Rental income	YRENTADJ
Proprietors' income	
Nonfarm	YENTNFADJ
Farm	YENTAFADJ
Corporate Profits	**ZB**
Business interest payments	**INTBUS**
Other labor income	**YOL**
Health insurance	YOLERGHI
Other benefits	YOLOTH
Employer-paid payroll taxes	**TWER**
Federal	TWGFER
State & local	TWGSLER
Subsidies less current surplus	***SUB_SRPG***
Federal enterprises	*SUB_SRPGF*
State & local government enterprises	*SUB_SRPGSL*
Transfer payments by business	VBUS
Adjustment for capital consumption allowance	CCADJZB
Corporate inventory valuation adjustment	IVACORP
Wage accruals less disbursements	***WALD***
Federal government	*WALDGF*
State & local government	*WALDGSL*
Private sector	*WALDSV*
Statistical discrepancy	*STAT*

* Variables denoted in bold are defined by identities; variables denoted in italics are exogenous.

Table A7. Components of Personal Income (Nominal) in the Global Insight Model of the U.S. Economy *

YP = WSD + YOL + DIV_PER + VGF_PER + VGSL_PER + YINTPER + VBUS_PER + YRENTADJ + YENTNFADJ + YENTAFADJ - TWPER

Personal income	**YP**
Wage and salary disbursements	**WSD**
Private sector	WSDP
Government	WSDG
Other labor income	**YOL**
Health insurance	YOLERGHI
Other benefits	YOLOTH
Dividend payments to individuals	**DIV_PER**
Transfer payments to residents	
Federal	**VGF_PER**
Social Security	VGF_PERSS
Medicare	**VGF_PERMED**
Other full-employment	VGF_PERHIO
Remaining cyclical component	VGF_PERO
State and Local	**VGSL_PER**
Medical	**VGSL_PERMED**
All other	VGSL_PERO
Personal interest income	YINTPER
Business transfers	**VBUS_PER**
Rental income	YRENTADJ
Proprietors' income	
Nonfarm	YENTNFADJ
Farm	YENTAFADJ
Social insurance tax receipts from individuals	**TWPER**

* Variables denoted in bold are defined by identities; variables denoted in italics are exogenous.

Table A8. Key Variables in the Tax Sector of the Global Insight Model of the U.S. Economy *

Federal tax receipts	**TGF**
Personal	**TPGF**
Corporate	**TCGF**
Payroll	**TWGF**
Excise	**TXGF**
VAT	TXGFVAT
Other	TXGFOTH
Federal tax rates	
Personal	
Effective	RTPGF
Marginal	*RTPMARGF*
Corporate	
Statutory rate	*RTCGFS*
Investment tax credits (marginal rates)	*RITC...*
Payroll	*RTWGF*
State & local tax receipts	**TGSL**
Personal	**TPGSL**
Corporate	**TCGSL**
Payroll	**TWGSL**
Excise	TXGSL
Property	TXGSLPRTY
Federal grants-in aid to state & local governments	**VAIDGF_SL**
Medicaid	VAIDGF_SLMED
Other	VAIDGF_SLO
State & local tax rates	
Personal	RTPGSL
Corporate	*RTCGSL*
Payroll	*RTWGSL*

* Variables denoted in bold are defined by identities; variables denoted in italics are exogenous.

Table A9. Key Variables in the Trade Sector (Real) of the Global Insight Model of the U.S. Economy *

Exports	
Goods	**EXDAN96C**
Food	EX96CNIA0
Industrial supplies	EX96CNIA1
Capital equipment other than motor vehicles	**EX96CNIA2**
Aircraft	EX96CNIA2AC
Computers	EX96CNIA2BM
Other capital equipment	EX96CNIA2O
Motor vehicles & parts	EX96CNIA3
Consumer goods other than motor vehicles	EX96CNIA4
Miscellaneous goods	EX96CNIAO
Services	EXS96C
Imports	
Goods	**MDAN96C**
Food	M96CNIA0
Industrial supplies	**M96CNIA1**
Petroleum and products	M96CNIA100
Other	M96CNIA1_PET
Capital equipment other than motor vehicles	**M96CNIA2**
Aircraft	M96CNIA2AC
Computers	M96CNIA2BM
Other capital equipment	M96CNIA2O
Motor vehicles & parts	M96CNIA3
Consumer goods other than motor vehicles	M96CNIA4
Miscellaneous goods	M96CNIA5
Services	MS96C
Trade-weighted exchange rates	
With industrial countries	EXCH_IND
With developing countries	EXCH_DEV
Prices	
Industrial countries	WPIW_IND
Developing countries	WPIW_DEV
Lever controlling relative price impacts	*TRADEPLEV*
Lever controlling US price feedthroughs	*WPIWLEV*
Output	
Real trade-weighted GDP in other industrial countries	*GDPR_IND*
Real trade-weighted GDP in developing countries	*GDPR_DEV*
Long-term government bond yield	
Rest of industrialized world	RMGBL_IND

* Variables denoted in bold are defined by identities; variables denoted in italics are exogenous.

Table A10. Key Variables in the Financial Sector of the Global Insight Model of the U.S. Economy *

Interest rates	
Federal funds rate	**RMFEDFUNDNS**
Supply of reserve as instrument	RMFF_RES
Reaction function as instrument	RMFF_RCT
Treasury yield	
3-month bill rate	RMGBS3NS
6-month bill rate	RMGBS6NS
1-year bill yield	RMGFCM_1NS
2-year note yield	RMGFCM_2NS
5-year note yield	RMGFCM_5NS
10-year note yield	RMGFCM_10NS
Long-term bond yield	RMGFCM_30NS
Other	
Prime rate	RM1
3-month CDs, secondary market	RMCD3SECNS
3-month commercial paper	RMCML3NS
3-month Eurodollar deposits	RMLIBOR$3NS
48-month auto loans	RMALANCBNS
New York Fed discount rate	RMFRBNY
11th district cost of funds	RMCOF11DNS
30-year mortgage rate	RMMTGCONNS
Effective rate on loans closed on existing homes	RMMTGENS
Moody Aaa industrial bonds	RMMBCAAANS
Moody Baa industrial bonds	RMMBCBAANS
AA public utility bonds	RMPUAANS
Aaa-rated municipal bonds	RMAAAGSLNS
Municipal bond buyer 20-bond index	RMMCPLBBNS
Other Financial Variables	
M1	**MNY1**
Currency and travelers' checks	CURRATC
Checkable deposits	DCHK
M2	MNY2
M3	MNY3
Household net worth	**HHNETWORTH**
Real estate & other nonfinancial assets	HHOTHERASSETS
Financial assets	**HHFASSETS**
Equities	HHEQUITY
Money	HHMNY
Other	HHOTHERINV
Household liabilities	HH_LBL
Home mortgages outstanding	MTGHO
Non-mortgage consumer credit	CDTPI
Business loans at commercial banks	ALCAI_CB
S&P 500	JSAP500NS
Wilshire 5000	WL5000NS

* Variables denoted in bold are defined by identities; variables denoted in italics are exogenous.

Industry Model Detail

Table A11. Final Demand Categories Driving the Industry Model

Personal Consumption Expenditures

CDFURN96C	Real consumer spending on furniture & household equipment
CDAUTON96C	Real consumer spending on new automobiles
CDTTAAP96C	Real consumer spending on tires, tubes, accessories & parts
CDMVOTH96C	Weighted sum of CDTRUCKN96C & CDMVOTHO96C
CDTRUCKN96	Real consumer spending on new light trucks
CDMVOTHO96C	Real consumer spending on motor vehicles other than cars & light trucks
CDAUTOUN96C	Real consumer spending on used automobiles
CDO96C	Real consumer spending on other durable goods
CNCS96C	Real consumer spending on clothing & shoes
CNFOOD96C	Real consumer spending on food
CNFUEL96C	Real consumer spending on fuel oil & coal
CNGAS96C	Real consumer spending on gasoline & motor oil
CNOO96C	Real consumer spending on other nondurables
CSHHOPE96C	Real consumer spending on electricity
CSHHOPG96C	Real consumer spending on natural gas
CSHHOPW96C	Real consumer spending on water & sewer service
CSHHOPT96C	Real consumer spending on telephony
CESHHOTH96C	Weighted sum of CSHHOPOTH96C & CSHHOPDOM96C
CSHHOPOTH96C	Real consumer spending on other household operations
CSHHOPDOM96C	Real consumer spending on domestic service
CSHOUS96C	Real consumer spending on housing
CSMED96C	Real consumer spending on medical services
CSRECOOO96C	Weighted sum of CSPERBUS96C & CSOTH96C
CSPERBUS96C	Real consumer spending on personal business services
CSOTH96C	Real consumer spending on other services
CSTRANS96C	Real consumer spending on transportation services

Investment and Inventories

IPDENRIND96C	Real gross nonresidential investment in industrial equipment
IPDENRINFO96C	Real gross nonresidential investment in information equipment
IPDENROTHR96C	Real gross nonresidential investment in other equipment
IPDENRTRANS96C	Real gross nonresidential investment in transportation equipment
ICNR96C	Real investment in nonresidential construction
IFIXR96C	Real gross private fixed residential investment
INV96CCH	Change in real stock of business inventories

Exports

EX96CNIA0	Real exports of foods, feeds & beverages
EX96CNIA1	Real exports of industrial materials &supplies
EX96CNIA2AC	Real exports of aircraft
EX96CNIA2BM	Real exports of computer equipment
EX96CNIA2O	Real exports of other capital equipment
EX96CNIA3	Real exports of motor vehicles & parts

EX96CNIA4	Real exports of non-automotive consumer goods
EX96CNIAO	Real exports of other goods
EXS96C	Real exports of services

Imports

M96CNIA0	Real imports of foods, feeds & beverages
M96CNIA100	Real imports of petroleum and products
M96CNIA1_PET	Real imports of industrial materials & supplies exc. petroleum & products
M96CNIA2AC	Real imports of aircraft
M96CNIA2BM	Real imports of computer equipment
M96CNIA2O	Real imports of other capital equipment other than motor vehicles
M96CNIA3	Real imports of motor vehicles & parts
M96CNIA4	Real imports of non-automotive consumer goods
M96CNIA5	Real imports of other goods
MS96C	Real imports of services

Government Spending

GFMLC_WSS96C	Weighted sum of GFMLCFC96C & GFMLCO96C
GFMLCFC96C	Real federal defense consumption of fixed capital
GFMLCO96C	Real federal defense consumption exc. depreciation & personnel
GFMLGI96C	Real federal defense gross investment
GFMLWSS_FAC96C	Real federal defense personnel outlays
GFOC_WSS96C	Weighted sum of GFOCFC96C & GFOCO96C
GFOCFC96C	Real federal nondefense consumption of fixed capital
GFOCO96C	Real federal nondefense consumption exc. depreciation & personnel
GFOGI96C	Real federal nondefense gross investment
GFOWSS_FAC96C	Real federal nondefense personnel outlays
GSLC_WSS96C	Weighted sum of GSLCFC96C & GSLCO96C
GSLCFC96C	Real state and local consumption of fixed capital
GSLCO96C	Real state and local consumption exc. capital consumption & personnel
GSLGI96C	Real state and local gross investment
GSLWSS_FAC96C	Real state and local personnel outlays

Table A12. Detailed Industrial Sectors

Sectoral Code	Definition	SIC (1987) Category
AGR	**Agriculture, Forestry, and Fishing**	01-09
AGRA	Dairy and Poultry	024, 0251-3, 0259
AGRB	Meats, Animals, Livestock	0211-9, 0271-3, 0279, 029
AGRC	Cotton	0131
AGRD	Food Grains	0111-2, 0119, 019
AGRE	Feed Grains	0115
AGRF	Oil-Bearing Crops	0116
AGRG	Agriculture, N.E.C.	0132-9, 016, 017, 0181
AGRH	Forestry and Fishing	0182, 08 (except 085), 09 (exc. 092)
AGRI	Forestry, Fishery Services	07, 085, 092
AGRCTOG	Agriculture - Crops	AGRC to AGRG
AGRABHI	Other Agriculture, Forestry & Fishing	AGRA, AGRB, AGRH, AGRI
MIN	Mining	10-14
10	Metal Mining	10
10A	Iron Ore	101, 106
10B	Copper	102
10C	Other Metal Mining	103-4, 108-9
12	Coal Mining	12
13	Oil and Gas Extraction	13
13A	Crude Petroleum	part of 13
13B	Natural Gas	part of 13
14	Nonmetal Minerals, except Fuels	14
14A	Chemical Fertilizer	147
14B	Other Nonmetal Mining	141-5, 148-9
1014	Metal and Nonmetal Minerals, except Fuels	10, 14
CON	Construction	15-17
CONA	Residential Contract Construction	152, 178, pt. of 171-7, pt. of 1793-4
CONB	Nonresidential Contract Construction	154, 1623-9, 1791, pt. of 1795-6, pt. of 171-7, pt. of 1793-4
CONC	Other Contract Construction	16 except 1623-9, pt. of 177-8, pt. of 1795-6
MFG	Manufacturing	20-39
MFGDUR	Durables	24-25, 32-39
MFGNON	Nondurables	20-23, 26-31
20	Food and Kindred Products	20
20A	Meat Products	201
20B	Dairy Products	202

Sectoral Code	Definition	SIC (1987) Category
20C	Fats and Oils	207
20D	Beverages	208
20E	All Other Foods	203-6, 209
21	Tobacco Products	21
22	Textile Mill Products	22
22A	Broadwoven Fabrics and Other Textiles	221-4, 226, 228-9
22B	Knitting Mill Products	225
22C	Carpets and Rugs	227
23	Apparel and Other Finished Textile Prods	23
24	Lumber and Wood Products	24
24A	Wood Containers, Pallets and Skids	244
24B	Wood Buildings, Mobile Homes	245
24C	Other Wood Products	241-3, 249
25	Furniture and Fixtures	25
25A	Household Furniture	251
25B	Furniture, except Household	52-4, 259
26	Paper and Allied Products	26
26A	Pulp, Paper, and Paperboard Mill Products	261-3
26B	Paperboard Containers and Boxes	265
26C	Miscellaneous Converted Paper Products	267
27	Printing, Publishing and Allied Industries	27
27A	Newspapers, Periodicals and Books	271-3
27B	Other Publishing and Printing	274-9
28	Chemicals and Allied Products	28
281A6	Inorganic & Organic Chemicals	281, 286
28D	Agricultural Chemicals	287
28OTH	Other Chemicals	28 – 281A6 - 28D
29	Petroleum Refining and Related Industries	29
29A	Asphalt Paving and Roofing Materials	295
29B	Petroleum Refining, exc Paving and Roofing	291, 299
30	Rubber and Miscellaneous Plastic Products	30
30A	Tires and Tubes	301
30B	Rubber and Plastic Footwear, Hose, Belting	302, 305-6
30C	Miscellaneous Plastic Products, n.e.c.	308
31	Leather and Products	31
31A	Leather, Tanning & Finishing & Cut Stock	311, 313
31B	Other Leather Products	314-9

Sectoral Code	Definition	SIC (1987) Category
32	Stone, Clay, and Glass Products	32
32GLASS	Glass & Glass Products	321, 322, 323
32CEMENT	Cement	324
32OTH	Other Stone and Clay Products	32 – 321 to 324
33	Primary Metal Industries	33
33A	Blast Furnaces and Steel Mills Products	331
33B	Iron and Steel Foundry Products	332
33ALUM	Aluminum	3334, pt 3341, 3353-5
33COTH	Other Nonferrous Metal Products	33C - 33ALUM
34	Fabricated Metal Products	34
34A	Metal Cans and Shipping Containers	341
34B	Cutlery and Handtools	342 (exc 3429)
34C	Building Materials and Wire Products	3429, 343-4, 3495-96
34DE	Ordnance and Accessories	348
34F	Miscellaneous Fabricated Metal Products	345-347, 349 (exc 3495-95)
35	Industrial Machinery and Equipment	35
35A	Turbines and Turbine Generator Sets	3511
35B	Internal Combustion Engines	3519
35C	Farm and Garden Machinery	352
35D	Construction, Mining, & Mat'l Handling Eq.	353
35E	Metalworking Machinery	354
35F	Special Industry Machinery	355
35G	General Industrial Machinery	356
35H	Computer and Office Machines	357
35I	Refrigeration, Heating & Service Industry	358
35J	Industrial Machinery, n.e.c.	359
36	Electronic and other Electrical Equipment	36
36A	Electrical Transmission and Distribution Eq.	361
36B	Electrical Industrial Apparatus	362
36C	Household Appliances	363
36D	Electric Lighting and Wiring Equipment	364
36E	Household Radio and Video Equipment	365
36FG	Communication Equipment	366
36H	Electronic Components and Accessories	367
36I	Miscellaneous Electrical Equip & Supplies	369
37	Transportation Equipment	37
37AB	Motor Vehicles and Parts	371
37CD	Complete Aircraft	3721, 61
37EF	Aircraft Parts	3724, 3728, 3764, 3769
37GH	Shipbuilding and Tanks	3731, 3795
37I	Railroad Equipment	374
37J	Other Transportation	3732, 375, 3792, 3799

Sectoral Code	Definition	SIC (1987) Category
38	Instruments and Related Products	38
38AB	Search and Navigation Equipment	381
38C	Measuring and Controlling Devices	382
38D	Medical Instruments and Supplies	384
38E	Ophthalmic Goods	385, 387
38F	Photographic Goods	386
39	Other Durable Goods	39
39A	Miscellaneous Personal Goods	391-4, 396, 3995
39B	Other Durable Goods	395, 399 (exc 3995)
	Service Sectors:	
TRN	Transportation	40-47
40	Railroads	40
41	Local and Interurban Passenger	41
42	Motor Freight and Warehousing	42
43	Postal Service	43
44	Water	44
45	Air	45
46	Pipelines, Except Natural Gas	46
47	Transportation Services	47
48	Communications	48
48A	Radio and Television Broadcasting	483
48B	Other Communications	481-2, 484-9
49	Utilities	49
49A	Electric (Public and Private)	491, part of 493
49B	Gas	492, part of 493
49C	Sanitary Services	494-7
WRT	Wholesale and Retail Trade	50-59
WST	Wholesale Trade	50-51
RET	Retail Trade	52-59
FIR	Finance, Insurance and Real Estate	60-69
FIN	Finance	60-62, 67
INS	Insurance	63-64
RE	Real Estate	65
SER	Services	70-89
70	Hotels and Lodging	70
PRS	Personal and Repair Services	72, 76
73	Business Services	73
75	Auto Repair and Rental	75
AMU	Amusements	78, 79
80	Health	80
81	Legal	81

Sectoral Code	Definition	SIC (1987) Category
82	Educational	82
SERO	Membership and Social Services	83, 84, 86
87	Engineering & Management Services	87
GGEG	General Government	90-97
GEFX491	Federal Enterprises	part of 01-89
GENX491	State and Local Enterprises	part of 01-89

Employment Model Detail

Table A13. Employment Sectors

Code	Description
MFG	**Manufacturing**
20	Food & Kindred Products
21	Tobacco Manufactures
22	Fabric, Yarn & Thread Mills
23	Apparel and Other Finished Textile Products
24	Lumber and Wood Products
25	Furniture and Fixtures
26	Paper and Allied Products
27	Printing, Publishing and Allied Industries
28	Chemicals and Allied Products
281A6	Inorganic & Organic Chemicals
28D	Agricultural Chemicals
28OTH	Other Chemicals
29	Petroleum Refining and Related Industries
29A	Asphalt Paving and Roofing Materials
29B	Petroleum Refining, exc. Paving and Roofing
30	Rubber and Miscellaneous Plastic Products
31	Leather and Products
32	Stone, Clay, and Glass Products
32GLASS	Glass & Glass Products
32CEMENT	Cement
32OTH	Other Stone and Clay Products
33	Primary Metal Industries
33A	Glass Containers
33B	Kitchen Articles and Pottery
33ALUM	Aluminum
33COTH	Other Nonferrous Metal Products
34	Fabricated and Metal Products
35	Industrial Machinery and Equipment
36	Electronic and other Electrical Equipment
37	Transportation Equipment
38	Instruments and Related Products
39	Other Durable Goods
AGR	**Agriculture, Forestry, and Fishing**
AGRABHI	Livestock and Products (Including Dairy and Poultry & Meats, Animals, Livestock & Forestry and Fishing & Forestry, Fishery Services)
AGRCTOG	Crops and Products (Including Cotton, Food Grains, Feed Grains, Oil-Bearing Crops, & Agriculture, n.e.c.)

Code	Description
MIN	**Mining**
1014	Metal Mining & Nonmetal Minerals, excepts Fuels
10	Metal Mining
12	Coal Mining
13	Oil and Gas Extraction
14	Nonmetal Minerals, excepts Fuels
CON	**Construction**
SER	**Service**
TRN	Transportation
48	Communications
49	Utilities
49A	Electric (Public and Private)
49B	Gas
49C	Sanitary Services
WST	Wholesale Trade
RET	Retail Trade
58	Eating and Drinking Places
FIR	Finance, Insurance and Real Estate
SERX	Miscellaneous Services (Hotels and Lodging, Personal and Repair, Business, Amusements, Health, Legal, Educational, Membership and Management Services)
75	Auto Repair and Rental
87	Engineering & Management Services
GGE	Public, Administration
GFED	Federal Government
GSAL	State & Local Government

Regional Model Detail

Table A14. Output Detail in the Regional Model

Code	Description	SIC (1987) Category
1	Food & Kindred Products	20 less 208
2	Beverage and Tobacco Products	208 & 21
3	Textile Mill Products	22
4	Apparel Products	23
5	Lumber & Products	24
6	Furniture & Fixtures	25
7	Paper & Products	26
8	Printing & Publishing	27
	Chemicals & Products	28
9	Basic Inorganic Chemicals	281
10	Basic Organic Chemicals	286
11	Synthetic Materials	282
12	Agricultural Chemicals	287
13	Other Chemicals	283-5, 289
	Petroleum & Products	29
14	Petroleum Refining	291, 295
15	Other Petroleum Products	299
16	Rubber & Plastics Products	30
17	Leather Products	31
	Stone, Clay & Glass Products	32
18	Glass Products	321-3
19	Cement	324
20	Other Stone, Clay & Glass	325-9
	Primary Metals	33
21	Basic Steel & Mill Products	331
22	Aluminum	3334, 3341, 3353-5
23	Other Primary Metals	33 less steel & aluminum
24	Fabricated Metal Products	34
25	Non-electrical Machinery	35
26	Electrical Machinery	36
27	Transportation Equipment	37
28	Instruments	38
29	Miscellaneous Manufacturing	39
30	Crops	various 01-09
31	Livestock	various 01-09
32	Coal Mining	12
33	Oil & Gas Extraction	13
34	Other Mining	10, 14
35	Construction	15, 16, 17

Table A15. Employment Detail in the Regional Model

Code	Description	SIC (1987) Category
EEA	Total Nonfarm Employment	10-99
E20	Food & Kindred Products	20
E21	Tobacco Products	21
E22	Textile Mill Products	22
E23	Apparel Products	23
E24	Lumber & Products	24
E25	Furniture & Fixtures	25
E26	Paper & Products	26
E27	Printing & Publishing	27
E28	Chemicals and Allied Products	28
E29	Petroleum Refining and Related Industries	29
E30	Rubber & Plastics Products	30
E31	Leather Products	31
E32	Stone, Clay, and Glass Products	32
E33	Primary Metal Industries	33
E34	Fabricated Metal Products	34
E35	Non-electrical Machinery	35
E36	Electrical Machinery	36
E37	Transportation Equipment	37
E38	Instruments	38
E39	Miscellaneous Manufacturing	39
EAG	Agriculture, Forestry, and Fishing	01-09
EMI	Mining	10-14
EC	Construction	15-17
ETW	Wholesale Trade	50-51
ETR	Retail Trade	52-59
ER	Transportation, Communications & Utilities	47-49
EFIR	Finance, Insurance and Real Estate	60-69
ESV	Services	70-89
EGF	Federal Government	part of 90-99
EGSL	State & Local Government	part of 90-99

Commercial Floorspace Model Detail

Table A16. Commercial Floorspace Types

Code	Description
STOR	Stores and restaurants
WARE	Manufacturing and wholesale trade, public and federally-owned warehouses
OFFI	Private, federal, and state and local offices
AUTO	Auto service and parking garages
MFG	Manufacturing
EDU	Primary, secondary and higher education
HEAL	Health - hospitals and nursing homes
PUB	Federal and state and local government
REL	Religious
AMUS	Amusement
MISC	Miscellaneous, non-residential - transportation related and all other not elsewhere classified
HOTE	Hotels and motels
DORM	Dormitories, educational and federally-owned (primarily military)

Appendix B: MAM Input and Output

Introduction

This Appendix describes the input data, parameters, variables, and data calibrations that are required for the execution of the Macroeconomic, Industry, Employment, Regional and Commercial Floorspace Submodules of the Macroeconomic Activity Module (MAM). These data provide a detailed representation of drivers required to support macroeconomic activity forecasting in support of MAM. Appendix B also presents the primary outputs generated by MAM, and the MAM filenames required for the generation of NEMS scenarios. As described in the main text of this Volume, the Macroeconomic Submodule of MAM uses the Global Insight Model of the U.S. Economy, and the Industry and Employment Submodules of MAM also use proprietary econometric models developed by Global Insight.

Table B1 identifies the files used/produced by MAM during the NEMS execution process. It also indicates whether each file is an input or an output file, and describes the general contents of each file.

Input

Table B2 describes the parameters and controls specified at the start of a MAM run. They include user-specified modeling switches and variable subscripts used in the MAM FORTRAN source code. The user-specified switches enable the modeler to choose between alternative assumptions in the scenario development process.

Table B3 lists the contents of the MCBASE input file, which contains the baseline values of all the national variables passed from MAM to NEMS. There are three versions of MCBASE for the three macroeconomic scenarios - the Reference case, High Economic Growth case, and Low Economic Growth case. The NEMS user chooses one version of MCBASE (see MMAC in Table B2) to serve as the baseline to drive the energy market solution. The values contained in the MCBASE file are developed by running the three Global Insight models – Macroeconomic Model, Industry Model and Employment Model - based on an initial set of energy assumptions set out in the beginning of the forecasting process. In a simulation run, ratios describing the deviations of the scenario results from the model baseline are computed, and are multiplied to the MCBASE values to produce the simulation results. The variables in the MCBASE file are national in scope, and cover the period from 1990 through 2025, annually.

Table B4 lists the contents of the MCRGBASE input file, which contains the baseline values of all the regional variables for 1990 through 2025. The file has 828 records, covering 92 variables for the nine Census Divisions. In the Annual Energy Outlook 2004, the 2003 version of

MCRGBASE was used. Region-to-national ratios were computed for each variable and applied to the national variables to derive the regional variables. For a policy simulation, the same set of ratios is used but they are applied onto the national variables derived from the simulations of the other MAM Submodules.

Input from NEMS

Before calling on the EViews version of the Macroeconomic model, MAM calculates the 26 Global Insight input values using 68 NEMS selection variables. Table B5 defines the input energy variables. For each, the Global Insight model mnemonic is given along with its definition. The final column of Table B5 lists the NEMS variables which are used to calculate the corresponding Global Insight selection variable.

MAM also calculates industrial gross output growth rates for the energy sectors (Petroleum Refining, Coal Mining, Oil & Gas Extraction, Electric Utilities, and Gas Utilities) based on physical activity for the appropriate NEMS supply or conversion modules, and applies them onto the historical output series in the Industry Model. In the Employment Model, employment forecasts for two energy sectors (Coal Mining and Oil & Gas Extraction) are computed using growth rates extracted from the appropriate NEMS modules. Table B6 describes the NEMS variables used to calculate the growth rates for each sector.

Output

Table B7 lists the macroeconomic variables output from the Macroeconomic Submodule of MAM. Annual historical data as from 1990 and forecasts through 2025 are produced on a worksheet called MC_NATIONAL.

Table B8 defines industrial gross output variables contained within the Industry Submodule of MAM. Forecast growth rates of the five energy industry sectors are replaced by the NEMS results. MC_INDUSTRIAL is a worksheet that presents the history and forecasts of the industrial output by sector for the nine Census Divisions and for the United States.

Table B9 defines the employment variables contained in the Employment Submodule of MAM. Forecast growth rates of two energy industry sectors are replaced by the NEMS results. Historical and forecast data for the detailed industry sectors and aggregates are shown in MC_EMPLOYMENT.

Regional data and commercial floorspace data produced by the Regional Submodule and the Commercial Floorspace Submodule of MAM are presented in MC_REGIONAL. Table B10 describes the regions and variables contained in the worksheet.

Table B11 provides a listing of the MACOUT common block variables referenced by other NEMS modules. The final column lists the referencing NEMS modules and submodules, with a description of the module and submodule abbreviations following Table B11.

Table B1. MAM Input and Output Files

Filename	Content	Input or Output
MCPARMS.TXT	Parameters	Input
MCBASE.WK1 (Reference, High or Low Economic Growth Cases)	Macroeconomic (including Industry and Employment) baseline variables (scenario specific)	Input
MCRGBASE.WK1	Regional baseline variables	Input
MC_NATIONAL.WK1	National variable solution results and baseline values, including percent changes from base	Output
MC_INDUSTRIAL.WK1	Industrial variable solution results and baseline values	Output
MC_EMPLOYMENT.WK1	Employment variable solution results and baseline values	Output
MC_REGIONAL.WK1	Regional variable solution results and baseline values	Output
MC_COMMON.WK1	Common block variables for all submodules, including National, Employment, Industrial and Regional	Output

Table B2. MAM Input Control and Parameters

Parameter Name	Input Type (filename)	Input Description
EXM	Run-time option (SCEDES)	MAM Model Switch, 1 = on, 0 = off
MMAC	Run-time option (SCEDES)	Macroeconomic growth scenario: 1 = Low, 2 = Reference, 3 = High
MACTAX	User-defined parameter (SCEDES)	Distribution of energy tax, 0=No distribution, 1=Return to consumers, 2=Return to business
CAFE (currently not used)	User-defined parameter (SCEDES)	Unit cost of automobiles under new CAFE standards, 0=No change from baseline, 1=factor cost determined by NEMS TRAN results, 2=factor cost endogenously determined in model
MACFDBK	Run-time option (SCEDES)	Macroeconomic feedback lever, 1 = on, 0 = off
MCNMFDVARS = 59	MAM parameter (MCPARMS)	Number of macroeconomic final demand variables
MCNMIND = 35	MAM parameter (MCPARMS)	Number of regionalized industry output variables
MCNMSERV = 10	MAM parameter (MCPARMS)	Number of non-regionalized service output variables
MCLHISYR = 2003	MAM parameter (MCPARMS)	Last historical year in the forecast
MCNMMAC = 54	MAM parameter (MCPARMS)	Number of non-regionalized macroeconomic variables in the baseline
MCNMNATREG = 14	MAM parameter (MCPARMS)	Number of regionalized macroeconomic variables from the macroeconomic model in the baseline
MCNMMACREG = 57	MAM parameter (MCPARMS)	Number of regionalized macroeconomic variables in the baseline
MCNMINV = 216	MAM parameter (MCPARMS)	Number of capital equipment variables in the baseline
MCNUMMNF = 29	MAM parameter (MCPARMS)	Number of manufacturing industry variables in the baseline
MCNUMREGS = 11	MAM parameter (MCPARMS)	The nine Census Divisions, a placeholder for California (currently not in use), and the national total of all Census Divisions
MCNMFLTYPE=14	MAM parameter (MCPARMS)	Number of commercial floorspace types, including total
NUMEMPL = 46	MAM parameter (MCPARMS)	Number of Industrial Employment categories
NEMSENERGYNUM = 170	MAM parameter (MCPARMS)	Number of exogenous variables (aggregates and components) from NEMS
SCENNUM = 55	MAM parameter (MCPARMS)	Number of driver variables passed to MAM models from NEMS
NUMEPMAC = 261	MAM parameter (MCPARMS)	Number of solution variables returned to NEMS from MAM
RMFFLEV	MAM parameter (MCPARMS)	Federal Fund Rate Lever, 0=Rate determined by balance of reserve, 1=Rate determined in response to changes in inflation and unemployment

Table B3. MCBASE Input Variables

(First 26 rows are the NEMS energy variables)

Row	Variable Name	Description	Source
27	CONS96C	Consumer Spending on all Goods & Services, billions of chained 96$	Macro
28	CD96C	Consumer Spending on Durable Goods, billions of chained 96$	Macro
29	CDMVAP96C	Consumer Spending on Motor Vehicles and Parts, billions of chained 96$	Macro
30	CDFURN96C	Consumer Spending on Furniture, billions of chained 96$	Macro
31	CDCMPASW96C	Consumer Spending on Computers and Software, billions of chained 96$	Macro
32	CDFURN_CSW96C	Consumer Spending on Furniture, exc Computers and Software, billions of chained 96$	Macro
33	CDOTH96C	Consumer Spending on Other Durable Goods, billions of chained 96$	Macro
34	CDOOPHT96C	Consumer Spending on Ophthalmic Products, billions of chained 96$	Macro
35	I96C	Gross Private Domestic Investment, Total, billions of chained 96$	Macro
36	IFIX96C	Gross Private Fixed Investment, billions of chained 96$	Macro
37	IFIXNR96C	Gross Private Fixed Nonresidential Investment, billions of chained 96$	Macro
38	IPDENR96C	Gross Nonresidential Investment in Equipment, billions of chained 96$	Macro
39	IPDENRLV96C	Gross Nonresidential Investment in Light Duty Vehicles, billions of chained 96$	Macro
40	IPDENREQC96C	Gross Nonresidential Investment in Communications Equipment, billions of chained 96$	Macro
41	IPDENRMCP96C	Gross Nonresidential Investment in Computer Equipment, billions of chained 96$	Macro
42	IPDENRSW96C	Gross Nonresidential Investment in Software, billions of chained 96$	Macro
43	IPDENRMISC96C	Gross Nonresidential Investment in Miscellaneous Equipment, billions of chained 96$	Macro
44	ICNR96C	Gross Nonresidential Investment in Structures, billions of chained 96 $	Macro
45	ICNRBAO96C	Gross Investment in Nonresidential Structures, Buildings and Other, billions of chained 96$	Macro
46	ICNRMIAPET96C	Gross Investment in Nonresidential Structures, Mining and Exploration, billions of chained 96$	Macro
47	ICNRPU96C	Gross Investment in Nonresidential Structures, Public Utilities, billions of chained 96$	Macro
48	IFIXR96C	Gross Private Fixed Residential Investment, billions of chained 96$	Macro
49	ICR96C	Gross Residential Investment, billions of chained 96$	Macro
50	IPDER96C	Gross Investment in Residential Equipment, billions of chained 96$	Macro
51	GDP96C	Gross Domestic Product, billions of chained 96$	Macro
52	GDP96CFE	Gross Domestic Product at full employment, billions of chained 96$	Macro
53	CONS96C	Consumer Spending on all Goods & Services, billions of chained 96$	Macro
54	I96C	Gross Private Domestic Investment, Total, billions of chained 96$	Macro
55	EX96C	Exports of Goods & Services, billions of chained 96$	Macro

56	M96C	Imports of Goods & Services, billions of chained 96$	Macro
57	G96C	Government Purchases of Goods & Services, billions of chained 96$	Macro
58	CD96C	Consumer Spending on Durable Goods, billions of chained 96$	Macro
59	CN96C	Consumer Spending on Nondurable Goods, billions of chained 96$	Macro
60	CS96C	Consumer Spending on Services, billions of chained 96$	Macro
61	ICNR96C	Gross Nonresidential Investment in Structures, billions of chained 96 $	Macro
62	ICR96C	Gross Residential Investment, billions of chained 96$	Macro
63	IPDENR96C	Gross Nonresidential Investment in Equipment, billions of chained 96$	Macro
64	IPDER96C	Gross Residential Investment in Equipment, billions of chained 96$	Macro
65	IFIX96C	Gross Private Fixed Investment, billions of chained 96$	Macro
66	IFIXNR96C	Gross Private Fixed Nonresidential Investment, billions of chained 96$	Macro
67	IFIXR96C	Gross Private Fixed Residential Investment, billions of chained 96$	Macro
68	EX96CNIA0	Exports, Foods, Feeds, & Beverages, billions of chained 96$	Macro
69	EX96CNIA1	Exports, Industrial Supplies & Materials, billions of chained 96$	Macro
70	EX96CNIA2	Exports, Capital Goods exc autos, billions of chained 96$	Macro
71	EX96CNIA3	Exports, Automotive Vehicles, Engines & Parts, billions of chained 96$	Macro
72	EX96CNIA4	Exports, Consumer Goods except Automotive, billions of chained 96$	Macro
73	EXDAN96C	Exports, Goods, billions of chained 96$	Macro
74	EXS96C	Exports, Services, billions of chained 96$	Macro
75	M96CNIA0	Imports, Foods, Feeds, and Beverages, billions of chained 96$	Macro
76	M96CNIA1	Imports, Industrial Supplies & Materials, billions of chained 96$	Macro
77	M96CNIA2	Imports, Capital Goods excl. Motor Vehicles, billions of chained 96$	Macro
78	M96CNIA3	Imports, Motor Vehicles & Parts, billions of chained 96$	Macro
79	M96CNIA4	Imports, Non-automotive Consumer Goods, billions of chained 96$	Macro
80	MS96C	Imports, Services, billions of chained 96$	Macro
81	INV96CCH	Change in Real Stock of Business Inventories, billions of chained 96$	Macro
82	GFML96C	Federal Defense Purchases of Goods and Services, billions of chained 96$	Macro
83	GDP	Gross Domestic Product, billions of nominal $	Macro
84	CONS	Consumer Spending on all Goods & Services, billions of nominal $	Macro
85	I	Gross Private Domestic Investment, billions of nominal $	Macro
86	GNP96C	Gross National Product, billions of chained 96$	Macro
87	PCWGDP	Chained Price Index, GDP, 1996 = 1.0 (1987 = 1.0 in MC_COMMON)	Macro
88	RMGBS3NS	Discount Rate on 3-Month U.S. Treasury Bills	Macro
89	RMMTGCONNS	Conventional 30-Year Mortgage Commitment Rate	Macro
90	RMPUAANS	Yield on AA Public Utility Bonds	Macro
91	REALRMGBLUS	Real Average Yield on U.S. Treasury Long-term Bonds	Macro
92	ECIWSP	Employment Cost Index, Wages & Salaries, Private Sector, June 1989 = 1.0	Macro

93	SQTRCARS	Unit Sales of Automobiles, Total, millions of units	Macro
94	SQLV	Unit Sales of New Light Vehicles, millions of units	Macro
95	SQDTRUCKSL	Unit Sales of New Light Trucks, millions of units	Macro
96	SQDTRUCKSHAM	Unit Sales of Heavy and Medium Trucks, millions of units	Macro
97	RUC	Unemployment Rate, All Civilian Workers	Macro
98	WPI	Producer Price Index, All Commodities, 1982 = 1.0	Macro
99	WPI11	Producer Price Index, Machinery & Equipment, 1982 = 1.0	Macro
100	WPI14	Producer Price Index, Transportation Equipment, 1982 = 1.0	Macro
101	LC_DW	Civilian Labor Force as Measured by the Household Survey, millions of persons	Macro
102	RMFEDFUNDNS	Effective Rate on Federal Funds	Macro
103	WPI05	Producer Price Index, Fuels, Related Products & Power, 1982 = 1.0	Macro
104	RMGFCM_10NS	Yield on 10-year Treasury Notes	Macro
105	CPI	Consumer Price Index (All Urban) - All Items, 1982-84 = 1.0	Macro
106	YD96C	Disposable Personal Income, billions of chained 96$	Macro
107	WSD	Wage & Salary Disbursements, billions of nominal $	Macro
108	YP96C	Personal Income, billions of chained 96$	Macro
109	SHUMBL	Mobile Homes Shipments, millions of units	Macro
110	HUSTS1	Single-Family Housing Starts, millions of units	Macro
111	HUSTS2A	Multi-Family Housing Starts, millions of units	Macro
112	KQMH	Stock of Mobile Homes, millions of units	Macro
113	KQHUSTS1	Stock of Single-Family Housing, millions of units	Macro
114	KQHUSTS2A	Stock of Multi-Family Housing, millions of units	Macro
115	N_DW	Population Including Armed Forces Overseas, millions of persons	Macro
116	N16A_DW	Population Aged 16 and Over, millions of persons	Macro
117	RWM_SUM	Average Annual Manufacturing Wages, thousands of nominal $	Regional
118	RWNM_SUM	Average Annual Non-Manufacturing Wages, thousands of nominal $	Regional
119	EE	Employment, Total Nonfarm, millions of employees	Macro
120 - 122	not used		
123	EEGFED	Employment, Federal Government, millions of employees	Macro
124 - 146	not used		
147	EEGSAL	Employment, State & Local Government, millions of employees	Macro
148	not used		
149	IOMC_MFGO1	Production, Food & Kindred Products exc Beverages (SIC 20 less 208), millions of fixed 96$	Industry
150	IOMC_MFGO2	Production, Beverages & Tobacco Products (SIC 208, 21), millions of fixed 96$	Industry
151	IOMC_MFGO3	Production, Textile Mill Products (SIC 22), millions of fixed 96$	Industry

152	IOMC_MFGO4	Production, Apparel & Other Textiles (SIC 23), millions of fixed 96$	Industry
153	IOMC_MFGO5	Production, Lumber & Wood Products (SIC 24), millions of fixed 96$	Industry
154	IOMC_MFGO6	Production, Furniture & Fixtures (SIC 25), millions of fixed 96$	Industry
155	IOMC_MFGO7	Production, Paper & Allied Industries (SIC 26), millions of fixed 96$	Industry
156	IOMC_MFGO8	Production, Printing & Publishing (SIC 27), millions of fixed 96$	Industry
157	IOMC_MFGO9	Production, Inorganic Chemicals (SIC 281), millions of fixed 96$	Industry
158	IOMC_MFGO10	Production, Organic Chemicals (SIC 286), millions of fixed 96$	Industry
159	IOMC_MFGO11	Production, Plastic Materials & Synthetics (SIC 282), millions of fixed 96$	Industry
160	IOMC_MFGO12	Production, Agricultural Chemicals (SIC 287), millions of fixed 96$	Industry
161	IOMC_MFGO13	Production, Other Chemicals & Allied (SIC 28, nec), millions of fixed 96$	Industry
162	IOMC_MFGO14	Production, Petroleum Refining (SIC 291), millions of fixed 96$	Industry
163	IOMC_MFGO15	Production, Asphalt, Coal, & Miscellaneous Products (SIC 295, 299), millions of fixed 96$	Industry
164	IOMC_MFGO16	Production, Rubber & Miscellaneous Plastic Products (SIC 30), millions of fixed 96$	Industry
165	IOMC_MFGO17	Production, Leather & Leather Products (SIC 31), millions of fixed 96$	Industry
166	IOMC_MFGO18	Production, Glass & Glass Products (SIC 321, 322, 323), millions of fixed 96$	Industry
167	IOMC_MFGO19	Production, Cement, Hydraulic (SIC 324), millions of fixed 96$	Industry
168	IOMC_MFGO20	Production, Other Stone, Clay, & Glass Products (SIC 32, nec), millions of fixed 96$	Industry
169	IOMC_MFGO21	Production, Blast Furnace & Basic Steel (SIC 331), millions of fixed 96$	Industry
170	IOMC_MFGO22	Production, Aluminum (SIC 3334, pt 3341, 3353-5), millions of fixed 96$	Industry
171	IOMC_MFGO23	Production, Other Primary Metals (SIC 33, nec), millions of fixed 96$	Industry
172	IOMC_MFGO24	Production, Fabricated Metal Products (SIC 34), millions of fixed 96$	Industry
173	IOMC_MFGO25	Production, Industrial Machinery & Equipment (SIC 35), millions of fixed 96$	Industry
174	IOMC_MFGO26	Production, Electronic & Other Electric Equipment (SIC 36), millions of fixed 96$	Industry
175	IOMC_MFGO27	Production, Transportation Equipment (SIC 37), millions of fixed 96$	Industry
176	IOMC_MFGO28	Production, Instruments & Related Products (SIC 38), millions of fixed 96$	Industry
177	IOMC_MFGO29	Production, Miscellaneous Manufacturing Industries (SIC 39), millions of fixed 96$	Industry
178	IOMC_MFGO30	Production, Agricultural Production, Crops (SIC 01), millions of fixed 96$	Industry
179	IOMC_MFGO31	Production, Other Agricultural Production Including Livestock (SIC 02, 07, 08, 09), millions of fixed 96$	Industry
180	IOMC_MFGO32	Production, Coal Mining (SIC 12), millions of fixed 96$	Industry
181	IOMC_MFGO33	Production, Oil & Gas Extraction (SIC 13), millions of fixed 96$	Industry
182	IOMC_MFGO34	Production, Metal & Other Mining (SIC 10, 14), millions of fixed 96$	Industry

183	IOMC_MFGO35	Production, Construction (SIC 15, 16, 17), millions of fixed 96$	Industry
184	IOMC_NMFGO1	Production, Transportation Services (SIC 40, 41, 42, 43, 44, 45, 46, 47), millions of fixed 96$	Industry
185	IOMC_NMFGO2	Production, Communications (SIC 48), millions of fixed 96$	Industry
186	IOMC_NMFGO3	Production, Electric Utilities (SIC 491, part of 493), millions of fixed 96$	Industry
187	IOMC_NMFGO4	Production, Gas Utilities (SIC 496, part of 493), millions of fixed 96$	Industry
188	IOMC_NMFGO5	Production, Water & Sewer Services (SIC 494, 495, 496, 497, part of 493), millions of fixed 96$	Industry
189	IOMC_NMFGO6	Production, Wholesale Trade (SIC 50,51), millions of fixed 96$	Industry
190	IOMC_NMFGO7	Production, Retail Trade (SIC 52, 53, 54, 55, 56, 57, 59, 739), millions of fixed 96$	Industry
191	IOMC_NMFGO8	Production, Finance, Insurance, Real Estate (SIC 60, 61, 62, 63, 65, 66, 153), millions of fixed 96$	Industry
192	IOMC_NMFGO9	Production, Services (SIC 58, 70, 73, 75, 76, 78, 79, 80, 82, 83, 84, 86, 89), millions of fixed 96$	Industry
193	IOMC_NMFGO10	Production, Government Enterprises (SIC part of 41, 431), millions of fixed 96$	Industry
194	IOMC_MFGTOT	Production, All Manufacturing, millions of fixed 96$	Industry
195	IOMC_INDTOT	Production, All non-service Industries, millions of fixed 96$	Industry
196	IOMC_TOTOUT	Production, Total, millions of fixed 96$	Industry
197	EPMC_EMP1	Employment, Food & Kindred Products exc Beverages (SIC 20 less 208), millions of employees	Employment
198	EPMC_EMP2	Employment, Beverages & Tobacco Products (SIC 208, 21), millions of employees	Employment
199	EPMC_EMP3	Employment, Textile Mill Products (SIC 22), millions of employees	Employment
200	EPMC_EMP4	Employment, Apparel & Other Textiles (SIC 23), millions of employees	Employment
201	EPMC_EMP5	Employment, Lumber & Wood Products (SIC 24), millions of employees	Employment
202	EPMC_EMP6	Employment, Furniture & Fixtures (SIC 25), millions of employees	Employment
203	EPMC_EMP7	Employment, Paper & Allied Industries (SIC 26), millions of employees	Employment
204	EPMC_EMP8	Employment, Printing & Publishing (SIC 27), millions of employees	Employment
205	EPMC_EMP9	Employment, Inorganic Chemicals (SIC 281), millions of employees	Employment
206	EPMC_EMP10	Employment, Organic Chemicals (SIC 286), millions of employees	Employment
207	EPMC_EMP11	Employment, Plastic Materials & Synthetics (SIC 282), millions of employees	Employment
208	EPMC_EMP12	Employment, Agricultural Chemicals (SIC 287), millions of employees	Employment
209	EPMC_EMP13	Employment, Other Chemicals & Allied (SIC 28, nec), millions of employees	Employment
210	EPMC_EMP14	Employment, Petroleum Refining (SIC 291), millions of employees	Employment
211	EPMC_EMP15	Employment, Asphalt, Coal, & Miscellaneous Products (SIC 295, 299), millions of employees	Employment
212	EPMC_EMP16	Employment, Rubber & Miscellaneous Plastic Products (SIC 30), millions of employees	Employment

213	EPMC_EMP17	Employment, Leather & Leather Products (SIC 31), millions of employees	Employment
214	EPMC_EMP18	Employment, Glass & Glass Products (SIC 321, 322, 323), millions of employees	Employment
215	EPMC_EMP19	Employment, Cement, Hydraulic (SIC 324), millions of employees	Employment
216	EPMC_EMP20	Employment, Other Stone, Clay, & Glass Products (SIC 32, nec), millions of employees	Employment
217	EPMC_EMP21	Employment, Blast Furnace & Basic Steel (SIC 331), millions of employees	Employment
218	EPMC_EMP22	Employment, Aluminum (SIC 3334, pt 3341, 3353-5), millions of employees	Employment
219	EPMC_EMP23	Employment, Other Primary Metals (SIC 33, nec), millions of employees	Employment
220	EPMC_EMP24	Employment, Fabricated Metal Products (SIC 34), millions of employees	Employment
221	EPMC_EMP25	Employment, Industrial Machinery & Equipment (SIC 35), millions of employees	Employment
222	EPMC_EMP26	Employment, Electronic & Other Electric Equipment (SIC 36), millions of employees	Employment
223	EPMC_EMP27	Employment, Transportation Equipment (SIC 37), millions of employees	Employment
224	EPMC_EMP28	Employment, Instruments & Related Products (SIC 38), millions of employees	Employment
225	EPMC_EMP29	Employment, Miscellaneous Manufacturing Industries (SIC 39), millions of employees	Employment
226	EPMC_EMP30	Employment, Agricultural Production, Crops (SIC 01), millions of employees	Employment
227	EPMC_EMP31	Employment, Other Agricultural Production Including Livestock (SIC 02, 07, 08, 09), millions of employees	Employment
228	EPMC_EMP32	Employment, Coal Mining (SIC 12), millions of employees	Employment
229	EPMC_EMP33	Employment, Oil & Gas Extraction (SIC 13), millions of employees	Employment
230	EPMC_EMP34	Employment, Metal & Other Mining (SIC 10, 14), millions of employees	Employment
231	EPMC_EMP35	Employment, Construction (SIC 15, 16, 17), millions of employees	Employment
232	EPMC_NEMP1	Employment, Transportation Services (SIC 40, 41, 42, 43, 44, 45, 46, 47), millions of employees	Employment
233	EPMC_NEMP2	Employment, Communications (SIC 48), millions of employees	Employment
234	EPMC_NEMP3	Employment, Electric Utilities (SIC 491, part of 493), millions of employees	Employment
235	EPMC_NEMP4	Employment, Gas Utilities (SIC 492, part of 493), millions of employees	Employment
236	EPMC_NEMP5	Employment, Water & Sewer Services (SIC 494, 495, 496, 497, part of 493), millions of employees	Employment
237	EPMC_NEMP6	Employment, Wholesale Trade (SIC 50,51), millions of employees	Employment
238	EPMC_NEMP7	Employment, Retail Trade (SIC 52, 53, 54, 55, 56, 57, 59, 739), millions of employees	Employment
239	EPMC_NEMP8	Employment, Finance, Insurance, Real Estate (SIC 60, 61, 62, 63, 65, 66, 153), millions of employees	Employment
240	EPMC_NEMP9	Employment, Services (SIC 58, 70, 73, 75, 76, 78, 79, 80, 82, 83, 84, 86,	Employment

		89), millions of employees	
241	EPMC_NEMP10	Employment, Federal Government, millions of employees	Employment
242	EPMC_NEMP11	Employment, State & Local Government, millions of employees	Employment

Table B4. MCRGBASE Input Variables (Variables by Region)

Regions:

Census Division	Description
NENG	New England
MATL	Middle Atlantic
ENC	East North Central
WNC	West North Central
SATL	South Atlantic
ESC	East South Central
WSC	West South Central
MTN	Mountain
PAC	Pacific

Variables:

Name	Description
CPI	Consumer Price Index (All Urban) - All Items, 1982-84 = 1.0
YD96C	Disposable Personal Income, billions of chained 96$
WSD	Wage & Salary Disbursements, billions of nominal $
YP	Personal Income, billions of nominal $
SHUMBL	Mobile Homes Shipments, millions of units
HUSTS1	Single-Family Housing Starts, Private including Farm, millions of units
HUSTS2A	Multi-Family Housing Starts, Private including Farm, millions of units
KSHUMBL	Stock of Mobile Homes, millions of units (same as KQMH)
KH1	Stock of Single-Family Housing, millions of units (same as KQHUST1)
KH2A	Stock of Multi-Family Housing, millions of units (same as KQHUSTS2A)
NR	Population Including Armed Forces Overseas, millions of persons (same as N)
NR16A	Population Aged 16 and Over, millions of persons (same as N16A)
RWM	Average Annual Manufacturing Wages, thousands of nominal $
RWNM	Average Annual Non-Manufacturing Wages, thousands of nominal $
KAMUSE	Commercial Floorspace, Amusement, billion square feet
KAUTO	Commercial Floorspace, Automotive, billion square feet
KDORM	Commercial Floorspace, Dormitories, billion square feet
KEDUC	Commercial Floorspace, Education, billion square feet
KHEALTH	Commercial Floorspace, Health, billion square feet
KHOTEL	Commercial Floorspace, Hotels and Motels, billion square feet
KMFG	Commercial Floorspace, Manufacturing billion square feet

KMISCNR	Commercial Floorspace, Miscellaneous Non-residential, billion square feet
KOFFICE	Commercial Floorspace, Offices, billion square feet
KPUB	Commercial Floorspace, Public Sector, billion square feet
KREL	Commercial Floorspace, Religious, billion square feet
KSTORES	Commercial Floorspace, Stores and Restaurants, billion square feet
KWARE	Commercial Floorspace, Warehouses, billion square feet
EEASUM	Employment, Total Non-Agricultural, millions of employees
EC	Employment, Construction (SIC 15-17), millions of employees
EGF	Employment, Federal Government, millions of employees
EFIR	Employment, Finance, Insurance, and Real Estate (SIC 60-67), millions of employees
EMI	Employment, Mining (SIC 10-14), millions of employees
ESV	Employment, Services (SIC 70-89), millions of employees
EGSL	Employment, State & Local Government, millions of employees
ER	Employment, Transportation, Communications, Public Utilities (SIC 40-49), millions of employees
ETR	Employment, Retail Trade (SIC 52-59), millions of employees
ETW	Employment, Wholesale Trade (SIC 50-51), millions of employees
E24	Employment, Lumber & Wood Products (SIC 24), millions of employees
E25	Employment, Furniture & Fixtures (SIC 25), millions of employees
E32	Employment, Stone, Clay, & Glass (SIC 32), millions of employees
E33	Employment, Primary Metals (SIC 33), millions of employees
E34	Employment, Fabricated Metal Products (SIC 34), millions of employees
E35	Employment, Industrial Machinery and Equipment (SIC 35), millions of employees
E36	Employment, Electronic and other Electrical Equipment (SIC 36), millions of employees
E37	Employment, Transportation Equipment (SIC 37), millions of employees
E38	Employment, Instruments (SIC 38), millions of employees
E39	Employment, Miscellaneous Manufacturing (SIC 39), millions of employees
E20	Employment, Food & Kindred Products (SIC 20), millions of employees
E21	Employment, Tobacco Products (SIC 21), millions of employees
E22	Employment, Textile Mill Products (SIC 22), millions of employees
E23	Employment, Apparel & Other Textile Products (SIC 23), millions of employees
E26	Employment, Paper & Allied Products (SIC 26), millions of employees
E27	Employment, Printing & Publishing (SIC 27), millions of employees
E28	Employment, Chemicals & Allied Products (SIC 28), millions of employees
E29	Employment, Petroleum & Coal Products (SIC 29), millions of employees
E30	Employment, Rubber & Miscellaneous Plastics Products (SIC 30), millions of employees
E31	Employment, Leather & Leather Products (SIC 31), millions of employees
Q20	Production, Food & Kindred Products (SIC 20), billions of fixed 96$
Q21	Production, Tobacco Products (SIC 21), billions of fixed 96$
Q22	Production, Textile Mill Products (SIC 22), billions of fixed 96$

Q23	Production, Apparel & Other Textiles (SIC 23), billions of fixed 96$
Q24	Production, Lumber & Wood Products (SIC 24), billions of fixed 96$
Q25	Production, Furniture & Fixtures (SIC 25), billions of fixed 96$
Q26	Production, Paper & Allied Industries (SIC 26), billions of fixed 96$
Q27	Production, Printing & Publishing (SIC 27), billions of fixed 96$
Q281	Production, Inorganic Chemicals (SIC 281), billions of fixed 96$
Q286	Production, Organic Chemicals (SIC 286), billions of fixed 96$
Q282	Production, Plastic Materials & Synthetics (SIC 282), billions of fixed 96$
Q287	Production, Agricultural Chemicals (SIC 287), billions of fixed 96$
Q28O	Production, Other Chemicals & Allied (SIC 28, nec), billions of fixed 96$
Q291A5	Production, Petroleum Refining (SIC 291), billions of fixed 96$
Q299	Production, Asphalt, Coal, & Miscellaneous Products (SIC 295, 299), billions of fixed 96$
Q30	Production, Rubber & Miscellaneous Plastic Products (SIC 30), billions of fixed 96$
Q31	Production, Leather & Leather Products (SIC 31), billions of fixed 96$
Q321	Production, Glass & Glass Products (SIC 321, 322, 323), billions of fixed 96$
Q324	Production, Cement, Hydraulic (SIC 324), billions of fixed 96$
Q32O	Production, Other Stone, Clay, & Glass Products (SIC 32, nec), billions of fixed 96$
Q331	Production, Blast Furnace & Basic Steel (SIC 331), billions of fixed 96$
Q3334	Production, Aluminum (SIC 3334, pt 3341, 3353-5, 3363, 3365), billions of fixed 96$
Q33O	Production, Other Primary Metals (SIC 33, nec), billions of fixed 96$
Q34	Production, Fabricated Metal Products (SIC 34), billions of fixed 96$
Q35	Production, Industrial Machinery & Equipment (SIC 35), billions of fixed 96$
Q36	Production, Electronic & Other Electric Equipment (SIC 36), billions of fixed 96$
Q37	Production, Transportation Equipment (SIC 37), billions of fixed 96$
Q38	Production, Instruments & Related Products (SIC 38), billions of fixed 96$
Q39	Production, Miscellaneous Manufacturing Industries (SIC 39), billions of fixed 96$
QCROPS	Production, Agricultural Production, Crops (SIC 01), billions of fixed 96$
QLVSTK	Production, Other Agricultural Production Including Livestock (SIC 02, 07, 08, 09), billions of fixed 96$
QCOAL	Production, Coal Mining (SIC 12), billions of fixed 96$
QPET	Production, Oil & Gas Extraction (SIC 13), billions of fixed 96$
QOMI	Production, Metal & Other Mining (SIC 10, 14), billions of fixed 96$
QC	Production, Construction (SIC 15, 16, 17), billions of fixed 96$

Table B5. NEMS Input Variables for MAM Macroeconomic Submodule

Macroeconomic Variable Name	Definition	NEMS Variable Name and Source
ENGDOMPETANG	Domestic Production of Petroleum and Natural Gas	PMMBLK Common Block: RFQTDCRD - Production of Crude Oil RFPQNGL - Production of Natural Gas Liquids NGTDMREP Common Block: OGPRDNG - Production of Dry Natural Gas
ENGDOMOTHER	Domestic Production of Other Energy	QBLK Common Block: QUREL - Uranium, Electricity QTRAS - Total Renewables, All Sectors QSTRS - Solar Thermal, Residential QSTCM - Solar Thermal, Commercial QETTR - Ethanol, Transportation QPVCM - Photovoltaic, Commercial QHYTR - Liquid Hydrogen, Transportation COALOUT Common Block: CQSBB - Production of Coal RESDREP Common Block: QGERS - Geothermal, Residential PMMRPT Common Block: RFETHE85 - Production of E85 RFMETM85 - Production of M85 RFQDINPOT - Other Domestic Inputs to Refiners PMMOUT Common Block: RFCRDOTH - Other Crude Inputs NGTDMREP Common Block: OGPRSUP - Production of Supplemental Natural Gas
DTFUELSALLB	Demand for All Fuels - All Sectors	QBLK Common Block: QTPAS – Total Petroleum, All Sectors QNGAS - Natural Gas, All Sectors QGPTR - Natural Gas, Pipeline, Transportation QLPIN - Lease and Plant Fuel, Industrial QCLAS - Coal, All Sectors QMCIN - Metallurgical Coal, Industrial QCIIN - Net Coal Coke Imports, Industrial QUREL - Uranium, Electricity QTRAS - Total Renewables, All Sectors QSTRS - Solar Thermal, Residential QSTCM - Solar Thermal, Commercial QPVCM - Photovoltaic, Commercial QEIEL - Net Electricity Imports QMETR - Methanol, Transportation QHYTR - Liquid Hydrogen, Transportation

		RESDREP Common Block: QGERS - Geothermal, Residential
DENDUSE_COAL	End-Use Demand for Coal	QBLK Common Block: QMCIN - Metallurgical Coal, Industrial QCLAS - Coal, All Sectors QCLEL - Coal, Electricity Generation QCIIN - Net Coal Coke Imports, Industrial
DENDUSE_ELC	Electricity Sales to Ultimate Consumers	QBLK Common Block: QELAS - Purchased Electricity, All Sectors
DENDUSE_NG	End-Use Demand for Natural Gas	QBLK Common Block: QNGAS - Natural Gas, All Sectors QGPTR - Natural Gas, Pipeline, Transportation QLPIN - Lease and Plant Fuel, Industrial QNGEL - Natural Gas, Electricity
DENDUSE_PET	End-Use Demand for Petroleum	QBLK Common Block: QDSAS - Distillate, All Sectors QDSEL - Distillate, Electricity QKSAS - Kerosene, All Sectors QJFTR - Jet Fuel, Transportation QLGAS - Liquified Petroleum Gases, All Sectors QMGAS - Motor Gasoline, All Sectors QPFIN - Petrochemical Feedstocks, Industrial QRSAS - Residual Fuel, All Sectors QRSEL - Residual Fuel, Electricity QOTAS - Other Petroleum, All Sectors QSGIN - Still Gas, Industrial QPCIN - Petroleum Coke, Industrial QASIN - Asphalt and Road Oil, Industrial
IPSN2121	Industrial Production Index - Coal Mining	COALOUT Common Block: CQSBB - Production of Coal
IPSG211A3	Industrial Production Index -Oil and Gas Extraction	PMMOUT Common Block: RFQTDCRD - Production of Crude Oil RFPQNGL - Production of Natural Gas Liquids NGTDMREP Common Block: OGPRDNG - Production of Dry Natural Gas
QGASASF	Highway Consumption of Gasoline and Special Fuels	QBLK Common Block: QMGTR - Motor Gasoline, Transportation QDSTR - Distillate, Transportation
CNFUEL96C	Consumption of Household Fuel Oil	QBLK Common Block: QTPRS - Total Petroleum, Residential
CNGAS96C	Consumption of Consumer Gasoline and Oil	QBLK Common Block: QMGTR - Motor Gasoline, Transportation QDSTR - Distillate, Transportation

CSHHOPE96C	Consumption of Household Electricity	QBLK Common Block: QELRS - Electricity, Residential
CSHHOPG96C	Consumption of Household Natural Gas	QBLK Common Block: QNGRS - Natural Gas, Residential
PCWCNFUEL	Personal Consumption Deflator, Household Fuel Oil	MPBLK Common Block: PTPRS - Residential Total Petroleum Price
PCWCNGAS	Personal Consumption Deflator, Consumer Gasoline and Oil	AMPBLK Common Block: PMGTR - Transportation Motor Gasoline Price PDSTR - Transportation Distillate Price QBLK Common Block: QMGTR - Motor Gasoline, Transportation QDSTR - Distillate, Transportation
PCWCSHHOPE	Personal Consumption Deflator, Household Electricity	AMPBLK Common Block: PELRS - Residential Purchased Electricity Price
PCWCSHHOPG	Personal Consumption Deflator, Household Natural Gas	AMPBLK Common Block: PNGRS - Residential Natural Gas Price
WPI051	Producer Price Index - Coal	AMPBLK Common Block: PCLIN - Industrial Purchased Coal Price
WPI053	Producer Price Index - Gas Fuels	NGTDMREP Common Block: OGWPRNG - Natural Gas Wellhead Price
WPI054	Producer Price Index - Electric Power	AMPBLK Common Block: PELRS - Residential Purchased Electricity Price PELCM - Commercial Purchased Electricity Price PELIN - Industrial Purchased Electricity Price PELTR - Transportation Purchased Electricity Price
WPI055	Producer Price Index - Utility Natural Gas	AMPBLK Common Block: PNGRS - Residential Natural Gas Price PNGCM - Commercial Natural Gas Price PNGIN - Industrial Natural Gas Price PNGTR - Transportation Natural Gas Price PNGEL - Natural Gas Price to Electric Generators
WPI0561	Producer Price Index - Crude Petroleum	INTOUT Common Block: IT_WOP - World Oil Price
WPI057	Producer Price Index - Refined Petroleum Products	AMPBLK Common Block: PTPRS - Residential Total Petroleum Price PDSCM - Commercial Distillate Price PRSCM - Commercial Residual Fuel Price PDSIN - Industrial Distillate Price PRSIN - Industrial Residual Fuel Price PDSTR - Transportation Distillate Price PJFTR - Transportation Jet Fuel Price PMGTR - Transportation Motor Gasoline Price

		PRSTR - Transportation Residual Fuel Price
WPI0574	Producer Price Index - Residual Petroleum Fuels	AMPBLK Common Block: PRSCM - Commercial Residual Fuel Price PRSIN - Industrial Residual Fuel Price PRSTR - Transportation Residual Fuel Price
PCOF	Weighted Average Price of Imported Crude	INTOUT Common Block: IT_WOP - World Oil Price

Table B6. Energy Industry and Employment Growth Determined by NEMS Results

MACOUT Common Block Name	Industry Sector Definition	NEMS Variable Name and Source
MC_MFGO(32)	Output, Coal Mining	COALOUT Common Block: CQSBB - Total Coal Production
MC_MFGO(33)	Output, Oil and Gas Extraction	PMMOUT Common Block: RFQTDCRD - Total Crude Oil Production RFPQNGL - Total Natural Gas Plant Liquids Production OGPRDNG - Total Dry Natural Gas Production OGPRSUP - Supplemental Natural Gas Production
MC_MFGO(14)	Output, Petroleum Refining	PMMOUT Common Block: RFQPRDT - Total Petroleum Product Supplied PMMRPT Common Block: RFPQIPRDT - Total Imported Petroleum Products
MC_NMFGO(3)	Output, Electric Utilities	UEFDOUT Common Block: UGNTLNR - Total Electricity Generation
MC_NMFGO(4)	Output, Gas Utilities	PMMOUT Common Block: OGPRDNG - Total Dry Natural Gas Production
EPMC_EMP32	Employment, Coal Mining	COALOUT Common Block: TOTMINERS – Number of coal miners
EPMC_EMP33	Employment, Oil and Gas Extraction	OGSMOUT Common Block: OGJOBS – Number of jobs in oil and gas supply sector

Table B7. MC_NATIONAL Output Variables

MACOUT Common Block Name	Description
MC_GDP96CFE	Gross Domestic Product at full employment, billions of chained 96$
MC_CONS96C	Consumer Spending on all Goods & Services, billions of chained 96$
MC_I96C	Gross Private Domestic Investment, billions of chained 96$
MC_EX96C	Exports of Goods & Services, billions of chained 96$
MC_M96C	Imports of Goods & Services, billions of chained 96$
MC_G96C	Government Purchases of Goods & Services, billions of chained 96$
MC_CD96C	Consumer Spending on Durable Goods, billions of chained 96$
MC_CN96C	Consumer Spending on Nondurable Goods, billions of chained 96$
MC_CS96C	Consumer Spending on Services, billions of chained 96$
MC_ICNR96C	Gross Nonresidential Investment in Structures, billions of chained 96 $
MC_ICR96C	Gross Residential Investment, billions of chained 96$
MC_IPDENR96C	Gross Nonresidential Investment in Equipment, billions of chained 96$
MC_IPDER96C	Gross Residential Investment in Equipment, billions of chained 96$
MC_IFIX96C	Gross Private Fixed Investment, billions of chained 96$
MC_IFIXNR96C	Gross Private Fixed Nonresidential Investment, billions of chained 96$
MC_IFIXR96C	Gross Private Fixed Residential Investment, billions of chained 96$
MC_EX96CNIA0	Exports, Foods, Feeds, & Beverages, billions of chained 96$
MC_EX96CNIA1	Exports, Industrial Supplies & Materials, billions of chained 96$
MC_EX96CNIA2	Exports, Capital Goods exc autos, billions of chained 96$
MC_EX96CNIA3	Exports, Automotive Vehicles, Engines & Parts, billions of chained 96$
MC_EX96CNIA4	Exports, Consumer Goods except Automotive, billions of chained 96$
MC_EXDAN96C	Exports, Goods, billions of chained 96$
MC_EXS96C	Exports, Services, billions of chained 96$
MC_M96CNIA0	Imports, Foods, Feeds, and Beverages, billions of chained 96$
MC_M96CNIA1	Imports, Industrial Supplies & Materials, billions of chained 96$
MC_M96CNIA2	Imports, Capital Goods excl. Motor Vehicles, billions of chained 96$
MC_M96CNIA3	Imports, Motor Vehicles & Parts, billions of chained 96$
MC_M96CNIA4	Imports, Non-automotive Consumer Goods, billions of chained 96$
MC_MS96C	Imports, Services, billions of chained 96$
MC_INV96CCH	Change in Real Stock of Business Inventories, billions of chained 96$
MC_GFML96C	Federal Defense Purchases of Goods and Services, billions of chained 96$
MC_GDP	Gross Domestic Product, billions of nominal $
MC_CONS	Consumer Spending on all Goods & Services, billions of nominal $
MC_I	Gross Private Domestic Investment, billions of nominal $
MC_GNP96C	Gross National Product, billions of chained 96$

MC_PCWGDP	Chain-Type Price Index, GDP, 1996 = 1.0 (1987 = 1.0 in MC_COMMON)
MC_RMGBS3NS	Discount Rate on 3-Month U.S. Treasury Bills
MC_RMMTGCCNS	Conventional 30-Year Mortgage Commitment Rate
MC_RMPUAANS	Yield on AA Utility Bonds
MC_REALRMGBLUS	Real Average Yield on U.S. Treasury Long-term Bonds
MC_ECIWSP	Employment Cost Index, Wages & Salaries, Private Sector, June 1989 = 1.0
MC_SQTRCARS	Unit Sales of Automobiles, Total, millions of units
MC_SQLV	Unit Sales of Light Duty Vehicles, Domestic, millions of units
MC_SQDTRUCKSL	Unit Sales of New Light Trucks, millions of units
MC_SQDTRUCKSHAM	Unit Sales of Heavy and Medium Trucks, millions of units
MC_RUC	Unemployment Rate, All Civilian Workers
MC_WPI	Producer Price Index, All Commodities, 1982 = 1.0
MC_WPI11	Producer Price Index, Machinery & Equipment, 1982 = 1.0
MC_WPI14	Producer Price Index, Transportation Equipment, 1982 = 1.0
MC_LC	Civilian Labor Force as Measured by the Household Survey, millions of persons
MC_RMFEDFUNDNS	Effective Rate on Federal Funds
MC_WPI05	Producer Price Index, Fuels, Related Products & Power, 1982 = 1.0
MC_RMGFCM_10NS	Yield on 10-year Treasury Notes

Table B8. MC_INDUSTRIAL Output Variables (Variables by Region)

Regions:

Census Division	Description
NENG	New England
MATL	Middle Atlantic
ENC	East North Central
WNC	West North Central
SATL	South Atlantic
ESC	East South Central
WSC	West South Central
MTN	Mountain
PAC	Pacific
US	United States

Variables:

MACOUT Common Block Name	Description
MC_MFGO(1)	Production, Food & Kindred Products exc Beverages (SIC 20 less 208), millions of fixed 96$
MC_MFGO(2)	Production, Beverages & Tobacco Products (SIC 208, 21), millions of fixed 96$
MC_MFGO(3)	Production, Textile Mill Products (SIC 22), millions of fixed 96$
MC_MFGO(4)	Production, Apparel & Other Textiles (SIC 23), millions of fixed 96$
MC_MFGO(5)	Production, Lumber & Wood Products (SIC 24), millions of fixed 96$
MC_MFGO(6)	Production, Furniture & Fixtures (SIC 25), millions of fixed 96$
MC_MFGO(7)	Production, Paper & Allied Industries (SIC 26), millions of fixed 96$
MC_MFGO(8)	Production, Printing & Publishing (SIC 27), millions of fixed 96$
MC_MFGO(9)	Production, Inorganic Chemicals (SIC 281), millions of fixed 96$
MC_MFGO(10)	Production, Organic Chemicals (SIC 286), millions of fixed 96$
MC_MFGO(11)	Production, Plastic Materials & Synthetics (SIC 282), millions of fixed 96$
MC_MFGO(12)	Production, Agricultural Chemicals (SIC 287), millions of fixed 96$
MC_MFGO(13)	Production, Other Chemicals & Allied (SIC 28, nec), millions of fixed 96$
MC_MFGO(14)	Production, Petroleum Refining (SIC 291), millions of fixed 96$
MC_MFGO(15)	Production, Asphalt, Coal, & Miscellaneous Products (SIC 295, 299), millions of fixed 96$
MC_MFGO(16)	Production, Rubber & Miscellaneous Plastic Products (SIC 30), millions of fixed 96$
MC_MFGO(17)	Production, Leather & Leather Products (SIC 31), millions of fixed 96$
MC_MFGO(18)	Production, Glass & Glass Products (SIC 321, 322, 323), millions of fixed 96$
MC_MFGO(19)	Production, Cement, Hydraulic (SIC 324), millions of fixed 96$
MC_MFGO(20)	Production, Other Stone, Clay, & Glass Products (SIC 32, nec), millions of fixed 96$
MC_MFGO(21)	Production, Blast Furnace & Basic Steel (SIC 331), millions of fixed 96$

MC_MFGO(22)	Production, Aluminum (SIC 3334, pt 3341, 3353-5), millions of fixed 96$
MC_MFGO(23)	Production, Other Primary Metals (SIC 33, nec), millions of fixed 96$
MC_MFGO(24)	Production, Fabricated Metal Products (SIC 34), millions of fixed 96$
MC_MFGO(25)	Production, Industrial Machinery & Equipment (SIC 35), millions of fixed 96$
MC_MFGO(26)	Production, Electronic & Other Electric Equipment (SIC 36), millions of fixed 96$
MC_MFGO(27)	Production, Transportation Equipment (SIC 37), millions of fixed 96$
MC_MFGO(28)	Production, Instruments & Related Products (SIC 38), millions of fixed 96$
MC_MFGO(29)	Production, Miscellaneous Manufacturing Industries (SIC 39), millions of fixed 96$
MC_MFGO(30)	Production, Agricultural Production, Crops (SIC 01), millions of fixed 96$
MC_MFGO(31)	Production, Other Agricultural Production Including Livestock (SIC 02, 07, 08, 09), millions of fixed 96$
MC_MFGO(32)	Production, Coal Mining (SIC 12), millions of fixed 96$
MC_MFGO(33)	Production, Oil & Gas Extraction (SIC 13), millions of fixed 96$
MC_MFGO(34)	Production, Metal & Other Mining (SIC 10, 14), millions of fixed 96$
MC_MFGO(35)	Production, Construction (SIC 15, 16, 17), millions of fixed 96$
MC_MFGO	Production, Chemicals (SIC 28)
MC_MFGO	Production, Petroleum Products (SIC 29)
MC_MFGO	Production, Stone, Clay, Glass and Cement (SIC 32)
MC_MFGO	Production, Primary Metals (SIC 33)
MC_MFGO	Production, Total Manufacturing Output
MC_MFGO	Production, Total Industrial Output

Table B9. MC_EMPLOYMENT Output Variables

MAM Variable Name	Description
EPMC_EMP1	Food & Kindred Products exc Beverages (SIC 20 less 208), millions of employees
EPMC_EMP2	Beverages & Tobacco Products (SIC 208, 21), millions of employees
EPMC_EMP3	Textile Mill Products (SIC 22), millions of employees
EPMC_EMP4	Apparel & Other Textiles (SIC 23), millions of employees
EPMC_EMP5	Lumber & Wood Products (SIC 24), millions of employees
EPMC_EMP6	Furniture & Fixtures (SIC 25), millions of employees
EPMC_EMP7	Paper & Allied Industries (SIC 26), millions of employees
EPMC_EMP8	Printing & Publishing (SIC 27), millions of employees
EPMC_EMP9	Inorganic Chemicals (SIC 281), millions of employees
EPMC_EMP10	Organic Chemicals (SIC 286), millions of employees
EPMC_EMP11	Plastic Materials & Synthetics (SIC 282), millions of employees
EPMC_EMP12	Agricultural Chemicals (SIC 287), millions of employees
EPMC_EMP13	Other Chemicals & Allied (SIC 28, nec), millions of employees
EPMC_EMP14	Petroleum Refining (SIC 291), millions of employees
EPMC_EMP15	Asphalt, Coal, & Miscellaneous Products (SIC 295, 299), millions of employees
EPMC_EMP16	Rubber & Miscellaneous Plastic Products (SIC 30), millions of employees
EPMC_EMP17	Leather & Leather Products (SIC 31), millions of employees
EPMC_EMP18	Glass & Glass Products (SIC 321, 322, 323), millions of employees
EPMC_EMP19	Cement, Hydraulic (SIC 324), millions of employees
EPMC_EMP20	Other Stone, Clay, & Glass Products (SIC 32, nec), millions of employees
EPMC_EMP21	Blast Furnace & Basic Steel (SIC 331), millions of employees
EPMC_EMP22	Aluminum (SIC 3334, pt 3341, 3353-5), millions of employees
EPMC_EMP23	Other Primary Metals (SIC 33, nec), millions of employees
EPMC_EMP24	Fabricated Metal Products (SIC 34), millions of employees
EPMC_EMP25	Industrial Machinery & Equipment (SIC 35), millions of employees
EPMC_EMP26	Electronic & Other Electric Equipment (SIC 36), millions of employees
EPMC_EMP27	Transportation Equipment (SIC 37), millions of employees
EPMC_EMP28	Instruments & Related Products (SIC 38), millions of employees
EPMC_EMP29	Miscellaneous Manufacturing Industries (SIC 39), millions of employees
EPMC_EMP30	Agricultural Production, Crops (SIC 01), millions of employees
EPMC_EMP31	Other Agricultural Production Including Livestock (SIC 02, 07, 08, 09), millions of employees
EPMC_EMP32	Coal Mining (SIC 12), millions of employees
EPMC_EMP33	Oil & Gas Extraction (SIC 13), millions of employees
EPMC_EMP34	Metal & Other Mining (SIC 10, 14), millions of employees

EPMC_EMP35	Construction (SIC 15, 16, 17), millions of employees
EPMC_NEMP1	Transportation Services (SIC 40, 41, 42, 43, 44, 45, 46, 47), millions of employees
EPMC_NEMP2	Communications (SIC 48), millions of employees
EPMC_NEMP3	Electric Utilities (SIC 491, part of 493), millions of employees
EPMC_NEMP4	Gas Utilities (SIC 492, part of 493), millions of employees
EPMC_NEMP5	Water & Sewer Services (SIC 494, 495, 496, 497, part of 493), millions of employees
EPMC_NEMP6	Wholesale Trade (SIC 50,51), millions of employees
EPMC_NEMP7	Retail Trade (SIC 52, 53, 54, 55, 56, 57, 59, 739), millions of employees
EPMC_NEMP8	Finance, Insurance, Real Estate (SIC 60, 61, 62, 63, 65, 66, 153), millions of employees
EPMC_NEMP9	Services (SIC 58, 70, 73, 75, 76, 78, 79, 80, 82, 83, 84, 86, 89), millions of employees
EPMC_NEMP10	Federal Government, millions of employees
EPMC_NEMP11	State & Local Government, millions of employees
(Aggregates)	Manufacturing, millions of employees
(Aggregates)	Non-Manufacturing, millions of employees
(Aggregates)	Services, millions of employees
(Aggregates)	Total Nonfarm, millions of employees

Table B10. MC_REGIONAL Output Variables

Regions:

Census Division	Description
NENG	New England
MATL	Middle Atlantic
ENC	East North Central
WNC	West North Central
SATL	South Atlantic
ESC	East South Central
WSC	West South Central
MTN	Mountain
PAC	Pacific
US	United States

Variables:

MACOUT Common Block Name	Description
MC_CPI	Consumer Price Index (All Urban) - All Items, 1982-84 = 1.0
MC_YD96C	Disposable Personal Income, billions of chained 96$
MC_WSD	Wage & Salary Disbursements, billions of nominal $
MC_YP	Personal Income, billions of nominal $
MC_SHUMBL	Mobile Homes Shipments, millions of units
MC_HUSTS1	Single-Family Housing Starts, Private including Farm, millions of units
MC_HUSTS2A	Multi-Family Housing Starts, Private including Farm, millions of units
MC_KSHUMBL	Stock of Mobile Homes, millions of units (same as KQMH)
MC_KH1	Stock of Single-Family Housing, millions of units (same as KQHUST1)
MC_KH2A	Stock of Multi-Family Housing, millions of units (same as KQHUSTS2A)
MC_NR	Population Including Armed Forces Overseas, millions of persons (same as N)
MC_NR16A	Population Aged 16 and Over, millions of persons (same as N16A)
MC_RWM	Average Annual Manufacturing Wages, thousands of nominal $
MC_RWNM	Average Annual Non-Manufacturing Wages, thousands of nominal $
MC_COMMFLSP(KAMUSE)	Commercial Floorspace, Amusement, billion square feet
MC_COMMFLSP(KAUTO)	Commercial Floorspace, Automotive, billion square feet
MC_COMMFLSP(KDORM)	Commercial Floorspace, Dormitories, billion square feet
MC_COMMFLSP(KEDUC)	Commercial Floorspace, Education, billion square feet
MC_COMMFLSP(KHEALTH)	Commercial Floorspace, Health, billion square feet

MC_COMMFLSP(KHOTEL)	Commercial Floorspace, Hotels and Motels, billion square feet
MC_COMMFLSP(KMFG)	Commercial Floorspace, Manufacturing billion square feet
MC_COMMFLSP(KMISCNR)	Commercial Floorspace, Miscellaneous Non-residential, billion square feet
MC_COMMFLSP(KOFFICE)	Commercial Floorspace, Offices, billion square feet
MC_COMMFLSP(KPUB)	Commercial Floorspace, Public Sector, billion square feet
MC_COMMFLSP(KREL)	Commercial Floorspace, Religious, billion square feet
MC_COMMFLSP(KSTORES)	Commercial Floorspace, Stores and Restaurants, billion square feet
MC_COMMFLSP(KWARE)	Commercial Floorspace, Warehouses, billion square feet
MC_COMMFLSP	Total Commercial Floorspace, billion square feet
MC_EMPNA(EEASUM)	Employment, Non-Agricultural Establishments, millions of persons
MC_EMPNA(EC)	Employment, Contract Construction, millions of persons
MC_EMPNA(EGF)	Employment, Federal Government, millions of persons
MC_EMPNA(EFIR)	Employment, Financial, Insurance, Real Estate, millions of persons
MC_EMPNA(EMI)	Employment, Mining, millions of persons
MC_EMPNA(ESV)	Employment, Services, millions of persons
MC_EMPNA(EGSL)	Employment, State & Local Government, millions of persons
MC_EMPNA(ER)	Employment, Transportation & Public Utilities, millions of persons
MC_EMPNA(ETR)	Employment, Retail Trade, millions of persons
MC_EMPNA(ETW)	Employment, Wholesale Trade, millions of persons
MC_EMPNA(E24)	Employment, Lumber & Wood Products, millions of persons
MC_EMPNA(E25)	Employment, Furniture & Fixtures, millions of persons
MC_EMPNA(E32)	Employment, Stone, Clay and Glass, millions of persons
MC_EMPNA(E33)	Employment, Primary Metal Industries, millions of persons
MC_EMPNA(E34)	Employment, Fabricated Metal Products, millions of persons
MC_EMPNA(E35)	Employment, Machinery except Electrical, millions of persons
MC_EMPNA(E36)	Employment, Electrical Machinery, millions of persons
MC_EMPNA(E37)	Employment, Transportation Equipment, millions of persons
MC_EMPNA(E38)	Employment, Instruments, millions of persons
MC_EMPNA(E39)	Employment, Miscellaneous Manufacturing, millions of persons
MC_EMPNA(E20)	Employment, Food & Products, millions of persons
MC_EMPNA(E21)	Employment, Tobacco Manufactures, millions of persons
MC_EMPNA(E22)	Employment, Textile Mill Products, millions of persons
MC_EMPNA(E23)	Employment, Apparel & Other Textile Products, millions of persons
MC_EMPNA(E26)	Employment, Paper & Products, millions of persons
MC_EMPNA(E27)	Employment, Printing & Publishing, millions of persons
MC_EMPNA(E28)	Employment, Chemicals & Allied Products, millions of persons
MC_EMPNA(E29)	Employment, Petroleum & Products, millions of persons
MC_EMPNA(E30)	Employment, Rubber & Misc Plastics, millions of persons
MC_EMPNA(E31)	Employment, Leather & Products, millions of persons

MC_EMPNA(EAG)	Employment, Agricultural, millions of persons
MC_MFGO(1)	Production, Food & Kindred Products (SIC 20), billions of fixed 96$
MC_MFGO(2)	Production, Tobacco Products (SIC 21), billions of fixed 96$
MC_MFGO(3)	Production, Textile Mill Products (SIC 22), billions of fixed 96$
MC_MFGO(4)	Production, Apparel & Other Textiles (SIC 23), billions of fixed 96$
MC_MFGO(5)	Production, Lumber & Wood Products (SIC 24), billions of fixed 96$
MC_MFGO(6)	Production, Furniture & Fixtures (SIC 25), billions of fixed 96$
MC_MFGO(7)	Production, Paper & Allied Industries (SIC 26), billions of fixed 96$
MC_MFGO(8)	Production, Printing & Publishing (SIC 27), billions of fixed 96$
MC_MFGO(9)	Production, Inorganic Chemicals (SIC 281), billions of fixed 96$
MC_MFGO(10)	Production, Organic Chemicals (SIC 286), billions of fixed 96$
MC_MFGO(11)	Production, Plastic Materials & Synthetics (SIC 282), billions of fixed 96$
MC_MFGO(12)	Production, Agricultural Chemicals (SIC 287), billions of fixed 96$
MC_MFGO(13)	Production, Other Chemicals & Allied (SIC 28, nec), billions of fixed 96$
MC_MFGO(14)	Production, Petroleum Refining (SIC 291), billions of fixed 96$
MC_MFGO(15)	Production, Asphalt, Coal, & Misc. Products (SIC 295, 299), billions of fixed 96$
MC_MFGO(16)	Production, Rubber & Miscellaneous Plastic Products (SIC 30), billions of fixed 96$
MC_MFGO(17)	Production, Leather & Leather Products (SIC 31), billions of fixed 96$
MC_MFGO(18)	Production, Glass & Glass Products (SIC 321, 322, 323), billions of fixed 96$
MC_MFGO(19)	Production, Cement, Hydraulic (SIC 324), billions of fixed 96$
MC_MFGO(20)	Production, Other Stone, Clay, & Glass Products (SIC 32, nec), billions of fixed 96$
MC_MFGO(21)	Production, Blast Furnace & Basic Steel (SIC 331), billions of fixed 96$
MC_MFGO(22)	Production, Aluminum (SIC 3334, pt 3341, 3353-5, 3363, 3365), billions of fixed 96$
MC_MFGO(23)	Production, Other Primary Metals (SIC 33, nec), billions of fixed 96$
MC_MFGO(24)	Production, Fabricated Metal Products (SIC 34), billions of fixed 96$
MC_MFGO(25)	Production, Industrial Machinery & Equipment (SIC 35), billions of fixed 96$
MC_MFGO(26)	Production, Electronic & Other Electric Equipment (SIC 36), billions of fixed 96$
MC_MFGO(27)	Production, Transportation Equipment (SIC 37), billions of fixed 96$
MC_MFGO(28)	Production, Instruments & Related Products (SIC 38), billions of fixed 96$
MC_MFGO(29)	Production, Miscellaneous Manufacturing Industries (SIC 39), billions of fixed 96$
MC_MFGO(30)	Production, Agricultural Production, Crops (SIC 01), billions of fixed 96$
MC_MFGO(31)	Production, Other Agri. Production Inc. Livestock (SIC 02, 07- 09), billions of fixed 96$
MC_MFGO(32)	Production, Coal Mining (SIC 12), billions of fixed 96$
MC_MFGO(33)	Production, Oil & Gas Extraction (SIC 13), billions of fixed 96$
MC_MFGO(34)	Production, Metal & Other Mining (SIC 10, 14), billions of fixed 96$
MC_MFGO(35)	Production, Construction (SIC 15, 16, 17), billions of fixed 96$

Table B11. MAM Variables Used by Other NEMS Modules

MACOUT Common Block Name	Macroeconomic Variable Description	Referencing NEMS Module or Submodules
MC_CPI	Consumer Price Index (All Urban) - All Items, 1982-84 = 1.0	NGTDM TRAN
MC_ECIWSP	Employment Cost Index, Wages & Salaries, Private Sector, June 1989 = 1.0	NGTDM UEFP
MC_EX96C	Exports of Goods & Services, billions of chained 96$	TRAN
MC_EXDAN96C	Exports, Goods, billions of chained 96$	TRAN
MC_GDP96C	Gross Domestic Product, billions of chained 96$	INTERCV MAIN RENEW TRAN
MC_GFML96C	Federal Defense Purchases of Goods & Services, billions of chained 96$	TRAN
MC_GNP96C	Gross National Product, billions of chained 96$	TRAN
MC_HUSTS1	Single-Family Housing Starts, millions of units	RESD
MC_HUSTS2N (=MC_HUSTS2A)	Multi-Family Housing Starts, millions of units	RESD
MC_M96C	Imports of Goods & Services, billions of chained 96$	TRAN
MC_N (=MC_N_DW)	Population Including Armed Forces Overseas, millions of persons	COMM RENEW TRAN
MC_N16N (=MC_N16A_DW)	Population Aged 16 and Over, millions of persons	RESD TRAN

MC_PCWGDP	Chained Price Index, GDP, 1996 = 1.0 (1987 = 1.0 in MACOUT)	COALCDS COALCPS COMM EPM IND NGHIST NGPTM NGTDM REFETH REFINE REFRPT RENEW RESD TRAN TRANFRT UDAT UECP EUEFD UEFP ULDSM WELLAK WELLCOST WELLEXP WELLIMP WELLLNG WELLOFF WELLOGS WELLUGR
MC_REALRMGBLUS	Real Average Yield on U.S. Treasury Long-term Bonds	COMM NGTDM
MC_RMGBS3NS	Discount Rate on 3-Month U.S. Treasury Bills	UEFP
MC_RMGFCM_10NS	Yield on 10-year Treasury Notes	UEFP
MC_RMMTGCCNS (=MC_RMMTGCONNS)	Commitment Rate on Conventional 30-year Mortgage	RESD

MC_RMPUAANS	Yield on AA Utility Bonds	COALCDS NGPTM NGTDM UEFP
MC_RLRMPUAANS	Real Yield on AA Utility Bonds (= Nominal Yield - inflation)	COALCPS WELLOGS
MC_SHUMBL	Mobile Homes Shipments, millions of units	RESD
MC_SQDTRUCKSHAM	Unit Sales of New Heavy & Medium Trucks	TRANFRT
MC_SQTRCARS	Unit Sales of Automobiles, Total, millions of units	TRAN
MC_VEHICLES	Unit Sales of Light Trucks by Size Class	TRAN TRANFRT
MC_WPI11	Producer Price Index, Machinery & Equipment, 1982 = 1.0	UEFP
MC_WPI14	Producer Price Index, Transportation Equipment	COALCDS COALCPS
MC_YD96C	Disposable Personal Income, billions of chained 96$	COMM RESD TRAN
MC_COMMFLSP	Commercial Floor Space by Type of Building, billion square feet	COMM
MC_EMPNA	Employment by Industrial (SIC 20-39, Agriculture, Mining, Construction) Sector, millions of employees	IND
MC_MFGO	Gross Output by Manufacturing (SIC 20-39) Sector, billions of fixed 96$	IND TRAN TRANFRT
MC_NMFGO	Gross Output by Non-Manufacturing & Service Sector, billions of fixed 96$	TRAN TRANFRT

NEMS Module/Submodule Descriptions:

COALCDS	Coal Market Module, Coal Distribution Submodule
COALCPS	Coal Market Module, Coal Production Submodule
COMM	Commercial Demand Module
EPM	Future Emission Policy Module
IND	Industrial Demand Module
INTERCV	Integrating Module, Inter-cycle
MAIN	Integrating Module, Main
NGHIST	Natural Gas Transmission & Distribution Module, Historical Processing Code
NGPTM	Natural Gas Transmission & Distribution Module, Pipeline Tariff Submodule
NGTDM	Natural Gas Transmission & Distribution Module, Main Module
REFETH	Petroleum Market Module, Refinery, Ethanol Supply Submodule

REFRPT	Petroleum Market Module, Refinery Report Writer
REFINE	Petroleum Market Module, Refinery Processes
RENEW	Renewable Fuels Module
RESD	Residential Demand Module
TRAN	Transportation Demand Module
TRANFRT	Transportation Demand Module, Freight Transport Submodule
UDAT	Electricity Market Module, Electricity Data Processing
UECP	Electricity Market Module, Electricity Capacity Planning Submodule
UEFD	Electricity Market Module, Electricity Fuel Dispatch Submodule
UEFP	Electricity Market Module, Finance and Pricing Submodule
ULDSM	Electricity Market Module, Load and Demand-Side Management Submodule
WELLCOST	Oil & Gas Supply Module, Cost Submodule
WELLEXP	Oil & Gas Supply Module, Drilling Submodule
WELLIMP	Oil & Gas Supply Module, Foreign Supply Submodule
WELLLNG	Oil & Gas Supply Module, Liquid Natural Gas Submodule
WELLOFF	Oil & Gas Supply Module, Offshore Supply Submodule
WELLOGS	Oil & Gas Supply Module, Main Module
WELLUGR	Oil & Gas Supply Module, Unconventional Gas Recovery Supply Submodule