The Oregon Economic Model

Annual Review of Methodology
2010

Office of Economic Analysis
Department of Administrative Services
State of Oregon

Table of Contents

I. INTRODUCTION

The annual Oregon economic model methodological review opens the model's "black box" for public comment and criticism. These pages are intended to serve as a guide to the economic model, its use, and its limitations. Companion reviews describe the methodology used for forecasting state personal and corporate income taxes, and state video lottery revenues. This section will briefly describe the model's history, its present form, and how input – from IHS Global Insight, the Office of Economic Analysis, the Department of Administrative Services Economic Advisory Group, the Governor's Council of Economic Advisors, and others – helps produce the model results.

The Oregon economic model was developed in 1980 by State Economist Chang Mook Sohn and several DRI consultants. The first official results were printed in early 1981. Since then, the economic model has been used to produce forecasts every quarter; in March, June, September, and December. During legislative sessions in years ending in odd digits, the June forecast is released on May 15. The model has evolved over time as new ideas are put in rigorous form, as updated information is obtained, and as the structure of the state's economy has changed.

Although the specifics of the model are complex, the general structure is simple. It is an export-based model, which means that basic industries are dependent upon national economic conditions. Most of Oregon's manufacturing industries and the agricultural sector are "export" or basic industries. Other industries – such as trade, services, construction, transportation, and government – are treated as "domestic" industries which are dependent upon local economic conditions.

The Oregon economic model is currently linked to the national forecast developed by IHS Global Insight (IHS acquired Global Insight in 2008, which was formerly DRI-WEFA). Data Resources Incorporated (DRI) forecasts drove the state model from 1980 to 1986. From 1986 to 1991, Oregon's forecast was based on Wharton Econometric Forecasting Associates (WEFA) national outlook and from 1992 to 2001 DRI-WEFA was used. Each biennium, the Office of Economic Analysis reviews the services of the major forecast consulting firms and reaches a decision regarding the most appropriate provider.

The model is composed of 38 single and simultaneous equations and additional identities. Each equation is used to predict or forecast an economic variable, such as Oregon lumber and wood products manufacturing employment. Many of these equations are interrelated, as changes in one variable may affect others. For instance, employment increases in lumber and wood products will increase wages and salaries and thus personal income, increasing spending that will further increase employment in domestic industries. Because some of the variables are jointly determined through the solution of the economic equations, the Oregon model is considered to have a "simultaneous" block of equations.

A forecast of the national economy is needed so that forecasts of key Oregon variables which are closely tied to national conditions can be made. IHS Global Insight produces several alternative forecasts of the U.S. economy every month.[1] Each national forecast is composed of over 1,740 separate forecasts of economic variables related to the U.S. economy. In most cases, the Oregon economic model uses the forecasted variables from IHS Global Insight's baseline, or most likely,

[1] See Appendix A for a description of the IHS Global Insight Model of the U.S. Economy.

forecast. These IHS Global Insight baseline forecasts and the economic relationships embodied in the Oregon model equations produce forecasts for each of the Oregon variables. The primary Oregon variables forecasted are non-agricultural employment in various sectors, wages, personal income, housing starts, population, and consumer prices. Many state government agencies and private citizens use these forecasts to help produce their own caseload, costs, or economic projections. Most important for state government planning purposes is use of the forecast values (particularly personal income) to estimate tax revenue.

The economic forecasting process is designed to incorporate Oregon specific information and human judgment through an open review process. After IHS Global Insight produces its baseline forecast, the Office of Economic Analysis combines IHS Global Insight's national forecast with the state economic model equations to produce an initial state economic forecast. These results can be altered with "add factors" until the forecast incorporated knowledge of recent economic events that the equations do not have. The end product is then printed as the Preliminary Economic Forecast.

Two groups – the Department of Administrative Services Economic Advisory Committee and the Governor's Council of Economic Advisors – review the forecast and may recommend changes.2 The Advisory committee is composed of economists within Oregon state government with expertise in areas such as employment, housing, forestry, transportation, energy, and economic development. The Governor's Council of Economic Advisors is composed of leading economists appointed by the Governor from Oregon's business and academic communities. Recommendations from these two groups are incorporated into the forecast. Occasionally these groups may recommend use of one of IHS Global Insight's alternative national forecasts rather than the baseline projection. The final state economic forecast is used to estimate future state personal and corporate income taxes.

The remainder of this review is devoted to an in-depth look at the Oregon economic model. Section II describes the theory behind the model and gives an overall view of the model's equations and the data used. The appendices describe the IHS Global Insight national model, lists the members of the Department of Administrative Services Economic Advisory Committee and the Governor's Council of Economic Advisors, and the variables and equations contained in the model.

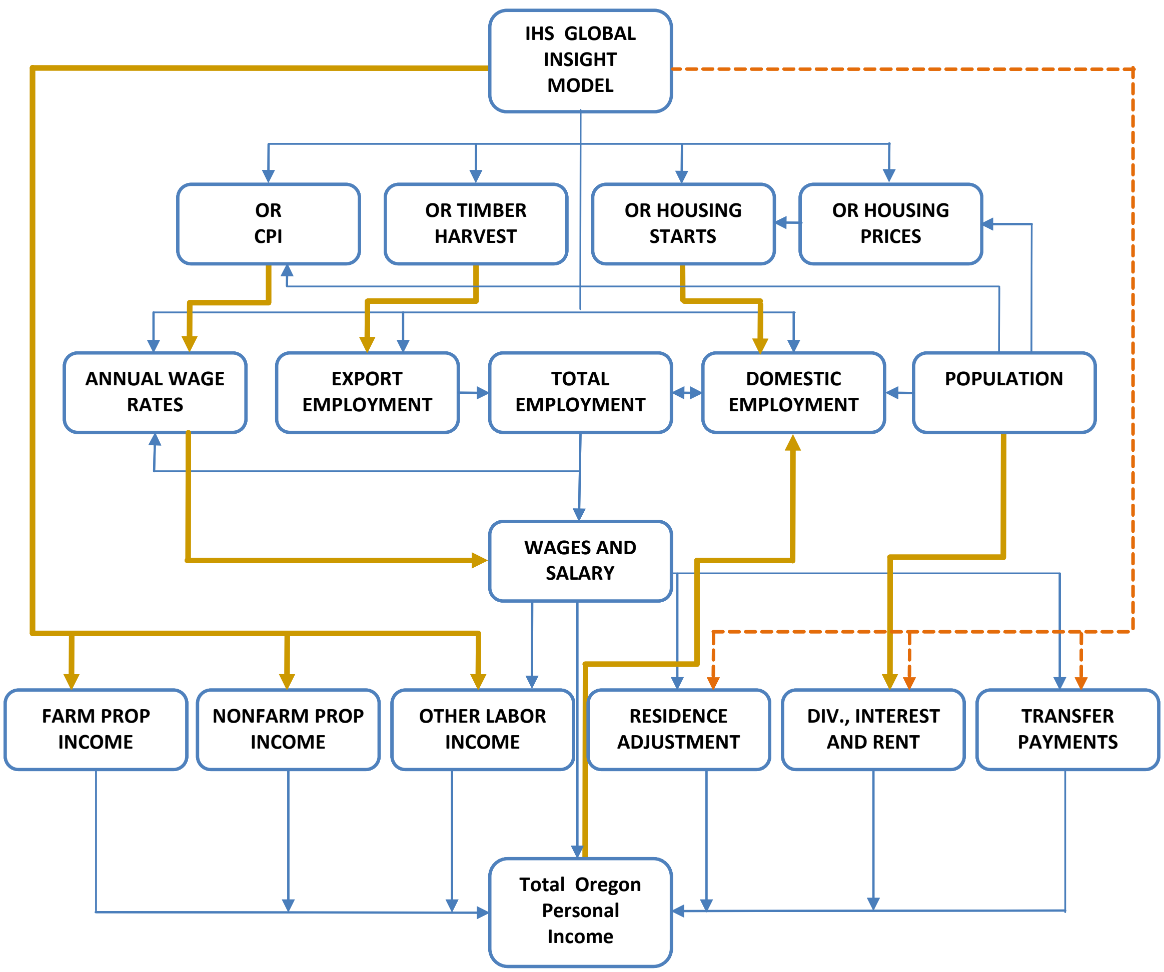
[2] Members of the Economic Advisory Committee and Council of Economic Advisors are listed in appendices B and C, respectively.

II. OREGON ECONOMIC MODEL

Econometric modeling is an ongoing process. New data, new technology, improvements in economic theory, and changing economic relationships require continual model refinements. The Oregon model has evolved in response to change since its development in 1980.

In spite of continuous modifications, the basic structure of the Oregon model remains essentially unchanged. There are now 38 independent equations and a number of additional identities in a Simultaneous Equations System (see Diagram 2). The procedure for selecting explanatory variables consists of four steps. First, the explanatory variable must have a strong theoretical link with the dependent (forecasted) variable. Second, each variable must statistically improve the forecast equation. Third, the overall equation must be able to explain most of the variance in the forecasted variable. Finally, the variable must be a good predictor of future trends, not just past events. If a potential explanatory variable meets these conditions, it is a candidate for inclusion in the equation. Ordinary least squares or generalized least squares are then used to estimate the coefficients for each equation.

Diagram 2



The final step in the forecast process involves the use of add factors. Add factors are designed to incorporate information that the forecaster has but the model does not. The model has information on the national economy through variables forecasted by IHS Global Insight and on the historical relationships of Oregon variables to these national variables. It does not have information on current economic events in Oregon such as strikes, plant openings/closures, or government policy changes. Some Oregon variables may not closely track national trends. For example, employment in the electrical machinery sector saw a decline at the national level, but Oregon witnessed a substantial rise in the 1990s. These developments are incorporated into the model by add factoring the relevant equation. The model then captures the impact of these changes on the overall state economy. It is through the use of add factors that the expertise of the Governor's Council of Economic Advisors and the Department of Administrative Services Advisory Committee can be incorporated into the forecast.

The primary focus of the model is on the simultaneous estimation of Oregon's non-agricultural employment and personal income. Non-agricultural employment is important in the estimation of personal income for several reasons. First, employment data is published monthly, allowing continuous monitoring of forecast accuracy. Personal income data is released on a quarterly basis and does not cover the most recent quarter. Second, Oregon employment data is generally subject to smaller revisions than is personal income data. Finally, employment data gives a more detailed look at the economy because information in provided at various industry levels through the North American Industrial Classification System (NAICS).

Although data limitations clearly make it the most appropriate focus of the model, reliance on non-agricultural employment does present some disadvantages. Job growth often does not accurately reflect output or income growth. Sectors which experience higher labor productivity growth tend to lag behind in job growth while sectors with minimal productivity improvement generate above average employment increases. Manufacturing tends to be a rapidly increasing productivity sector with smaller job gains, while many service-producing sectors experience the opposite. Another limitation of the employment data base is the exclusion of proprietors and agricultural workers. This causes the model to understate the importance of small businesses and agriculture.

Other important variables include population, wage rates, timber harvest, consumer prices, and housing affordability. Population is used as a determinant of housing starts and employment of certain sectors such as state and local government and service-based employment. Population growth is influenced by previous job growth, and differentials in unemployment and personal income between neighboring states. Although population enters the Oregon Economic Model as an exogenous variable, economic factors are used to model and forecast population. Wage rates are used along with employment to forecast wage and salary disbursements, the most important component of personal income. In addition, wage rates reflect on the state's relative business costs. Timber harvest is included because of the importance of the lumber and wood products industry. It also allows for the incorporation of policy decisions regarding the availability of public timber. Prices are included through forecasting the Portland area consumer price index (CPI) and the Oregon repeat purchase house price index.

The Oregon economic model does not forecast national variables. Rather, it uses the national forecast as the driver for the Oregon forecast. Many of the equations in the Oregon economic model use national data as explanatory variables. The national forecast is provided by IHS Global Insight, the national data and forecast provider for the Office of Economic Analysis.

The basic structure of Oregon Economic Model (with number of independent non-identity equations in parenthesis) can be summarized as follows:

EMPLOYMENT EQUATIONS (24)
- Manufacturing (7)
  - Durable Manufacturing (5)
  - Non-durable Manufacturing (2)
- Non-manufacturing (17)
  - Construction (1)
  - Mining (1)
  - Transportation, Warehousing, and Utilities (1)
  - Trade (2)
  - Financial (1)
  - Health and Private Education (2)
  - Information (1)
  - Leisure and Hospitality (1)
  - Professional and Business (1)
  - Other Services (1)
  - Government (5)

WAGE RATE EQUATIONS (1)

INCOME EQUATIONS (8)
- Other Labor Income (1)
- Non-farm Proprietor's Income (1)
- Dividend, Interest, and Rent (1)
- Transfer Payments (1)
- Contributions to Social Security (1)
- Residence Adjustment (1)
- Farm Proprietor's Income (1)
- Commodities Sector Wages and Salaries (1)

TIMBER HARVEST EQUATIONS (2)
- Public (1)
- Private (1)

MISCELLANEOUS EQUATIONS (3)
- Oregon House Price Index (1)
- Oregon Housing Starts (1)
- Oregon CPI (Portland-Salem) (1)

1. Employment Base

Any state's employment base can be divided into two groups: those employees that work in sectors which produce goods and services for export to other states and countries, and those that work in sectors engaged in producing goods and services for consumption within the state. In Diagram 2, on page 3, these groups are called export and domestic employment, respectively. Export employment primarily consists of manufacturing, but also includes jobs in agriculture, mining and federal government sectors. In addition, a small but growing portion of employment in the service-producing sectors is export oriented. Domestic employment is composed of the construction services; trade; state and local government; finance, insurance, and real estate; and transportation, communications and utilities sectors. Export employment is sensitive to national and international markets, while domestic employment is primarily determined by developments in the state economy.

In 2010, Oregon's manufacturing sector made up about 10.2 percent of non-agricultural jobs, but fluctuations in manufacturing filter through the domestic sectors to generate larger impacts on the state economy. The manufacturing sector has strong links to the state's natural resource base, but also includes technology-based industries. Resource-based lumber and wood industry employed 19,800 workers. Computer and electronic product manufacturing includes makers of computers, computer peripherals, communications equipment, and similar electronic products and that manufacture components for such products. This sector is estimated to have provided 34,900 jobs. Together, these industries comprised approximately 33.8 percent of Oregon's manufacturing employment. The other industries that comprise manufacturing employment are approximately one-third of metals, machinery, and other durables and one-third non-durable products which includes food processors.

Some service-producing sector employment reflects export activity and can, therefore, be a cause of economic fluctuations. Service-producing industries that fit this category include recreation and tourism and a portion of financial services and business services. Another important source of economic growth in recent years has been the in-migration of retirees into the state. Retirees act as an export sector because a large proportion of their income originates outside the state in the form of private and federal government pensions, interest and dividend earnings, and social security payments. The Oregon model captures these sectors only in an indirect sense through property income and transfer payments, population growth, and service-producing sector growth. The model is not well positioned to anticipate changes in the growth rate originating from these sectors.

The most basic form of estimating export employment is used for the transportation equipment manufacturing industry. The industry employment equation (ignoring the autocorrelation term) is:3

log(OEEM336) = 8.7489 + 1.5550* log(EMD336(-1)) - 0.2503 * log(JEXCHMTPREAL)

where log(x) means taking the log of the variable x, and

> OEE336 = Oregon employment in the NAISC 336, transportation equipment manufacturing, lagged one quarter
> EMD336(-1) = U.S. employment in NAICS 336, lagged one quarter, measured in millions
> JEXCHMTPREAL = Real U.S. trade-weighted exchange rate with major currency trading partners, 2005=1.0

All Oregon employment figures are in thousands. In this example, the forecast for employment in Oregon's transportation equipment industry is determined by IHS Global Insight's forecasts for the national industry employment and a weighted average US real exchange rate. Since producers in Oregon sell most of their output in national and international markets, it is likely that national economic variables such as interest rates, consumer and business demand, and productivity will determine industry trends in the state. These variables are reflected in IHS

[3] For reference, all model equations are catalogued in Appendix F.

Global Insight's national industry forecast. The exchange rate is included to account for Oregon's greater reliance on exports.

A second type of employment estimate is illustrated in the following equation for Oregon's retail trade:

log(OEETRET) = 0.3711 + 1.0536 * log(ERET) + 0.9482* log(ONP/NP)

where, OEETRET = Oregon employment in retail trade
ERET = U.S. employment in the retail trade sector
N = U.S. population
ONP = Oregon population

Employment in Oregon's retail trade sector is determined by developments within the Oregon and U.S. economies. Demand for retail trade services can be estimated by including retail trends at the national level and Oregon's population as a share of total U.S. population. Structural changes taking place nationally in the industry are reflected in national retail trade employment. Another key factor in determining retail sales (and retail employment) is demographic changes. A larger population typically results in a larger level of sales. Controlling for Oregon's percentage of total U.S. population allows for increasing or decreasing local demand, relative to the nation.

These two employment equations illustrate the basic differences between the "export" and "domestic" sectors. The export industry equation (e.g. transportation equipment manufacturing) shows the direct links between Oregon's export industries, national industry trends and international developments. Fluctuations in export industries will also generate secondary job effects in the state's local sectors. The retail trade sector illustrates the domestic sector structure which is more dependent on changes in personal income and population.

2. Wage Rates

The Oregon model contains a section designed to forecast average wages for total nonfarm employment. This is estimated on an annual rate basis and calculated as total nonfarm wage and salary disbursements divided by total nonfarm wage and salary employment. The annual wage rate is then multiplied by the employment forecast to derive a forecast for nonfarm wage and salary disbursements. To arrive at total wage and salary disbursements, farm wages and salaries are added to this forecast. However, farm wages and salaries are not forecasted through an analogous annual wage equation multiplied by employment. These wage and salary disbursements are forecasted as a function of nonfarm wage and salary disbursement as the two series exhibit similar behavior over time (farm wages are typically 12 percent as large as total nonfarm wages).

The following two equations specify how total wages and salaries in Oregon are forecasted.

OYWSD = OWRAVG*OEE + OYWSDF
where OYWSD = Oregon Total Wage and Salary Disbursement
OWRAVG = Oregon Nonfarm Average Wage
OEE = Oregon Total Nonfarm Employment
OWSDF = Oregon Farm Wage and Salary Disbursement

LOG(OWRAVG) = -7.831 + 0.746*LOG(YPCOMPWSD/EEA) – 0.068*LOG(OEE(-2)/ONP(-2)) + 0.326*LOG(OCPI(-1))

where OWRAVG = Oregon Nonfarm Average Wage
YPCOMPWSD = U.S Nonfarm Wage and Salary Disbursement
EEA = U.S. Total Nonfarm Employment
OEE = Oregon Total Nonfarm Employment
ONP = Oregon Population
OCPI = Oregon CPI

The equation specifies Oregon nonfarm average wage as a function of trends in U.S. average wages, changes in the relative cost-of-living in Oregon (as measured by the Portland CPI), and changes in the employment to population ratio in Oregon. If Oregon's labor market gets tight or the cost-of-living rises faster, wages in the state are expected to increase at a faster pace. However, the most important determinant of state wage patterns has been changes in national private sector wage rates.

3. Personal Income

Oregon personal income is the sum of all payments received by individuals within the state. It includes wage and salary disbursements, other labor income, proprietor's income (farm and non-farm), dividends, interest, rent, and net transfer payments (see Table 1). Personal income is adjusted for individuals who receive income in one state while residing in another. Taxable personal income, under current Oregon tax law, includes wages and salaries; proprietor's income; and dividends, rent, and interest. In 2009, wage and salary disbursements made up 51 percent of personal income and 68 percent of taxable income.

Other labor income consists of employee benefits such as insurance paid by employers. It is estimated as a function of Oregon wage and salary disbursements and the U.S. forecast for other labor income by IHS Global Insight. Other labor income constitutes about 12.7 percent of total state personal income.

Proprietors' income makes up about 7.2 percent of Oregon personal income. It is divided into non-farm and farm components for estimating purposes. Non-farm proprietors' income is determined by national nonfarm proprietors' income with inventory and capital construction adjustments in addition to previous levels of Oregon nonfarm proprietors' income (incorporated as both one and two quarter lagged variables). Farm proprietor income is extremely volatile and very difficult to accurately predict. In the model, it is specified as a function of an historic trend and IHS Global Insight's forecast for real, trade-weighted exchange rate of the U.S. Dollar.

Property income (dividends, rent, and interest) is forecast to track the national forecast for dividends, interest and rent along with Oregon's population growth relative to the nation's population growth. Property income comprises about 20.4 percent of Oregon's personal income.

Transfer payments are about 19.5 percent of Oregon's personal income in 2009. As the state and the nation were in the depths of the Great Recession, transfer payments increased substantially and resulted in a larger share of total personal income than during the expansion phase of the business cycle. During such years, transfer payments typically account for around 15 percent of total personal income. The bulk of transfer payments (about 75 percent) take the form of pensions and social security payments. The inclusion of national transfer payments accounts for trends in federal pensions and social security payments.

TABLE 1
SUMMARY OF INCOME EQUATIONS

Components of Oregon Personal Income (Dependent Variables)	Variables Used to Predict Components of Oregon Personal Income (Independent Variables)
Wages and salaries, by industry	Industry employment multiplied by sector wage rate.
Other labor income	Oregon wage and salary disbursements, national other labor income and Oregon lags of dependent variable
Non-farm proprietor's income	national nonfarm proprietor's income and Oregon lags of dependent variable
Farm proprietor's income	Real, trade-weighted exchange rate of the USD
Dividends, interest, rent	National dividends, rent and interest income, national population, Oregon population
Transfer payments	National transfer payments, State transfer payments
Contributions to social insurance	Oregon wage and salary disbursements, seasonal factors
Residence adjustment	U.S. wage and salary disbursements, Oregon wage and salary disbursements

Payroll taxes (contributions to social insurance) reduce state personal income and are estimated using Oregon'' wage and salary disbursements. Residence adjustment picks up differences between place of work and residence. In Oregon's case, residence adjustment is negative, indicating that out-of-state residents derive more income in Oregon than vice versa. Most of this income is earned in the Portland Metropolitan Area. Residence adjustment is assumed to follow the trends in both the nation's and Oregon's wage and salary disbursements.

4. Timber Harvest

The final variable to be predicted is the statewide timber harvest. It is broken into a federal lands component (Bureau of Land Management and Forest Service) and private lands (including state administered lands). Both public and private harvest are estimated as a function of price trends, as measured by the producer price index for lumber and wood products. However, in recent years, the public harvest has been estimated outside of the model due to restrictions imposed on federal lands. Inclusion of the harvest variable allows the model to simulate the impact of reduced timber harvest levels on the state economy.

5. Population

Population forecasts by single age and sex are developed using the cohort-component projection method. In this procedure, a cohort of population is projected forward based on the specific assumptions of components of change: vital events and migrations. Projection of vital events, births and deaths, is based on fertility and mortality schedule developed based on historical Oregon and national rates and national projections. Migration projections are based on age-specific migration rates controlled to migration totals estimated using regression analysis using

Oregon's employment change, difference in unemployment rates between Oregon and U.S., Washington, and California, and difference in income between Oregon and neighboring states. In the forecasting process, the base population is the most recent census counts. However the totals for the past years are controlled to the population from Population Research Center, PSU, and vital numbers are controlled to the numbers collected by Oregon Center for Vital Statistics, DHS.

6. Other Variables

The Portland-Salem CPI is the only consistent price index available for any part of the state. It is estimated by the U.S. Department of Labor using the same methodology as the national CPI. It is updated every six months. The equation used to forecast the Portland CPI is:

LOG(OPCI) = -12.875 + 0.345*LOG(CPI) + 1.187*LOG(ONP)
where: OPCI = Portland-Salem, OR-WA CPI
CPI = U.S. CPI for urban consumers
ONP = Oregon population

The Portland-Salem CPI is forecast to closely follow its national counterpart (as it has done in the past) and the population growth rate for Oregon.

The Oregon Home Price Index is another variable in the model and uses the price index for the state that the Federal Housing Finance Agency (formerly OFHEO) compiles on a quarterly basis. The equation used to forecast this price index for Oregon is:

DLOG(ORPI) = -0.110 + 0.888*DLOG(PHU1OFHEONS) + 1.957*LOG(ONP/ONP(-4)) + 0.009*LOG(OHUSTS)
where: ORPI = FHFA Oregon Home Price Index
PHU1OFHEONS = FHFA U.S. Home Price Index
ONP = Oregon population
OHUSTS = Oregon Housing Starts

The Oregon Home Price Index is modeled to forecast the change in home prices (using a first difference of the natural logarithm of the index). The explanatory variables include the change in national housing prices, the Oregon's population growth in the previous year and Oregon housing starts.

APPENDIX A
IHS GLOBAL INSIGHT Model of the U.S. Economy
The Model's Theoretical Position

An Econometric Dynamic Equilibrium Growth Model: The IHS Global Insight Model strives to incorporate the best insights of many theoretical approaches to the business cycle: Keynesian, New Keynesian, Neoclassical, Monetarist and Supply-side. In addition, the IHS Global Insight Model embodies the major properties of the *Neoclassical* growth models developed by Robert Solow. This structure guarantees that short-run cyclical developments will converge to robust long-run equilibrium.

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 or environmental 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 IHS Global Insight 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 inflation phenomena.

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 choice, each medium'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. 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 IHS Global Insight 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 our 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 to 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. Our 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 IHS Global Insight Model allows a choice in this matter. On the one hand, the user can simply accept IHS

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, he could reduce the consumer sentiment index. Such experiments can be made "rational" through model iterations that bring the current change in expectations in line with future endogenous changes in employment, prices, or financial conditions.

Theory As a Constraint: The conceptual basis of each equation in the IHS Global Insight 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 IHS 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 IHS Global Insight Model captures the full simultaneity of the U.S. economy, forecasting over 1400 concepts spanning final demands, aggregate supply, prices, incomes, international trade, industrial detail, interest rates, and financial flows. Chart 1 summarizes the structure of the eight interactive sectors (noted in Roman numerals). The following discussion presents the logic of each sector and the significant interactions with other sectors.

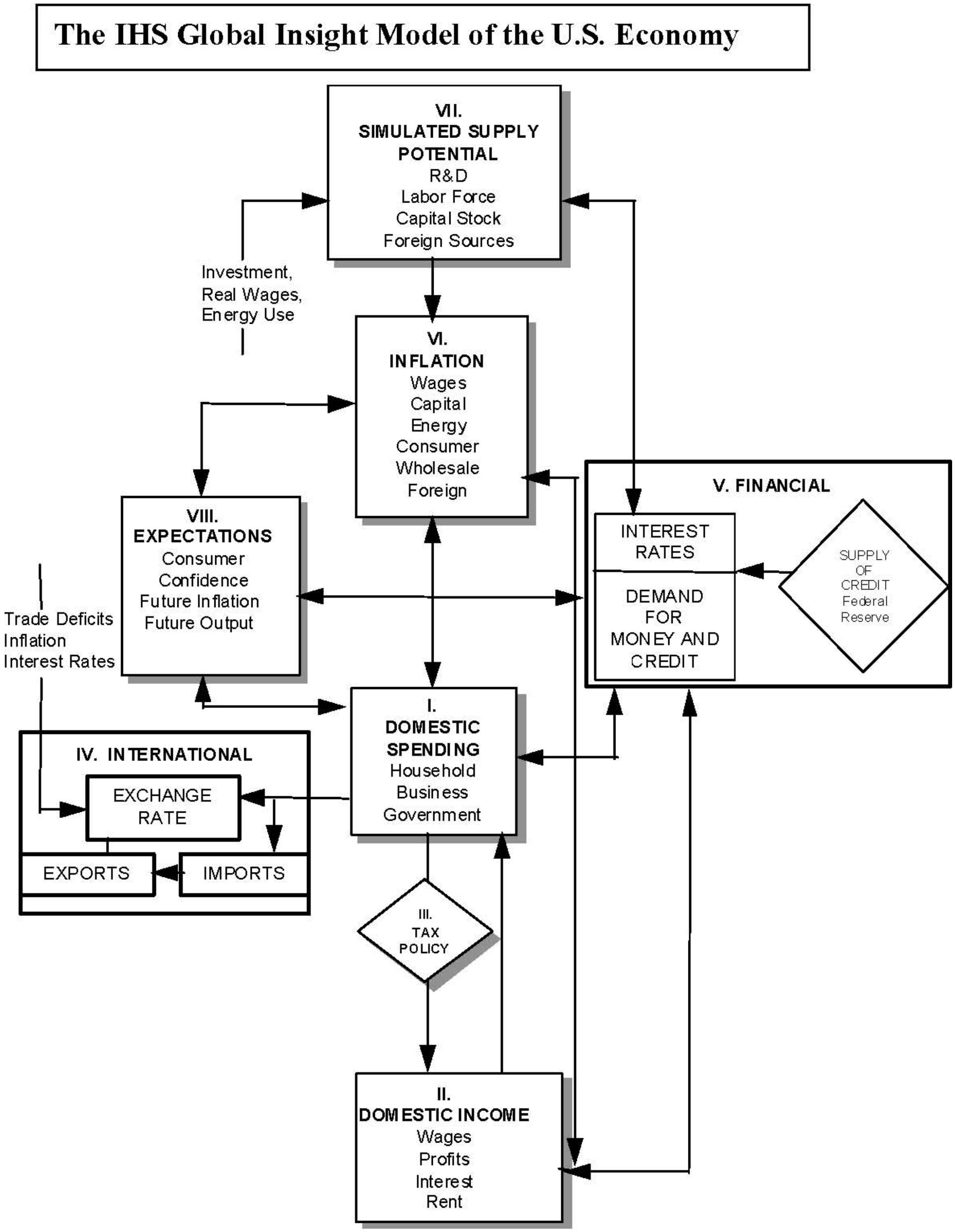
Spending-Consumer: The domestic spending (I), income (II), and tax policy (III) sectors model the central circular flow of behavior as measured by the national income and product accounts. If the rest of the model were "frozen," these blocks would produce a Keynesian system similar to the models pioneered 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 twelve categories: two new vehicles categories; two net purchases of used cars categories; motor-vehicle parts and accessories; furnishings and durable household equipment; computers; software; calculators, typewriters and other; other recreational goods and services; therapeutic appliances and equipment; and "other". Spending on nondurable goods is divided into seven categories: food; clothing and shoes; motor vehicle fuels, lubricants, and fluids; fuel oil and other fuels; tobacco; pharmaceutical and other medical products; and "other". Spending on services is divided into seventeen categories: housing; three utilities categories; four transportation categories; health care; recreation; food; accommodation; two financial categories; insurance; telecommunication; and "other". In addition, there is an additional services category for final consumption of nonprofit institutions serving households. 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 within equipment and software: four information processing equipment categories; industrial equipment; three transportation equipment categories; other producers' durable equipment. Within structures, there are three building categories; mining and petroleum structures; power and communication structures; land and all others. Equipment and (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 oil and natural gas prices and to oil and natural gas production.

Chart 1: Overview of the IHS Global Insight Model of the U.S. Economy



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 six 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. Surprise 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 categories (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 five GDP account categories: single family housing; multi-family housing; improvements; miscellaneous; and residential equipment.

Residential construction is typically the first sector to turn down 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 IHS Global Insight 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 multifamily 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 (equationdetermined) at the state and local level. The user sets the real level of federal nondefense and defense purchases (for compensation, consumption of fixed capital, CCC 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 – interest payments - is determined within the model because of its dependence on the model’s financial and tax sectors. 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.

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.

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 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.

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 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.

International: The international sector (IV) is a critical 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, IHS 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 two service categories are separately modeled for both imports and exports, with one additional goods category for oil imports. For example, export and import detail for computers is included as a natural counterpart to the inclusion of the computer component of producers' durable equipment spending. The computers 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 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.

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 or environmental 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 IHS Global Insight 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 interest rates are covered in order to meet client needs regarding investment and financial allocation strategies.

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 IHS Global Insight 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 an 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 IHS Global Insight Model; indeed, substantial emphasis on this side of the economy (VII) was incorporated as early as 1976. In the IHS Global Insight Model, aggregate supply is estimated by a Cobb-Douglas production function that combines factor input growth and improvements in total factor productivity. The output measure in the production function is a gross output concept that equals private GDP, excluding housing services, plus net energy imports.

Factor input equals a weighted average of labor, business fixed capital, public infrastructure, and energy. 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. To avoid double-counting energy input, the labor and capital inputs are both adjusted to deduct estimates of the labor and capital that produce energy. Total factor productivity depends upon the stock of research and development capital and trend technological change.

Potential GDP is the sum of the aggregate supply concept derived from the production function, less net energy imports, plus housing services and the compensation of government employees. Taxation and other government policies influence 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 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 IHS Global Insight 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.

APPENDIX B

MEMBERS OF THE DEPARTMENT OF ADMINISTRATIVE SERVICES
ECONOMIC ADVISORY COMMITTEE

The Department of Administrative Services Economic Advisory Group ("Insiders") is composed of economists from various branches of state government. The group meets prior to the Governor's council of Economic Advisors and comments on the appropriateness of the forecast. The Governor's council will often review comments and information provided by the Insiders. The members of the Advisory Group are listed below.

Chris Allanach
Legislative Revenue Office

Art Ayre
Oregon Employment Department

Dae Baek
Legislative Revenue Office

Nick Beleiciks
Employment Department

Steven Bender
Legislative Fiscal Office

Darren Q. Bond
Oregon State Treasury

David Cooke
Oregon Employment Department

Brian Conway
Public Utility Commission

Craig Fischer
Oregon Dept. of Revenue

Gary A. Helmer
Dept. of Consumer and Business Services

Betsy Jensvold
DHS Office of Forestry and Research

Dave Kavanaugh
Oregon Economic and Community Dev. Dept.
Jack Kenney
DAS Budget and Management

Gary Lettman
Oregon Dept. of Forestry

Mazen Malik
Legislative Revenue Office

Mark McMullen OEA Staff
Office of Economic Analysis

Tom Potiowsky OEA Staff
Office of Economic Analysis

John Radford
Department of Administrative Services

Brent Searle
Department of Agriculture

Jennifer Shawcross
Employment Department

Dennis Yee
Metro

Vic Todd
Department of Human Services

Paul Warner
Legislative Revenue Office

Stephen Willhite
Office of Forecasting and Research

APPENDIX C

MEMBERS OF THE
GOVERNOR'S COUNCIL OF ECONOMIC ADVISORS

The Governor's Council of Economic Advisors is a group of 12 economists and business leaders. The Council was formed by legislative act in 1982 and is responsible for comment on, and changes made to, the preliminary economic forecast. A listing of council members is given below.

Joe Cortright **CHAIR**
Impresa Inc.

Jennifer Black
Jennifer Black & Associates, LLC

William B. Conerly, Ph.D.
Conerly Consulting LLC

Tim Duy
Dept. of Economics

James Hendry
Brownstein, Rask, Sweeney, Kerr, Grim, DeSylvia & Hat

B. Starr McMullen
Oregon State University

Ham Nguyen
Portland General Electric -- 1-WTC8

Randall Pozdena
ECONorthwest

Hans Radtke
Yachats, Oregon

Mark Rasmussen
Mason, Bruce & Girard Inc.

Oran Teater
RBC Dain Rauscher

Tom Potiowsky **STAFF**
Office of Economic Analysis

Josh Lehner **STAFF**
Office of Economic Analysis

Appendix D

OREGON ECONOMIC MODEL Variable Definitions

These variables are calculated within the Oregon Economic Model. "O" implies the variable applies to Oregon. All of the Oregon employment series are seasonally adjusted.

Variable Name	Variable Description
CPI	Consumer price index, all-urban, 1982-84=1.00
ECON	Employment--Construction
EEA	Employment--Total Nonfarm Payrolls
EEHS62	Employment--Health Care & Social Assistance
EENRM	Employment--Natural Resources & Mining
EEPBS	Employment--Professional & Business Services
EFIN	Employment--Financial Activities
EG	Employment--Government
EG91	Employment--Federal
EINF	Employment--Information
ELHS	Employment--Leisure & Hospitality
EMD321	Employment--Wood Products
EMD327	Employment--Nonmetallic Mineral Products
EMD331	Employment--Primary Metals
EMD332	Employment--Fabricated Metal Products
EMD333	Employment--Machinery
EMD334	Employment--Computer & Electronic Products
EMD335	Employment--Electrical Equipment & Appliances
EMD336	Employment--Transportation Equipment
EMD337	Employment--Furniture & Related Products
EMD339	Employment--Miscellaneous Durable Manufacturing
EMN	Employment--Nondurable Manufacturing
EMN311	Employment--Food Manufacturing
ERET	Employment--Retail Trade
ETAW	Employment--Transportation & Warehousing
EUTI22	Employment--Utilities
EWST42	Employment--Wholesale Trade
HUSPS	Housing starts, Total
JEXCHMTPREAL	Real U.S. trade-wtd. exchange rate with major currency trading partners, 2005=1.0
JEXCHOITPREAL	Real U.S. trade-wtd. exchange rate with other important trading partners, 2005=1.0
JPC	Chained Price index-Total personal consumption expenditures, 2005=100
NP	Total population, including armed forces overseas
OCPI	Consumer price index, all-urban, 1982-84=100, Oregon
ODUMMY2002	Binary indicator with values of 0 for dates prior to 2001 and 1 after 2001
ODUMMY2004	Binary indicator with values of 0 for all dates except 2004Q1 when it is 1
ODUMMY9498	Binary indicator with values of 0 for all dates except 1994Q1 and 1998Q1 when it is 1
ODUMMY96	Binary indicator with values of 0 for dates prior to 1996 and 1 after 1996
ODUMMY99	Binary indicator with values of 0 for dates prior to 1999 and 1 after 1999
OEE	Oregon Total Nonfarm Employment
OEECON	Construction Employment, Oregon

OEEE61	Educational Services Employment, Private, Oregon
OEEE62	Health Services Employment, Oregon
OEEEHS	Education and Health Services Employment, Oregon
OEEFIN	Financial Services Employment, Oregon
OEEGFED	Federal Government Employment, Oregon
OEEGLO	Local Government Employment, Oregon
OEEGLOED	Local Education Employment, Oregon
OEEGOV	Government Employment, Oregon
OEEGST	State Government Employment, Oregon
OEEGSTED	State Education Employment, Oregon
OEEINF	Information Employment, Oregon
OEELHS	Leisure and Hospitality Employment, Oregon
OEEM311	Food Manufacturing Employment, Oregon
OEEM321	Wood Products Manufacturing Employment, Oregon
OEEM334	Computer and Electronics Manufacturing Employment, Oregon
OEEM336	Transportation Equipment Manufacturing Employment, Oregon
OEEMDUR	Durable Goods Manufacturing Employment, Oregon
OEEMFG	Manufacturing Employment, Oregon
OEEMMM	Metals Manufacturing Employment, Oregon
OEEMNON	Nondurable Manufacturing Employment, Oregon
OEEMODUR	Other Durable Manufacturing Employment, Oregon
OEEMONON	Other Nondurable Manufacturing Employment, Oregon
OEENONMFG	Private Nonmanufacturing Employment, Oregon
OEENRM	Natural Resources and Mining Employment, Oregon
OEEOTS	Other Services Employment, Oregon
OEEPBS	Professional and Business Services Employment, Oregon
OEETRET	Retail Trade Employment, Oregon
OEETTU	Trade, Transporation and Utilities Employment, Oregon
OEETTWU	Transportation and Utilities Employment, Oregon
OEETWST	Wholesale Trade Employment, Oregon
OEEXG	Private Employment, Oregon
OHUSTS	Housing Starts, annual rate, Oregon
ONP	Total Population, Oregon
ORPI	FHFA Housing Price Index, 1980Q1=100, Oregon
OTIMBER	Timber Harvest Total, Oregon
OTIMBERPRI	Timber Harvest, Private, Oregon
OTIMBERPUB	Timber Harvest, Public, Oregon
OWRAVG	Average Wage Rate, Oregon
OYDIR	Dividend, Interest and Rent Income, Oregon
OYOL	Other Labor Income, Oregon
OYP	Total Personal Income, Oregon
OYPRF	Farm Proprietors' Income, Oregon
OYPRN	Nonfarm Proprietors' Income, Oregon
OYRA	Residence Adjustment, Oregon
OYTR	Transfer Payment Income, Oregon
OYTWPER	Social Security Contribution Income, Oregon
OYWSD	Wage and Salary Disbursements, Oregon
OYWSDF	Farm Wage and Salary Disbursements, Oregon
PHU1OFHEONS	FHFA housing price index, 1980Q1=100
WPI08	Producer price index--lumber & wood products, 1982=1.0
YPCOMPSUPPAI	Other labor income (fringe benefits)
YPCOMPWSD	Wage & salary disbursements
YPDIR	Dividend, Interest and Rent Income

ypadiv	Dividend payments to individuals
yprentadj	Personal rental income with capital consumption adjustment
ypaint	Personal interest income
YPPROPADJNF	Farm proprietors' income
YPTRFGF	Federal government transfer payments
YPTRFGSL	State & local government transfers to individuals

Appendix E

VARIABLES IMPACTED BY CHANGES IN ENDOGENOUS VARIABLES

Variable Changed	Variable Impacted
CPI	OCPI
ECON	OEECON
EEA	OEELHS, OWRAVG
EEHS62	OEEE62
EENRM	OEENRM
EEPBS	OEEPBS
EFIN	OEEFIN
EG	OEEGST
EG91	OEEGFED, OEEGST
EINF	OEEINF
ELHS	OEELHS
EMD321	OEEM321
EMD327	OEEMODUR
EMD331	OEEMMM
EMD332	OEEMMM
EMD333	OEEMMM
EMD334	OEEM334
EMD335	OEEMODUR
EMD336	OEEM336
EMD337	OEEMODUR
EMD339	OEEMODUR
EMN	OEEMONON
EMN311	OEEM311, OEEMONON
ERET	OEETRET
ETAW	OEETTWU
EUTI22	OEETTWU
EWST42	OEETWST
HUSPS	OHUSTS
JEXCHMTPREAL	OEEM336
JEXCHOITPREAL	OEEM334, OEEMMM, OYPRF
JPC	OEEOTS
NP	OEETRET, OYDIR
OCPI	OWRAVG
ODUMMY2002	OYOL
ODUMMY2004	OYOL
ODUMMY9498	OTIMBERPUB
ODUMMY96	OEEGLO, OEEGLOED, OEEGST, OEEGSTED
ODUMMY99	OEEGSTED
OEE	OEELHS, OWRAVG, OYWSD
OEECON	OEENONMFG
OEEE61	OEEEHS
OEEE62	OEEEHS
OEEEHS	OEENONMFG
OEEFIN	OEENONMFG
OEEGFED	OEEGOV
OEEGLO	OEEGOV

OEEGLOED	
OEEGOV	OEE
OEEGST	OEEGOV
OEEGSTED	
OEEINF	OEENONMFG
OEELHS	OEENONMFG
OEEM311	OEEMNON
OEEM321	OEEMDUR
OEEM334	OEEMDUR
OEEM336	OEEMDUR
OEEMDUR	OEEMFG
OEEMFG	OEEXG
OEEMMM	OEEMDUR
OEEMNON	OEEMFG
OEEMODUR	OEEMDUR
OEEMONON	OEEMNON
OEENONMFG	OEEXG
OEENRM	OEENONMFG
OEEOTS	OEENONMFG
OEEPBS	OEENONMFG
OEETRET	OEETTU
OEETTU	OEENONMFG
OEETTWU	OEETTU
OEETWST	OEETTU
OEEXG	OEE
OHUSTS	OEECON
ONP	OCPI, OEECON, OEEE61, OEEFIN, OEEGLO, OEEGLOED, OEEGST, OEEGSTED, OEEOTS, OEETRET, ORPI, OWRAVG, OYDIR
ORPI	OHUSTS
OTIMBER	OEENRM
OTIMBERPRI	OTIMBER
OTIMBERPUB	OTIMBER
OWRAVG	OYWSD
OYDIR	OYP
OYOL	OYP
OYP	OEEOTS
OYPRF	OYP
OYPRN	OYP
OYRA	OYP
OYTR	OYP
OYTWPER	OYP
OYWSD	OYOL, OYRA, OYWSD, OYWSDF, OYP
OYWSDF	OYWSD
PHU1OFHEONS	ORPI
WPI08	OTIMBERPRI, OTIMBERPUB
YPCOMPSUPPAI	OYOL
YPCOMPWSD	OWRAVG, OYRA
YPDIR	OYDIR
ypadiv	YPDIR
yprentadj	YPDIR
ypaint	YPDIR
YPPROPADJNF	OYPRN

YPTRFGF	OYTR
YPTRFGSL	OYTR

Appendix F

Dependent Variable: LOG(OCPI)
Method: Least Squares
Date: 04/14/10 Time: 08:09
Sample: 1990Q1 2009Q4
Included observations: 80
Convergence achieved after 7 iterations

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LOG(CPI)	0.344769	0.069049	4.993095	0.0000
LOG(ONP)	1.186600	0.129644	9.152745	0.0000
C	-12.87481	1.913924	-6.726921	0.0000
AR(1)	0.844721	0.052981	15.94393	0.0000

R-squared	0.999566	Mean dependent var	5.143950
Adjusted R-squared	0.999549	S.D. dependent var	0.155489
S.E. of regression	0.003303	Akaike info criterion	-8.539542
Sum squared resid	0.000829	Schwarz criterion	-8.420441
Log likelihood	345.5817	F-statistic	58347.37
Durbin-Watson stat	1.456178	Prob(F-statistic)	0.000000

Inverted AR Roots	.84

Dependent Variable: LOG(OEECON)
Method: Least Squares
Date: 04/14/10 Time: 08:09
Sample (adjusted): 1990Q2 2009Q4
Included observations: 79 after adjustments
Convergence achieved after 23 iterations

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LOG(ECON)	1.025773	0.144208	7.113140	0.0000
LOG(OHUSTS(-1))	0.014542	0.023298	0.624192	0.5344
LOG(OHUSTS(-2))	0.027216	0.021595	1.260298	0.2116
LOG(ONP)	-0.352605	0.562164	-0.627227	0.5325
C	14.32251	8.521905	1.680670	0.0971
AR(1)	0.929543	0.026206	35.47104	0.0000

R-squared	0.993951	Mean dependent var	11.23492
Adjusted R-squared	0.993536	S.D. dependent var	0.204922
S.E. of regression	0.016475	Akaike info criterion	-5.301031
Sum squared resid	0.019814	Schwarz criterion	-5.121073
Log likelihood	215.3907	F-statistic	2398.916
Durbin-Watson stat	1.101510	Prob(F-statistic)	0.000000

Inverted AR Roots	.93

Dependent Variable: LOG(OEEE61)
Method: Least Squares
Date: 04/14/10 Time: 08:09
Sample (adjusted): 1990Q2 2009Q4
Included observations: 79 after adjustments
Convergence achieved after 5 iterations

Variable	Coefficient	Std. Error	t-Statistic	Prob.

LOG(ONP)	2.678697	0.073658	36.36658	0.0000
C	-30.27500	1.108289	-27.31687	0.0000
AR(1)	0.677876	0.076780	8.828786	0.0000

R-squared	0.994400	Mean dependent var	10.00354
Adjusted R-squared	0.994253	S.D. dependent var	0.222174
S.E. of regression	0.016843	Akaike info criterion	-5.292471
Sum squared resid	0.021561	Schwarz criterion	-5.202492
Log likelihood	212.0526	F-statistic	6747.609
Durbin-Watson stat	2.157270	Prob(F-statistic)	0.000000

Inverted AR Roots	.68

Dependent Variable: LOG(OEEE62)
Method: Least Squares
Date: 04/14/10 Time: 08:09
Sample (adjusted): 1990Q2 2009Q4
Included observations: 79 after adjustments
Convergence achieved after 5 iterations

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LOG(EEHS62)	1.109792	0.052945	20.96135	0.0000
C	9.084030	0.141924	64.00641	0.0000
AR(1)	0.920244	0.024036	38.28667	0.0000

R-squared	0.999448	Mean dependent var	11.91073
Adjusted R-squared	0.999433	S.D. dependent var	0.158099
S.E. of regression	0.003763	Akaike info criterion	-8.289887
Sum squared resid	0.001076	Schwarz criterion	-8.199908
Log likelihood	330.4505	F-statistic	68798.98
Durbin-Watson stat	1.801878	Prob(F-statistic)	0.000000

Inverted AR Roots	.92

Dependent Variable: LOG(OEEFIN)
Method: Two-Stage Least Squares
Date: 04/14/10 Time: 08:09
Sample (adjusted): 1990Q2 2009Q4
Included observations: 79 after adjustments
Convergence achieved after 22 iterations
Instrument list: LOG(ONP(-1)/NP(-1)) LOG(ONP(-2)/NP(-2)) LOG(EFIN)
ODUMMY2001
Lagged dependent
variable & regressors
added to instrument list

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LOG(EFIN)	0.975003	0.141846	6.873682	0.0000
LOG(ONP/ONP(-4))	4.581627	2.730350	1.678036	0.0975
C	9.432595	0.279974	33.69101	0.0000
AR(1)	0.932874	0.028428	32.81509	0.0000

R-squared	0.997425	Mean dependent var	11.42713
Adjusted R-squared	0.997322	S.D. dependent var	0.104635
S.E. of regression	0.005415	Sum squared resid	0.002199

F-statistic	9681.894	Durbin-Watson stat	1.380726
Prob(F-statistic)	0.000000	Second-Stage SSR	0.002331

Inverted AR Roots	.93

Dependent Variable: LOG(OEEGFED)
Method: Least Squares
Date: 04/14/10 Time: 08:09
Sample (adjusted): 1990Q2 2009Q4
Included observations: 79 after adjustments
Convergence achieved after 8 iterations

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LOG(EG91)	1.092067	0.071675	15.23628	0.0000
C	9.183902	0.075555	121.5526	0.0000
AR(1)	0.911107	0.048233	18.88980	0.0000

R-squared	0.947855	Mean dependent var	10.33189
Adjusted R-squared	0.946483	S.D. dependent var	0.044949
S.E. of regression	0.010398	Akaike info criterion	-6.257082
Sum squared resid	0.008218	Schwarz criterion	-6.167103
Log likelihood	250.1548	F-statistic	690.7412
Durbin-Watson stat	2.016237	Prob(F-statistic)	0.000000

Inverted AR Roots	.91

Dependent Variable: LOG(OEEGLO)
Method: Least Squares
Date: 04/14/10 Time: 08:09
Sample (adjusted): 1990Q2 2009Q4
Included observations: 79 after adjustments
Convergence achieved after 10 iterations

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LOG(ONP(-2))	1.045582	0.188039	5.560464	0.0000
ODUMMY96	0.057185	0.007883	7.254673	0.0000
C	-3.737866	2.835300	-1.318332	0.1914
AR(1)	0.926362	0.045806	20.22364	0.0000

R-squared	0.996518	Mean dependent var	12.01093
Adjusted R-squared	0.996379	S.D. dependent var	0.126221
S.E. of regression	0.007596	Akaike info criterion	-6.873154
Sum squared resid	0.004327	Schwarz criterion	-6.753182
Log likelihood	275.4896	F-statistic	7154.508
Durbin-Watson stat	1.935764	Prob(F-statistic)	0.000000

Inverted AR Roots	.93

Dependent Variable: LOG(OEEGLOED)
Method: Least Squares
Date: 04/14/10 Time: 08:09
Sample (adjusted): 1990Q2 2009Q4
Included observations: 79 after adjustments
Convergence achieved after 5 iterations

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LOG(ONP)	1.138952	0.100191	11.36782	0.0000
ODUMMY96	0.026165	0.012348	2.118906	0.0374
C	-5.760892	1.503031	-3.832850	0.0003
AR(1)	0.795148	0.070421	11.29137	0.0000

R-squared	0.987023	Mean dependent var	11.38280
Adjusted R-squared	0.986504	S.D. dependent var	0.105053
S.E. of regression	0.012204	Akaike info criterion	-5.924780
Sum squared resid	0.011171	Schwarz criterion	-5.804808
Log likelihood	238.0288	F-statistic	1901.548
Durbin-Watson stat	2.322892	Prob(F-statistic)	0.000000

Inverted AR Roots	.80

Dependent Variable: LOG(OEEGST)
Method: Least Squares
Date: 04/14/10 Time: 08:10
Sample (adjusted): 1990Q2 2009Q4
Included observations: 79 after adjustments
Convergence achieved after 8 iterations

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LOG(ONP(-1))	0.108743	0.245123	0.443624	0.6586
LOG(EG-EG91)	0.735341	0.237253	3.099391	0.0027
ODUMMY96	-0.107478	0.007736	-13.89402	0.0000
C	7.520720	3.026893	2.484634	0.0152
AR(1)	0.766125	0.081332	9.419732	0.0000

R-squared	0.965632	Mean dependent var	11.18837
Adjusted R-squared	0.963774	S.D. dependent var	0.040856
S.E. of regression	0.007776	Akaike info criterion	-6.814281
Sum squared resid	0.004475	Schwarz criterion	-6.664316
Log likelihood	274.1641	F-statistic	519.7856
Durbin-Watson stat	1.843244	Prob(F-statistic)	0.000000

Inverted AR Roots	.77

Dependent Variable: LOG(OEEGSTED)
Method: Least Squares
Date: 04/14/10 Time: 08:10
Sample (adjusted): 1990Q2 2009Q4
Included observations: 79 after adjustments
Convergence achieved after 8 iterations

Variable	Coefficient	Std. Error	t-Statistic	Prob.
ODUMMY96	-0.112708	0.011134	-10.12297	0.0000
ODUMMY99	-0.053061	0.010960	-4.841222	0.0000
LOG(ONP)	1.391628	0.163146	8.529959	0.0000
C	-10.66310	2.454576	-4.344173	0.0000
AR(1)	0.877782	0.046504	18.87534	0.0000

R-squared	0.967150	Mean dependent var	10.15882
Adjusted R-squared	0.965374	S.D. dependent var	0.057466
S.E. of regression	0.010693	Akaike info criterion	-6.177195

Sum squared resid	0.008462	Schwarz criterion	-6.027230
Log likelihood	248.9992	F-statistic	544.6600
Durbin-Watson stat	2.092336	Prob(F-statistic)	0.000000
Inverted AR Roots	.88		

Dependent Variable: LOG(OEEINF)
Method: Least Squares
Date: 04/14/10 Time: 08:10
Sample (adjusted): 1990Q2 2009Q4
Included observations: 79 after adjustments
Convergence achieved after 7 iterations

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LOG(EINF)	0.977240	0.143914	6.790466	0.0000
C	9.369298	0.167625	55.89424	0.0000
AR(1)	0.960610	0.033403	28.75798	0.0000

R-squared	0.986041	Mean dependent var	10.40626
Adjusted R-squared	0.985674	S.D. dependent var	0.114628
S.E. of regression	0.013720	Akaike info criterion	-5.702673
Sum squared resid	0.014306	Schwarz criterion	-5.612694
Log likelihood	228.2556	F-statistic	2684.248
Durbin-Watson stat	1.946957	Prob(F-statistic)	0.000000
Inverted AR Roots	.96		

Dependent Variable: LOG(OEELHS)
Method: Two-Stage Least Squares
Date: 04/14/10 Time: 08:10
Sample (adjusted): 1991Q1 2009Q4
Included observations: 76 after adjustments
Convergence achieved after 14 iterations
Instrument list: LOG(ELHS) LOG(OEE(-1)/EEA(-1)) LOG(OEE(-2)/EEA(-2))
LOG(OEE(-3)/EEA(-3)) LOG(OEE(-4)/EEA(-4)) ODUMMY2001
Lagged dependent
variable & regressors
added to instrument list

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LOG(ELHS)	0.994678	0.039968	24.88707	0.0000
LOG(OEE/EEA)	0.892958	0.214444	4.164071	0.0001
C	1.038093	1.962512	0.528961	0.5985
AR(1)	0.872912	0.058301	14.97238	0.0000

R-squared	0.999173	Mean dependent var	11.87171
Adjusted R-squared	0.999138	S.D. dependent var	0.134062
S.E. of regression	0.003935	Sum squared resid	0.001115
F-statistic	28971.32	Durbin-Watson stat	1.447908
Prob(F-statistic)	0.000000	Second-Stage SSR	0.001977
Inverted AR Roots	.87		

Dependent Variable: LOG(OEEM311)
Method: Least Squares

Date: 04/14/10 Time: 08:10
Sample (adjusted): 1990Q2 2009Q4
Included observations: 79 after adjustments
Convergence achieved after 21 iterations

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LOG(EMN311)	0.554983	0.602630	0.920935	0.3600
@TREND	0.000796	0.002229	0.357165	0.7220
C	9.692005	0.535093	18.11277	0.0000
AR(1)	0.927314	0.070586	13.13743	0.0000

R-squared	0.775701	Mean dependent var	10.05231
Adjusted R-squared	0.766730	S.D. dependent var	0.040625
S.E. of regression	0.019621	Akaike info criterion	-4.975119
Sum squared resid	0.028874	Schwarz criterion	-4.855147
Log likelihood	200.5172	F-statistic	86.45861
Durbin-Watson stat	2.313600	Prob(F-statistic)	0.000000
Inverted AR Roots	.93		

Dependent Variable: LOG(OEEM321)
Method: Least Squares
Date: 04/14/10 Time: 08:10
Sample (adjusted): 1990Q2 2009Q4
Included observations: 79 after adjustments
Convergence achieved after 4 iterations

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LOG(EMD321)	0.959920	0.054958	17.46649	0.0000
C	10.89820	0.064316	169.4484	0.0000
AR(1)	0.959769	0.009745	98.49217	0.0000

R-squared	0.995842	Mean dependent var	10.43872
Adjusted R-squared	0.995733	S.D. dependent var	0.163334
S.E. of regression	0.010669	Akaike info criterion	-6.205638
Sum squared resid	0.008652	Schwarz criterion	-6.115659
Log likelihood	248.1227	F-statistic	9101.824
Durbin-Watson stat	1.997063	Prob(F-statistic)	0.000000
Inverted AR Roots	.96		

Dependent Variable: LOG(OEEM334)
Method: Least Squares
Date: 04/14/10 Time: 08:10
Sample (adjusted): 1990Q2 2009Q4
Included observations: 79 after adjustments
Convergence achieved after 5 iterations

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LOG(EMD334)	1.062658	0.092233	11.52149	0.0000
LOG(JEXCHOITPREAL(-4))	-0.032015	0.055721	-0.574561	0.5673
C	10.55106	0.150505	70.10461	0.0000
AR(1)	0.979336	0.006340	154.4594	0.0000

R-squared	0.994082	Mean dependent var	10.58232

Adjusted R-squared	0.993845	S.D. dependent var	0.151345
S.E. of regression	0.011874	Akaike info criterion	-5.979699
Sum squared resid	0.010574	Schwarz criterion	-5.859727
Log likelihood	240.1981	F-statistic	4199.248
Durbin-Watson stat	1.217185	Prob(F-statistic)	0.000000
Inverted AR Roots	.98		

Dependent Variable: LOG(OEEM336)
Method: Least Squares
Date: 04/14/10 Time: 08:10
Sample (adjusted): 1990Q3 2009Q4
Included observations: 78 after adjustments
Convergence achieved after 7 iterations

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LOG(EMD336(-1))	1.555075	0.241462	6.440251	0.0000
LOG(JEXCHMTPREAL)	-0.250362	0.133145	-1.880365	0.0640
C	8.748961	0.148518	58.90861	0.0000
AR(1)	0.950956	0.023856	39.86245	0.0000

R-squared	0.947236	Mean dependent var	9.622794
Adjusted R-squared	0.945097	S.D. dependent var	0.151869
S.E. of regression	0.035585	Akaike info criterion	-3.783857
Sum squared resid	0.093706	Schwarz criterion	-3.663001
Log likelihood	151.5704	F-statistic	442.8209
Durbin-Watson stat	2.023941	Prob(F-statistic)	0.000000
Inverted AR Roots	.95		

Dependent Variable: LOG(OEEMMM)
Method: Least Squares
Date: 04/14/10 Time: 08:10
Sample (adjusted): 1990Q3 2009Q4
Included observations: 78 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LOG(EMD331+EMD332+EMD333)	0.032317	0.028385	1.138550	0.2586
LOG(OEEMMM(-1))	1.789037	0.077826	22.98779	0.0000
LOG(OEEMMM(-2))	-0.838617	0.069733	-12.02607	0.0000
LOG(JEXCHOITPREAL(-1))	-0.001563	0.019879	-0.078645	0.9375
C	0.481141	0.205378	2.342712	0.0219

R-squared	0.988639	Mean dependent var	10.51641
Adjusted R-squared	0.988017	S.D. dependent var	0.100360
S.E. of regression	0.010986	Akaike info criterion	-6.122404
Sum squared resid	0.008811	Schwarz criterion	-5.971333
Log likelihood	243.7738	F-statistic	1588.170
Durbin-Watson stat	1.545184	Prob(F-statistic)	0.000000

Dependent Variable: DLOG(OEEMODUR)
Method: Least Squares
Date: 04/14/10 Time: 08:10
Sample (adjusted): 1990Q3 2009Q4
Included observations: 78 after adjustments

Convergence achieved after 4 iterations

Variable	Coefficient	Std. Error	t-Statistic	Prob.
DLOG(EMD327+EMD335+EMD337+EMD339)	1.415215	0.174669	8.102289	0.0000
C	0.004924	0.002322	2.120934	0.0372
AR(1)	0.372551	0.107041	3.480448	0.0008

R-squared	0.660085	Mean dependent var	-0.001921
Adjusted R-squared	0.651021	S.D. dependent var	0.020204
S.E. of regression	0.011935	Akaike info criterion	-5.980958
Sum squared resid	0.010684	Schwarz criterion	-5.890316
Log likelihood	236.2574	F-statistic	72.82185
Durbin-Watson stat	2.063106	Prob(F-statistic)	0.000000

Inverted AR Roots	.37

Dependent Variable: DLOG(OEEMONON)
Method: Least Squares
Date: 04/14/10 Time: 08:10
Sample (adjusted): 1990Q2 2009Q4
Included observations: 79 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
DLOG(EMN-EMN311)	1.093577	0.104061	10.50900	0.0000
C	0.004424	0.001131	3.912389	0.0002

R-squared	0.589200	Mean dependent var	-0.003751
Adjusted R-squared	0.583865	S.D. dependent var	0.011307
S.E. of regression	0.007294	Akaike info criterion	-6.978469
Sum squared resid	0.004097	Schwarz criterion	-6.918483
Log likelihood	277.6495	F-statistic	110.4390
Durbin-Watson stat	1.747352	Prob(F-statistic)	0.000000

Dependent Variable: LOG(OEENRM)
Method: Least Squares
Date: 04/14/10 Time: 08:10
Sample (adjusted): 1990Q3 2009Q4
Included observations: 78 after adjustments
Convergence achieved after 55 iterations

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LOG(EENRM)	0.401296	0.231038	1.736923	0.0866
LOG(OTIMBER(-1))	0.104713	0.056950	1.838686	0.0700
C	9.752372	1.610281	6.056316	0.0000
@TREND	-0.007482	0.007253	-1.031637	0.3056
AR(1)	0.964458	0.062005	15.55441	0.0000

R-squared	0.955674	Mean dependent var	9.196220
Adjusted R-squared	0.953245	S.D. dependent var	0.116425
S.E. of regression	0.025174	Akaike info criterion	-4.464020
Sum squared resid	0.046264	Schwarz criterion	-4.312949
Log likelihood	179.0968	F-statistic	393.4713
Durbin-Watson stat	1.837346	Prob(F-statistic)	0.000000

Inverted AR Roots	.96

Dependent Variable: LOG(OEEOTS)
Method: Two-Stage Least Squares
Date: 04/14/10 Time: 08:10
Sample (adjusted): 1990Q2 2009Q4
Included observations: 79 after adjustments
Convergence achieved after 5 iterations
Instrument list: LOG((OYP(-2)/JPC(-2))/ONP(-2)) LOG((OYP(-1)/JPC(-1))/ONP(-1))
Lagged dependent variable & regressors added to instrument list

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LOG((OYP/JPC)/ONP)	0.673083	0.048676	13.82784	0.0000
C	16.36316	0.394338	41.49530	0.0000
AR(1)	0.800215	0.053704	14.90036	0.0000

R-squared	0.988669	Mean dependent var	10.89567
Adjusted R-squared	0.988371	S.D. dependent var	0.078914
S.E. of regression	0.008510	Sum squared resid	0.005504
F-statistic	3322.673	Durbin-Watson stat	1.542868
Prob(F-statistic)	0.000000	Second-Stage SSR	0.004488

Inverted AR Roots	.80

Dependent Variable: LOG(OEEPBS)
Method: Least Squares
Date: 04/14/10 Time: 08:11
Sample (adjusted): 1990Q3 2009Q4
Included observations: 78 after adjustments
Convergence achieved after 24 iterations

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LOG(EEPBS)	0.972700	0.157581	6.172688	0.0000
C	9.378707	0.437939	21.41557	0.0000
AR(1)	1.488668	0.103561	14.37480	0.0000
AR(2)	-0.528815	0.099765	-5.300630	0.0000

R-squared	0.998442	Mean dependent var	11.98212
Adjusted R-squared	0.998379	S.D. dependent var	0.198894
S.E. of regression	0.008008	Akaike info criterion	-6.766798
Sum squared resid	0.004746	Schwarz criterion	-6.645941
Log likelihood	267.9051	F-statistic	15807.79
Durbin-Watson stat	2.120528	Prob(F-statistic)	0.000000

Inverted AR Roots	.90	.59

Dependent Variable: LOG(OEETRET)
Method: Least Squares
Date: 04/14/10 Time: 08:11
Sample (adjusted): 1990Q2 2009Q4
Included observations: 79 after adjustments
Convergence achieved after 13 iterations

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LOG(ERET)	1.053635	0.086008	12.25045	0.0000
LOG(ONP/NP)	0.948222	0.332606	2.850888	0.0056
C	0.371123	2.986155	0.124281	0.9014
AR(1)	0.875632	0.051089	17.13950	0.0000

R-squared	0.997243	Mean dependent var	12.09471
Adjusted R-squared	0.997132	S.D. dependent var	0.090461
S.E. of regression	0.004844	Akaike info criterion	-7.772731
Sum squared resid	0.001760	Schwarz criterion	-7.652759
Log likelihood	311.0229	F-statistic	9041.521
Durbin-Watson stat	1.810663	Prob(F-statistic)	0.000000

Inverted AR Roots	.88

Dependent Variable: LOG(OEETTWU)
Method: Least Squares
Date: 04/14/10 Time: 08:11
Sample (adjusted): 1990Q2 2009Q4
Included observations: 79 after adjustments
Convergence achieved after 35 iterations

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LOG((ETAW+EUTI22))	0.875761	0.155149	5.644643	0.0000
C	9.552874	0.246145	38.80987	0.0000
AR(1)	0.944109	0.039139	24.12213	0.0000

R-squared	0.987850	Mean dependent var	10.90267
Adjusted R-squared	0.987531	S.D. dependent var	0.074620
S.E. of regression	0.008333	Akaike info criterion	-6.700064
Sum squared resid	0.005277	Schwarz criterion	-6.610085
Log likelihood	267.6525	F-statistic	3089.681
Durbin-Watson stat	1.460087	Prob(F-statistic)	0.000000

Inverted AR Roots	.94

Dependent Variable: LOG(OEETWST)
Method: Least Squares
Date: 04/14/10 Time: 08:11
Sample (adjusted): 1990Q2 2009Q4
Included observations: 79 after adjustments
Convergence achieved after 6 iterations

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LOG(EWST42)	0.919474	0.102683	8.954464	0.0000
C	9.637374	0.181401	53.12742	0.0000
AR(1)	0.942726	0.026439	35.65612	0.0000

R-squared	0.993141	Mean dependent var	11.20617
Adjusted R-squared	0.992961	S.D. dependent var	0.067396
S.E. of regression	0.005655	Akaike info criterion	-7.475488
Sum squared resid	0.002430	Schwarz criterion	-7.385509
Log likelihood	298.2818	F-statistic	5502.416
Durbin-Watson stat	1.852959	Prob(F-statistic)	0.000000

Inverted AR Roots	.94

Dependent Variable: LOG(OHUSTS)
Method: Least Squares
Date: 04/14/10 Time: 08:11
Sample: 1990Q1 2009Q4
Included observations: 80
Convergence achieved after 11 iterations

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LOG(HUSPS)	0.807541	0.097093	8.317179	0.0000
DLOG((ORPI))	2.244567	1.012537	2.216774	0.0296
C	9.648551	0.054463	177.1584	0.0000
AR(1)	0.802774	0.070036	11.46235	0.0000

R-squared	0.940021	Mean dependent var	9.967150
Adjusted R-squared	0.937654	S.D. dependent var	0.329771
S.E. of regression	0.082341	Akaike info criterion	-2.107183
Sum squared resid	0.515286	Schwarz criterion	-1.988082
Log likelihood	88.28734	F-statistic	397.0396
Durbin-Watson stat	2.185356	Prob(F-statistic)	0.000000

Inverted AR Roots	.80

Dependent Variable: DLOG(ORPI)
Method: Least Squares
Date: 04/14/10 Time: 08:11
Sample: 1990Q1 2009Q4
Included observations: 80
Convergence achieved after 12 iterations

Variable	Coefficient	Std. Error	t-Statistic	Prob.
DLOG(PHU1OFHEONS)	0.932819	0.081833	11.39908	0.0000
LOG(ONP/ONP(-4))	2.356901	0.474510	4.967020	0.0000
C	-0.030209	0.007631	-3.958971	0.0002
AR(1)	0.743511	0.077010	9.654675	0.0000

R-squared	0.890127	Mean dependent var	0.015264
Adjusted R-squared	0.885790	S.D. dependent var	0.016543
S.E. of regression	0.005591	Akaike info criterion	-7.486719
Sum squared resid	0.002375	Schwarz criterion	-7.367618
Log likelihood	303.4688	F-statistic	205.2362
Durbin-Watson stat	1.880941	Prob(F-statistic)	0.000000

Inverted AR Roots	.74

Dependent Variable: LOG(OTIMBERPRI)
Method: Least Squares
Date: 04/14/10 Time: 08:11
Sample (adjusted): 1990Q2 2009Q4
Included observations: 79 after adjustments
Convergence achieved after 7 iterations

Variable	Coefficient	Std. Error	t-Statistic	Prob.

C	8.030876	0.222461	36.10008	0.0000
DLOG(@MOVAV(WPI08,4))	1.761768	0.728313	2.418971	0.0180
AR(1)	0.964272	0.054450	17.70917	0.0000

R-squared	0.838032	Mean dependent var	8.146095
Adjusted R-squared	0.833770	S.D. dependent var	0.112149
S.E. of regression	0.045725	Akaike info criterion	-3.295118
Sum squared resid	0.158897	Schwarz criterion	-3.205139
Log likelihood	133.1572	F-statistic	196.6148
Durbin-Watson stat	2.045643	Prob(F-statistic)	0.000000

Inverted AR Roots	.96		

Dependent Variable: LOG(OTIMBERPUB)
Method: Least Squares
Date: 04/14/10 Time: 08:11
Sample (adjusted): 1990Q2 2009Q4
Included observations: 79 after adjustments
Convergence achieved after 6 iterations

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	5.602842	0.552889	10.13375	0.0000
DLOG(@MOVAV(WPI08,4))	3.810416	1.964958	1.939184	0.0562
ODUMMY9498	-0.281674	0.062840	-4.482432	0.0000
AR(1)	0.963020	0.019596	49.14465	0.0000

R-squared	0.971877	Mean dependent var	6.351186
Adjusted R-squared	0.970752	S.D. dependent var	0.720208
S.E. of regression	0.123169	Akaike info criterion	-1.301207
Sum squared resid	1.137802	Schwarz criterion	-1.181235
Log likelihood	55.39767	F-statistic	863.9628
Durbin-Watson stat	1.889296	Prob(F-statistic)	0.000000

Inverted AR Roots	.96		

Dependent Variable: LOG(OWRAVG)
Method: Least Squares
Date: 04/14/10 Time: 08:11
Sample (adjusted): 1990Q4 2009Q4
Included observations: 77 after adjustments
Convergence achieved after 20 iterations

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-7.830578	0.370152	-21.15502	0.0000
LOG(YPCOMPWSD/EEA)	0.745564	0.064171	11.61839	0.0000
LOG(OEE(-2)/ONP(-2))	-0.067542	0.104885	-0.643962	0.5216
LOG(OCPI(-1))	0.326052	0.101689	3.206348	0.0020
AR(1)	0.898939	0.064865	13.85865	0.0000

R-squared	0.999257	Mean dependent var	-3.439329
Adjusted R-squared	0.999215	S.D. dependent var	0.204554
S.E. of regression	0.005730	Akaike info criterion	-7.423485
Sum squared resid	0.002364	Schwarz criterion	-7.271290

Log likelihood	290.8042	F-statistic	24195.94
Durbin-Watson stat	2.550930	Prob(F-statistic)	0.000000
Inverted AR Roots	.90		

Dependent Variable: LOG(OYDIR)
Method: Least Squares
Date: 04/14/10 Time: 08:12
Sample: 1990Q1 2009Q4
Included observations: 80
Convergence achieved after 12 iterations

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LOG(YPDIR)	0.775698	0.059474	13.04260	0.0000
LOG(ONP/NP)	1.814540	1.675427	1.083031	0.2822
C	-12.83426	15.54264	-0.825746	0.4115
AR(1)	0.950632	0.028545	33.30306	0.0000

R-squared	0.998921	Mean dependent var	9.837488
Adjusted R-squared	0.998878	S.D. dependent var	0.264685
S.E. of regression	0.008865	Akaike info criterion	-6.564618
Sum squared resid	0.005973	Schwarz criterion	-6.445517
Log likelihood	266.5847	F-statistic	23447.70
Durbin-Watson stat	0.930070	Prob(F-statistic)	0.000000
Inverted AR Roots	.95		

Dependent Variable: DLOG(OYOL)
Method: Least Squares
Date: 04/14/10 Time: 08:12
Sample: 1990Q1 2009Q4
Included observations: 80

Variable	Coefficient	Std. Error	t-Statistic	Prob.
DLOG(YPCOMPSUPPAI)	0.719961	0.138288	5.206256	0.0000
DLOG(OYWSD)	0.245124	0.101828	2.407241	0.0185
ODUMMY2002	0.028868	0.011682	2.471203	0.0157
ODUMMY2004	-0.006417	0.011758	-0.545718	0.5869
C	0.000391	0.002687	0.145500	0.8847

R-squared	0.364408	Mean dependent var	0.013246
Adjusted R-squared	0.330510	S.D. dependent var	0.014037
S.E. of regression	0.011486	Akaike info criterion	-6.034958
Sum squared resid	0.009894	Schwarz criterion	-5.886081
Log likelihood	246.3983	F-statistic	10.75008
Durbin-Watson stat	1.157940	Prob(F-statistic)	0.000001

Dependent Variable: OYPRF
Method: Least Squares
Date: 04/14/10 Time: 08:12
Sample: 1990Q1 2009Q4
Included observations: 80
Convergence achieved after 10 iterations

Variable	Coefficient	Std. Error	t-Statistic	Prob.

@TREND	-3.124143	2.611232	-1.196425	0.2352
LOG(JEXCHOITPREAL)	-437.5370	363.0420	-1.205197	0.2319
C	805.0800	446.5015	1.803085	0.0753
AR(1)	0.811169	0.068314	11.87417	0.0000

R-squared	0.654964	Mean dependent var	282.6125
Adjusted R-squared	0.641345	S.D. dependent var	141.5628
S.E. of regression	84.77889	Akaike info criterion	11.76668
Sum squared resid	546247.0	Schwarz criterion	11.88578
Log likelihood	-466.6671	F-statistic	48.08903
Durbin-Watson stat	2.143032	Prob(F-statistic)	0.000000

Inverted AR Roots .81

Dependent Variable: LOG(OYPRN)
Method: Least Squares
Date: 04/14/10 Time: 08:12
Sample: 1990Q1 2009Q4
Included observations: 80

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LOG(YPPROPADJNF)	0.906540	0.125951	7.197546	0.0000
LOG(YPPROPADJNF(-1))	-0.641497	0.132522	-4.840689	0.0000
C	1.101408	0.235923	4.668511	0.0000
LOG(OYPRN(-1))	0.756013	0.098282	7.692288	0.0000
LOG(OYPRN(-2))	-0.072488	0.087952	-0.824176	0.4125

R-squared	0.997815	Mean dependent var	8.940700
Adjusted R-squared	0.997698	S.D. dependent var	0.341649
S.E. of regression	0.016391	Akaike info criterion	-5.323758
Sum squared resid	0.020149	Schwarz criterion	-5.174881
Log likelihood	217.9503	F-statistic	8562.245
Durbin-Watson stat	1.747590	Prob(F-statistic)	0.000000

Dependent Variable: OYRA
Method: Least Squares
Date: 04/14/10 Time: 08:12
Sample: 1990Q1 2009Q4
Included observations: 80
Convergence achieved after 8 iterations

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LOG(YPCOMPWSD)	505.8239	568.9069	0.889115	0.3767
LOG(OYWSD)	-2589.001	570.9655	-4.534427	0.0000
C	22074.26	1727.043	12.78153	0.0000
AR(1)	0.862010	0.057372	15.02486	0.0000

R-squared	0.997629	Mean dependent var	-1641.438
Adjusted R-squared	0.997535	S.D. dependent var	636.9322
S.E. of regression	31.62358	Akaike info criterion	9.794390
Sum squared resid	76003.84	Schwarz criterion	9.913491
Log likelihood	-387.7756	F-statistic	10657.10
Durbin-Watson stat	2.066135	Prob(F-statistic)	0.000000

Inverted AR Roots .86

Dependent Variable: LOG(OYTR)
Method: Least Squares
Date: 04/14/10 Time: 08:12
Sample: 1990Q1 2009Q4
Included observations: 80
Convergence achieved after 137 iterations

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LOG(YPTRFGF+YPTRFGSL)	0.977819	0.061052	16.01625	0.0000
C	49.44464	23877.19	0.002071	0.9984
AR(1)	0.999962	0.019689	50.78873	0.0000

R-squared	0.999484	Mean dependent var	9.465180
Adjusted R-squared	0.999471	S.D. dependent var	0.383346
S.E. of regression	0.008821	Akaike info criterion	-6.586579
Sum squared resid	0.005991	Schwarz criterion	-6.497253
Log likelihood	266.4632	F-statistic	74561.78
Durbin-Watson stat	1.018700	Prob(F-statistic)	0.000000

Inverted AR Roots 1.00

Dependent Variable: LOG(OYTWPER)
Method: Least Squares
Date: 04/14/10 Time: 08:12
Sample: 1990Q1 2009Q4
Included observations: 80
Convergence achieved after 8 iterations

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-1.343034	0.165970	-8.092016	0.0000
LOG(OYWSD)	0.962820	0.015268	63.06313	0.0000
@SEAS(1)	0.007627	0.001524	5.004521	0.0000
AR(1)	0.771080	0.065792	11.72004	0.0000

R-squared	0.999268	Mean dependent var	9.043148
Adjusted R-squared	0.999239	S.D. dependent var	0.308471
S.E. of regression	0.008512	Akaike info criterion	-6.646064
Sum squared resid	0.005506	Schwarz criterion	-6.526963
Log likelihood	269.8426	F-statistic	34561.52
Durbin-Watson stat	2.280432	Prob(F-statistic)	0.000000

Inverted AR Roots .77

Dependent Variable: LOG(OYWSDF)
Method: Least Squares
Date: 04/14/10 Time: 08:12
Sample (adjusted): 1990Q2 2009Q4
Included observations: 79 after adjustments
Convergence achieved after 7 iterations

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LOG(OYWSD(-1))	1.087488	0.086531	12.56760	0.0000
C	-5.441801	0.940617	-5.785352	0.0000

AR(1)	0.870746	0.055936	15.56679	0.0000

R-squared	0.993235	Mean dependent var	6.287857
Adjusted R-squared	0.993057	S.D. dependent var	0.349577
S.E. of regression	0.029129	Akaike info criterion	-4.196963
Sum squared resid	0.064484	Schwarz criterion	-4.106984
Log likelihood	168.7800	F-statistic	5579.123
Durbin-Watson stat	1.824336	Prob(F-statistic)	0.000000
Inverted AR Roots	.87		

oeegov = oeegfed + oeegst + oeeglo
oeemfg = oeemdur + oeemnon
oeemdur = oeem334 + oeemmm + oeem336 + oeemodur + oeem321
oeemnon = oeem311 + oeemonon
oywsd = owravg * oee + oywsdf
oyp = oywsd + oyol + oyprn + oyprf + oyra + oytr + oydir - oytwper
otimber = otimberpri + otimberpub
oee = oeegov + oeexg
oeexg = oeemfg + oeenonmfg
oeenonmfg = oeenrm + oeecon + oeettu + oeeinf + oeefin + oeepbs + oeeehs + oeelhs + oeeots
oeettu = oeetwst + oeetret + oeettwu
oeeehs = oeee61 + oeee62