THE WEFA U.S. MACRO MODEL WITH CHAIN-WEIGHTED GDP

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Abstract: We describe the impact of the new GDP methodology on WEFA's Quarterly model. First we briefly describe WEFA's Mark 11 Quarterly model and its uses, which create certain restrictions on the model specification. We then discuss the question of the possible impact of the new methodology on estimated elasticities and model multipliers. Since we adopted a new econometric methodology with the new model, the elasticities cannot be usefully compared. Finally, we describe our solution to the "adding up" problem created by BEA's complex Fisher Index number approximation. The new WEFA model uses a chained Laysperes index formula to approximate BEA's complete formula.

Introduction

In 1996 the Bureau of Economic Analysis (BEA) introduced a number of changes into the methodology for calculating the National Income and Product Accounts (NIPAs). The NIPAs have traditionally been the core of large-scale macroeconometric models used by industry and government for economic forecasting and analysis. WEFA is the oldest company to use this methodology in commercial applications, and, like other industry and government forecasters, was forced to respecify much of our model. We found little to suggest that the new data provide a substantially different view of the past, or that the new data would force us to rethink our view of the multipliers in our model. In our view, the major problem is that the components of GDP do not add up easily. Since our model has a very detailed breakdown of GDP, and since we use the model for long-term forecasting and analysis, we were forced to adopt an approximation of BEA’s complex methodology for adding up GDP components. No approximation can solve all of the problems BEA has created with the new methodology. Our approximation is a chained Laspeyeres index, which is a useful compromise between short-run and long-run accuracy.

The Quarterly Model

WEFA’s Quarterly model has changed substantially from the early version described by Vijaya Duggal, Lawrence Klein, and Michael McCarthy [1974]. The current version of the model uses many of the advances in macroeconomics that have occurred over the past thirty years. The model includes a detailed monetary sector, and has monetarist properties in the medium term. It also includes a long-run supply constraint in the form of a potential GDP equation. Expectations are explicitly modeled using survey data, and expected inflation appears in both labor cost and capital cost equations.

The model includes the following major sectors (see the appendix for more details):

- Aggregate demand, by detailed category

- Price sector, including an expectations-augmented Phillips curve

- Aggregate supply

As part of these overall sectors the model includes a number of specialized sectors such as a detailed auto sales and production sector, a housing sector, and producer price sector.

Estimation Techniques

As is usual for large-scale macroeconometric models, we use single equation techniques to estimate most equations. In our experience, simultaneous estimation does not add sufficient benefit to justify the cost and complexity added to the process.

MARK 11 differs from its predecessors in making extensive use of error correction models (ECM). These functional forms are used in most final demand equations in place of the traditional Almon lags. Many other key equations are also specified using these techniques.

Error corrections models assume that two series move, or "drift" together. Although the series are not "mean reverting" a linear combination of the two series is "mean reverting". (A series is said to be mean reverting if the mean of one subset of the series is the same as the mean in a different subset). This suggests that, when one series is shocked, or moves in such a way that the error from the linear combination is large, the other series will move to preserve the combination. When two series drift together in this way, they are said to be **cointegrated**.

In general, we did not carry out formal cointegration tests in building the model. Instead, we assumed that one equation — the "cointegration equation" — described the long-run relationship. For example, consumer spending in each category was assumed to depend, in the long run, on the level of income and the relative price of that consumer category. This yields the long-run equation below (equation 1):

$$Y_t = b_0 + b_1 X_{1t} + b_2 X_{t2} + e_t \quad (1)$$

Table 1: Estimated Equation for Exports of Consumer Goods Less Automobiles

```
dlog(exconxmvp92)=
      –0.02872 * dlog(exconxmvp92)[-1]
      –0.10076 * [log(exconxmvp92.1)
                 -(-1.3513)*log(pdcexconxmvp.1*rexmor18.1/
                        ppirow18.1)
                 -(2.0975)*log(gdp18w92.1)
                 -(0.0291)
      + 2.58291 * dlog(gdp18w92)
      – 0.44851 * dlog(pdcexconxmvp*rexmor18/ppirow18)
      – 0.00048
```

Notes: EXCONXMVP92 is real exports of consumer goods less automobiles: PDCEXCONXMVP is the chained price index for exports of consumer goods less automobiles: REXMOR18 is the Morgan Guaranty Trade-Weighted exchange rate: GDP18W92 is a trade-weighted foreign GDP measure: and PPIROW is the rest of world PPI used to construct the Morgan Guaranty exchange rate.

where *Y* is the dependent variable, the *X*'s are the independent variables, and *e* is the error or deviation from the long-run in period *t*. The variables are typically in log terms.

We then estimated a full equation by including the deviation in an equation in percent changes (log differences), as shown in equation 2.

$$\%\Delta Y_t = a_0 + a_1 \%\Delta Y_{t-1} + a_2 \%\Delta X_{1t} + a_3 \%\Delta X_{2t} + a_4 e_{t-1} + h_t \qquad (2)$$

The elasticities can now be easily identified. The b terms are the long-run elasticities of the respective variables, and the terms a_1, a_2, and a_3, are the short-run elasticities. a_4 is the speed of adjustment parameter to deviations from the long-term trend (*e*). It must be between zero and negative one if the equation is stable (returns to the long-run equation), and the variable adjusts more quickly, the closer is this parameter to -1. We normally substitute $Y_{t-1} - b_0 - b_1 X_{t-1} - b_2 X_{t-2}$ for the e_{t-1} term.

As an example, **Table 1** shows the equation for real exports of consumer goods less automobiles (EXCONXMVP92). The bold-faced part of the equation is the long-run relationship. Relative prices have a long-run elasticity of -1.35, and foreign GDP has an elasticity of 2.1. The short-run elasticities for prices and foreign GDP are, respectively, -0.45 and 2.58.

Simulation Characteristics

The U.S. Economic Model has Keynesian characteristics in the short run (0 to 2 years), monetarist characteristics in the medium run (5 to 10 years) and neoclassical growth properties in the long run (15+ years).

- ***Short-Run Keynesian Characteristics***: An IS-LM framework dominates short-run behavior. Consumption depends on permanent income less health care transfers, but can be affected in the short run by consumer confidence as well. The investment equations include both accelerator and cost-of-capital components. Exports and imports depend on world and U.S. demand and relative prices, including the exchange rate. Government purchases are generally exogenous in the model.

- ***Medium-Run Monetarist Characteristics****:* Wage demands are determined through an expectations-augmented wage equation of the Lucas type. Unemployment relative to the exogenous natural rate affects real wage inflation (deflating by a measure of inflationary expectations). As a result, a positive aggregate demand shock will push up wages. Employment then falls back toward the full employment level, but at a permanently higher level of inflation.

- ***Long-Run Neoclassical Growth Characteristics***: Output is constrained through the price sector to grow at the combined rate of labor, productivity, and an exogenous technical change parameter. If it grows too fast, capacity utilization rises, and inflation accelerates, reducing demand and growth.

Uses of the Model

WEFA’s model was originally developed for forecasting. Although this remains one of its main purposes, it has also proven to have great value as the core of a set of detailed models of the economy. The models allow users to analyze the impact of a given macroeconomic shock on different industries and regions. The ability to carry out risk analysis in this manner has proven very valuable to those interested in the differential impacts of shocks, and especially for financial institutions, who can use the set of integrated models to judge the vulnerability of a given portfolio to macroeconomic events.

There are three separate model systems that must be used to obtain such results. First, the *core* macroeconomic model (the model under discussion in this paper) creates the basic simulation of the overall economy. Second, the impact on the elements of final demand is translated into impact by industry and employment by industry via an input-output based *industry* model. Finally, the impact by industry determines (through the differential importance of industries in regional economies) regional impacts through a linked set of *state and metro area* models.

An important feature of this system is the need for considerable detail at the final demand level in the core model. By building up GDP from detailed categories of final demand, we are in a better position to translate the GDP impact into industry impacts. The appendix shows the substantial level of detail in the core model. Because of the importance of this use of the model, we needed to maintain the current level of complexity in the model, despite the "adding-up" problem described below.

BEA's New GDP Methodology

BEA's new methodology has been documented elsewhere (see Alan Young [1992], and J. Steven Landefeld and Robert Parker [1995] for a detailed discussion of the new methodology). The Bureau adopted a number of important changes in the 1992 benchmark revision. These include:

- Dividing government purchases into investment and consumption components, and adding an estimate of public capital consumption to the NIPAs.
- A new method of depreciation for the capital stocks.
- The new method of chain-weighting to obtain GDP aggregate quantity and price measures.

The last change was the most important and controversial change, and has had the most impact on model building and forecasting. We will therefore concentrate on the issues raised by the new method of chain weighting to calculate real GDP and the GDP deflator.

Data Changes

Each benchmark revision has created a changed set of data for judging economic history (although one of the purposes of the new methodology is to reduce the changes in historical data from adopting a new base year). This revision was no exception, and some observers believed that the new methodology might have a larger impact on our historical view of the economy.

Our analysis does not suggest that the new data tells us anything substantially different about the past business cycles. The short-run story of the economy is not substantially changed. The long-run view, however, may be somewhat different, particularly in the past ten years. The following comparison uses the old 1987 fixed-weighted data and the new 1992 chain-weighted data.

Short-run changes in GDP are not very different using the two measures over the period 1960-1995. In only 25 of 143 quarters (from 1960Q1 to 1995Q3) is the difference between the percentage change in a given quarter greater than 0.3 percentage points. The new data show the same high and low points in recessions (See Michael R. Pakko [1997] for a detailed discussion of this issue).

The implications for long-run growth measures are different, however. Table 2 compares average growth rates by decade for GDP and its components. For most of the decades GDP growth is slightly higher, but the difference is not great. In the period 1990 to 1995 GDP growth is definitely lower, as expected since the fixed-weighted methodology exaggerated growth beyond the old base year. The only components to show important differences are fixed investment, because of the importance of computers in this category, and imports. Lower imports in the 1990s probably reflect the increasing importance of increasingly cheaper computer equipment imports. In both the investment and computer

Table 2
Average Growth Rates (Annualized) for Real Quarterly GDP and Components

	1950-1959	1960-1969	1970-1979	1980-1989	1990-1995*
GDP					
New	4.4	4.3	3.3	2.8	1.9
Old	4.2	4.1	3.0	2.5	2.4
Consumption Expenditure					
New	3.8	4.4	3.5	3.1	2.1
Old	3.7	4.2	3.3	2.8	2.4
Fixed Investment					
New	4.7	5.4	5.4	2.3	3.1
Old	4.6	4.6	5.0	1.9	5.8
Exports					
New	6.0	10.5	9.1	5.8	7.6
Old	6.0	10.3	8.5	5.1	7.7
Imports					
New	10.2	9.2	6.3	6.8	7.1
Old	11.1	9.0	6.2	6.9	8.2
Government Purchases					
New	7.1	3.7	0.7	2.9	0.4
Old	6.7	3.9	0.2	2.8	0.4

cases, the rising nominal share of computer equipment combined with falling prices created a relatively large distortion in the fixed-weighted data, which the chain-weighted data largely corrects.

The numbers shown here are not large enough to change our view of long-run historical productivity growth in the United States, or, at first glance, to strongly affect any other knowledge we have of how the economy operates in the long run. Most of the changes are important mainly for our view of what happened over the past five or ten years.

Elasticity Changes

One of the important and interesting questions that often arises is whether the new data affected our estimates of various elasticities in the model. Unfortunately, we cannot answer this question directly because we changed our estimation techniques in Mark 11 to use many more of the error correction models described above. Early experiments with our older Almon-lag structure did not reveal any major differences in the multipliers or simulation characteristics of the model, so we are inclined to believe that the revised data would have little affect on most individual elasticities. Only those areas (primarily in investment of information processing equipment, for examples) where the new methodology had a direct impact would be likely to see any changes in elasticities.

The Adding-Up Problem

The major problem we faced with the new data was the technical question of how to define identities in the model. Additive identities have traditionally been important in this model because they track the traditional C+I+G framework for macroeconomics taught in the United States, and which our clients expect to see in their analysis. Prior to the revision, we simply estimated equations for individual components of real GDP and added them up to get total real GDP. The new methodology does not allow this, as the real components do not add up to the real total. This issue was the most contentious in the aftermath of the publication of the new methodology. (See the comments of Evelina Tainer in the NABE news of November 1995, page 29 for an example of how a working business economist approached the revision). The remainder of this paper will concentrate on our solution to this specific modeling problem.

Because of the complexity of BEA's methodology, forecasters can no longer expect to mimic BEA precisely in building up real GDP from its components. All models will be forced to approximate, in some form, the annual-weighted Fisher Ideal chained numbers. Any choice will require a tradeoff between accuracy and simplicity. For example, the simplest method is to simply add the components and ignore the residual or forecast it separately. For short-term forecasting this may work well, but for long-term forecasting, it is likely to be inaccurate. It is precisely in comparisons of GDP levels and in growth measures of long periods of time that the new methodology is most valuable, because nominal shares and relative prices will change by large amounts over such periods. Thus, either the forecasted residual will become unacceptably large in the long-run forecast, or the forecast error risks being very large, if the components are simply added together.

WEFA's model approximates the BEA methodology with a chained Laspeyeres calculation. Real GDP is built up from components according to equation 3 below:

$$\Delta\%Y92_t = \frac{X_{1,t-1}}{Y_{t-1}} \times \Delta\% X_1 92_t + \frac{X_{2,t-1}}{Y_{t-1}} \times \Delta\% X_2 92_t \tag{3}$$

where Y is the aggregate measure (here with two components, X_1 and X_2), 92 indicates a real (chained) 1992 dollar value, and Δ% indicates percentage change (calculated by log differences). The current real percentage change in Y is therefore a weighted average of the percentage change of the components, where the weights are the previous period's nominal shares of the total. We add a statistical discrepancy to the equation to correct for the approximation over history. This discrepancy will always be set to zero during the forecast period. Thus, the final form for the identity that determines real fixed business investment (IP92) from its components, equipment investment (IPE92) and structures investment (IPS92) is illustrated in equation 4:

$$IP92_t = e^{\Delta\% IPS92 \times \frac{IPS_{t-1}}{IP_{t-1}} + \Delta\% IPE92 \times \frac{IPE_{t-1}}{IP_{t-1}}} \times IP92_{t-1} + SDIP92_t \tag{4}$$

Note that the statistical discrepancies have no relationship to the published "residuals" in the NIPA table. We can, and do, publish forecasts of these residuals, but only by simply calculating them after the forecast. The published residual may be non-zero even when the forecast values of the discrepancies are all set to zero.

An additional set of statistical discrepancies exists for the nominal values of the lowest level of detail forecast. In each case, the formula, (equation 5 below),

$$Nominal = \frac{Price \times Real}{100} \tag{5}$$

holds only approximately. (If BEA used pure Fisher index calculations, the identity would hold exactly). A set of residuals therefore exists for the equations that bridge from the real to the nominal level of the detail forecasted in the model. These discrepancies are set equal to the latest value over the entire forecast period to avoid leap-off problems.

One additional set of approximations is required to complete the set of identities. Since the nominal detail must add to the nominal aggregates in the usual manner, the model will produce forecasts of implicit aggregate deflators by simple division. However, these deflators will not be exactly equal to the actual chain-weighted deflators during history for the reasons mentioned above. Thus, a third set of residuals is required for the aggregate price identities. These will be set to equal the last historical value in the forecast.

The new BEA methodology thus requires three new types of identities: real, nominal detail, and nominal aggregates. Each set has its own set of residuals, as well. In the WEFA model, the residuals are exogenous variables. It would also be possible to add the residuals as addfactors: the difference is merely one of housekeeping, and has no impact on how the model works. We chose to use exogenous residuals to simplify the use of the model for our subscribers.

WEFA's approximation is not the only method of approximating the identities. In the tail (basically, that period over which the BEA lacks full current and past annual weights), BEA uses a fixed-weighted methodology. Forecasters interested in accurate forecasts over the very short-term (for example, in current quarter models) may wish to use identities that incorporate the current fixed weights. These will presumably be more accurate for initial announcements of GDP. Each year, however, BEA will change the weights (by switching to the most recent available year). At that time, one past year's worth of data will be revised to use chain-weights.

Because of the change in methodology, no one approximation will be completely correct. Forecasters that use the fixed weights will sacrifice the long-run properties of the Fisher identities for short-run accuracy. Forecasters that use an approximation of chain-weighting may have somewhat lower short-run accuracy, but forecasts in the medium and long term will accurately reflect the impact of the new methodology, and provide users with a truer picture of the evolution of the economy over time.

We at WEFA have chosen to use the chain-weights for all forecasting for the following reasons:

1. *The difference between the two measures is small over short horizons.* The difference between fixed weights (where the weights are recent) and chain weights is small when the fixed weights are close to the forecast period. This, of course, will always be the case with the published data, since the fixed weights in the tail are from a recent period.

2. *Holding weights fixed at a given time will be extremely misleading for long-run horizons*. WEFA's longest forecast has a 25 year horizon. The difference between a chain-weighted and fixed-weighted forecast over this period would be very large, and create many problems of interpretation. Of course, a forecast based on fixed-weighted GDP over such a period would lose precisely the best features of the new methodology.

3. *Mixed forecasting would be confusing to forecast and model users*. A forecast that uses fixed weights in the short run and chain weights in the long run mixes data concepts in a confusing way. Suppose, for example, we want to compare forecasts from last year and this year for next year to see how the outlook has changed. If forecasts out one year use fixed-weights, and beyond one year chain weights, last year's forecast will have used a different weighting scheme than this year's. The forecasts will then be impossible to compare with any accuracy.

Using the chain-weighted approximations for short-term forecast leaves us violating an unwritten rule of forecasting. Our model now forecasts revised data, because the approximation is closer to the formulas BEA will use in its annual revision, when it applies the chain-weighted methodology, than the formulas it will use in the initial news releases.

This is an unfortunate side affect of the new methodology. Users who wish to compare forecasts may need to be aware of such issues.

Appendix

The WEFA Model in Detail

The following describes some of the essential details of WEFA's Mark 11 quarterly model. This discussion is not exhaustive, and interested readers should contact WEFA for more information and complete documentation of our model.

Aggregate Demand

The components of demand are modeled from the bottom up using standard approaches which employ various measures of permanent income/output and relative prices. This is the heart of the model, and is most important for short-run analysis. Each individual component of aggregate demand has its own stochastic equation for the real, 1992 chained dollar quantity, although equations in broad follow similar specifications. A separate price (deflator) equation is also estimated for each detailed component, and is used to create the nominal value for each detailed component.

Components of aggregate demand are modeled as followed (see table A1 for a detailed list of the components of aggregate demand in the model):

Consumption (25 detailed categories) is generally assumed to depend on permanent income and relative prices. Certain categories depend on sector-specific variables. Automobile purchases, for example, depend largely on unit sales of automobiles, which are modeled in a stock-flow framework in a separate section of the model.

Gross domestic investment (22 detailed categories) generally depends on the user cost of capital relative to overall prices. The investment equations also contain short-term accelerator terms, so that a rise in aggregate demand will initially call forth a rise in investment spending. If interest rates, and the user cost of capital, rises along with aggregate demand, investment spending will eventually be displaced, however.

Government purchases (9 detailed categories) are generally assumed to be exogenous, with the exception of pay variables. The government's wage bill depends on an employment assumption and a wage, which is strongly influenced by private wages. Otherwise both Federal and State and Local purchases are determined exogenously.

Exports (10 detailed categories) are estimated as functions of the relative price of home and foreign goods (including the exchange rate) and foreign GDP. The relationships are fairly aggregate: foreign prices are represented by a trade-weighted foreign PPI, and foreign demand by a trade-weighted foreign GDP.

Imports (11 detailed categories) mirror the export equations, with the exception that the relative price terms and demand terms can be more specific. Demand for imports of motor vehicles and parts is determined in the auto sector, for example, where unit light vehicle sales are divided into domestic and imported sales based on relative prices and income (the portion of imports tends to rise with higher income levels).

In addition, two sectors (housing and light vehicles) include detailed estimates of unit sales and other variables of interest. Light vehicle sales, for example, are depend on the driving age population, per capita income, and (in the short-run) consumer confidence. Sales are divided between cars and light trucks depending on relative price and demographics, and total consumer expenditure on cars and on other motor vehicles then follows the unit purchases closely.

The Monetary Sector and Interest Rates

Mark 11 uses two key interest rates to forecast financial conditions. The Fed funds rate is the main proxy for short-term interest rates, and mainly reflects Federal Reserve monetary policy. Long-term interest rates follow the 30-year bond rate, which is determined by economic conditions, the size of the Federal debt, and short-term rates. The model determines interest rate spreads for most intermediate Treasury rates and yields (eight), eight additional private short-term interest rates, and six private long-term bond yields using the two key rates and other economic variables. The wide variety of interest rates primarily help users who wish to examine the risk implications of a macro shock for various types of securities.

Monetary policy and short-term interest rates are determined together. The key equations are the reserves equation, which summarizes Federal reserve behavior, and the Fed funds rate, which is an inverted money demand function. The Fed sets reserve growth depending on present and past inflation and capacity utilization. Higher inflation or capacity utilization will reduce reserve growth; lower inflation or capacity utilization will raise reserve growth. The level of demand deposits follows the level of reserves closely, and is the main determinant of the crucial monetary aggregate in the model, M1. The Fed Funds rate equation is an inverted money demand function of the standard form shown in equation A1.

$$m - p = fy - lr \qquad \text{(A1)}$$

where m is the nominal stock of money, p is the price level, y is the level of real output, and r is an inflation-adjusted interest rate. All variables are in logs, so f is the income elasticity of money, and l is the interest elasticity of money. The income elasticity of money in the model equals 0.57, with an income elasticity close to one.

Prices and Aggregate Supply

Prices adjust in the medium term when aggregate demand is not equal to aggregate supply. The price adjustment serves to force aggregate demand toward aggregate supply over the five- to ten-year horizon. The model's price response works through two equations which allow for cost-push wage inflation as well as the effect of capacity constraints and bottlenecks. The result is an expectations adjusted Phillips curve in which workers attempt to maintain real wages, but which allows for traditional Keynesian demand-pull inflation as well. Inflationary shocks can become embedded in the model through the wage process, unless aggregate demand falls sufficiently to create slack labor markets. Labor market conditions, energy prices, and capacity utilization then determine final demand deflators through a mark-up equation.

Inflationary expectations are measured by the Philadelphia Fed's Survey of Professional Forecasters. Expected inflation appears in both the labor side of the economy, in the expectations-augmented Phillips curve, and in the capital side of the economy, in the user cost of capital (as well as in the formation of long-term interest rates). As a result, an inflationary shock can build a permanently higher level of inflationary expectations, labor cost growth, and a permanently higher level of long-term interest rates, even when unemployment returns to the exogenous "natural rate". The model therefore encapsulates the view that the Phillips curve is only operational in the short run, consistent with much rational expectations research.

Aggregate Supply

Potential GDP, the main proxy for aggregate supply, is determined through a Cobb-Douglas production function, based on WEFA estimates of the non-accelerating inflation rate of unemployment (NAIRU) and official capital stock data. WEFA assumes that labor supply is exogenous to the model, not because we believe this to be the case, but because there is no firm guide or consensus on the feedback effects from the economy to the labor force. We therefore prefer to make explicit assumptions about labor force changes in forecasting and scenario building.

Table A1
Detailed Components of Aggregate Demand in WEFA's Mark 11 U.S. Quarterly Model

Consumption Expenditure
New Autos
Used Autos, Net
Other Motor Vehicles
Tires, Acces, and Parts
Furniture & Household Equip
Other Durables
Clothing and Shoes
Off Premises Food Consumption
Purchased Meals
Other Food
Gasoline and Oil
Fuel Oil and Coal
Other Nondurables
Housing
Household Operation, Electricity
Household Operation, Gas
Household Operation, Water & Sanitary Services
Household Operation, Telephone & Telegraph
Household Operation, Domestic Services
Household Operation, Other
User Operated Transportation
Local Transportation
Intercity Transportation
Medical Care Services
Other Services

Gross Domestic Investment
Residential Investment, Single Family Structures
Residential Investment, Mult-Family Structures
Residential Investment, Other Structures
Residential Investment, Equipment
Nonresidential Structures, Commercial Buildings
Nonresidential Structures, Industrial Buildings
Nonresidential Structures, Farm Buildings
Nonresidential Structures, Other Buildings
Nonresidential Structures, Utilities
Nonresidential Structures, Mining and Petroleum
Nonresidential Structures, Other
Producers' Durable Equipment, Industrial
Producers' Durable Equipment, Information Processing
Producers' Durable Equipment, Transportation
Producers' Durable Equipment, Other
Inventories, Farm
Inventories, Manufacturing
Inventories, Auto Dealers
Inventories, Other Nonmanufacturing

Exports
Foods, Feeds, and Beverages
Industrial Supplies and Materials
Computer Equipment
Civilian Aircraft
Other Capital Goods
Motor Vehicles and Parts
Consumer Goods, Less Motor Vehicles and Parts
Other Goods
Services

Imports
Foods, Feeds, and Beverages
Oil and Petroleum Products
Other Industrial Supplies and Materials
Computer Equipment
Civilian Aircraft
Other Capital Goods
Motor Vehicles and Parts
Consumer Goods, Less Motor Vehicles and Parts
Other Goods
Services

Government Purchases
Federal Defense Consumption, Nonpay*
Federal Defense Consumption, Pay
Federal Defense Investment*
Federal Nondefense Consumption, Nonpay*
Federal Nondefense Consumption, Pay
Federal Nondefense Investment*
State and Local Consumption, Nonpay
State and Local Consumption, Pay
State and Local Investment

Intermediate categories (consumption of durable goods, e.g.) not shown in table. Stochastic equations exist for all equations except when indicated by an *, which are driven by exogenous assumptions

Bibliography

Duggal, Vijaya, Lawrence Klein, and Michael McCarthy. "The Wharton Model Mark III: A Modern IS-LM Construct", *International Economic Review,* 15(3), October 1974, p572-94.

--------. "Economic Statistics", *NABE News*, No. 114, November 1995, 24-45.

Landefeld, J. Steven and Robert Parker. "Preview of the Comprehensive Revision of the National Income and Product Accounts: BEA's New Featured Measures of Output and Prices", *Survey of Current Business*, 75(7), July 1995, 31-38.

Pakko, Michael R. "The Business Cycle and Chain-Weighted GDP: Has Our Perspective Changed*? Federal Reserve Bank of St. Louis Review,* 79(5), September/October 1997, 39-49.

Young, Alan. "Alternative Measures of Change in Real Output and Prices", Survey of Current Business, 72(4), April 1992, 32-41.