DRI·WEFA's Macroeconomic Models

The Model's Theoretical Position

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

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

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

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

Prices adjust in response to gaps between current production and supply potential and to changes in the cost of inputs. Wages adjust to labor supply-demand gaps (indicated by a demographically-adjusted unemployment rate), current and expected inflation (with a unit long-run elasticity), productivity, tax rates, and minimum wage legislation. The supply of labor positively responds to the perceived availability of jobs, to the after-tax wage level, and to the growth and age-sex mix of the population. Demand for labor is keyed to the level of output in the economy and the productivity of labor, capital, and energy. Because the capital stock is largely fixed in the short run, a higher level of output requires more employment and energy inputs. Such increases are not necessarily equal to the percentage increase in output because of the improved efficiencies typically achieved during an upturn. Tempering the whole process of wage and price determination is the exchange rate; a rise signals prospective losses of jobs and markets unless costs and prices are reduced.

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

The old tradition in macroeconomic model simulations of exogenous fiscal 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 DRI-WEFA 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. Thus the simple monetarist link from money growth to price inflation or nominal spending is therefore considered invalid as a rigid short-run proposition.

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

"Supply-Side" Economics: Since 1980, "supply-side" political economists have pointed out that the economy's growth potential is sensitive to the policy environment. They focused on potential labor supply, capital spending, and savings impacts of tax rate changes. The DRI-WEFA 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 DRI-WEFA Model allows a choice in this matter. On the one hand, the user can simply accept DRI-WEFA'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 DRI-WEFA 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 DRI-WEFA 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 DRI-WEFA Model captures the full simultaneity of the U.S. economy, forecasting over 1200 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.

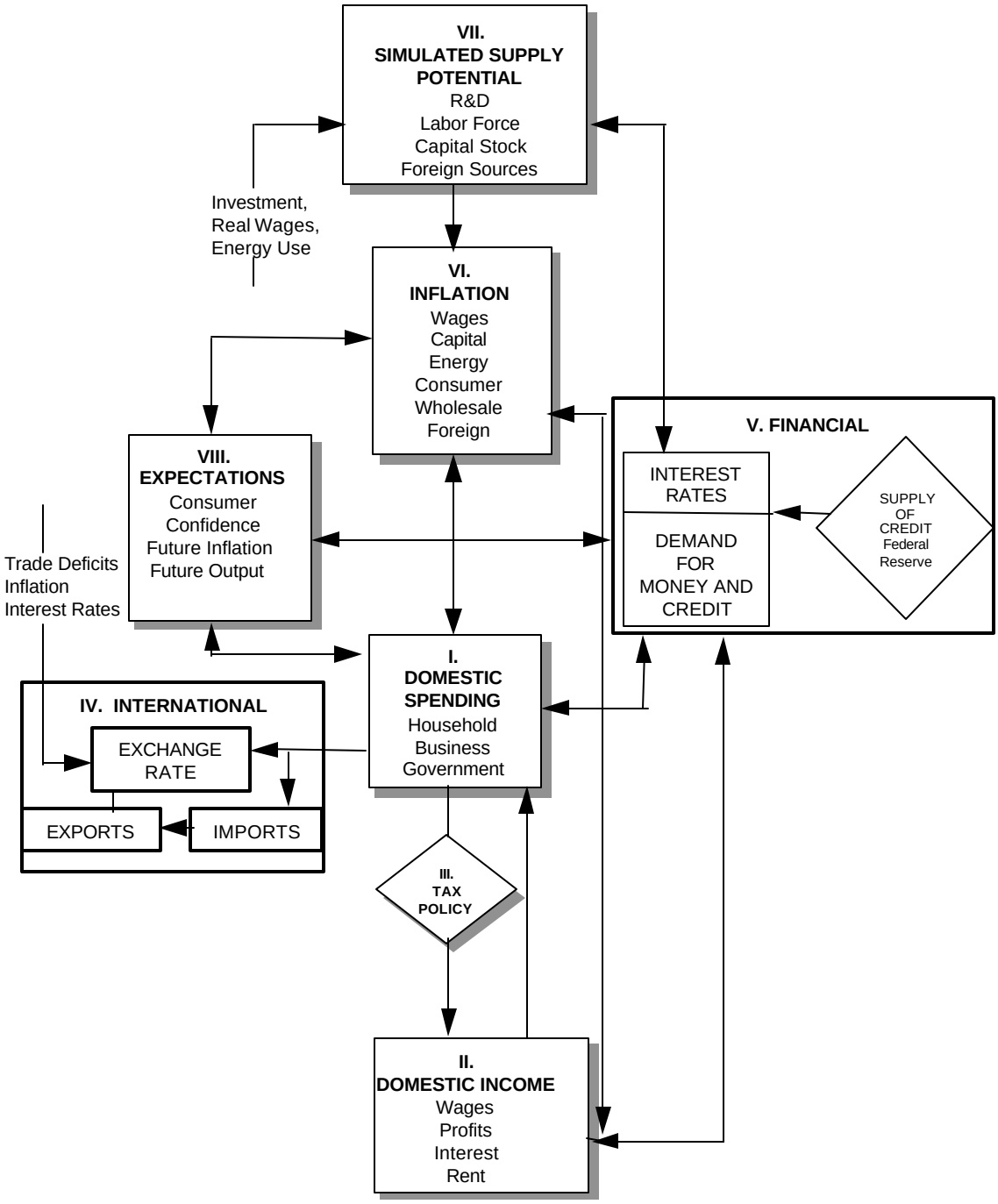
Spending-Consumer: The domestic spending (I), income (II), and tax policy (III) sectors model the central circular flow of behavior as measured by the national income and product accounts. If the rest of the model were "frozen," these blocks would produce a Keynesian system similar to the models pioneered 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 eleven categories: two light vehicles categories; net purchases of used cars, motor-vehicle parts; recreational vehicles; computers; software; other household equipment and furnishings; opthalmic and orthopedic products, and "other." Spending on nondurable goods is divided into nine categories: three food categories; clothing and shoes; gasoline and oil; fuel oil and coal; tobacco; drugs; and "other." Spending on services is divided into seventeen categories: housing; transportation; six household operation subcategories; five transportation categories; medical; recreation; two personal business service categories; and "other." (See Table A1.) In nearly all cases, real consumption expenditures are motivated by real income and the user price of a particular category relative to the prices of other consumer goods. Durable and semidurable goods are also especially sensitive to current financing costs, and consumer speculation on whether it is a "good time to buy." The University of Michigan Survey of Consumer Sentiment monitors this last influence, with the index itself modeled as a function of current and lagged values of inflation, unemployment, and the prime rate.

Spending--Business Investment: Business spending includes six fixed investment categories: four information processing equipment categories; industrial equipment; two transportation equipment categories; other producers' durable equipment; four building categories; mining and petroleum structures; public utility structures; and miscellaneous. (See Table A2.) 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 domestic oil prices and to oil and natural gas production.

The DRI-WEFA Economic Models Overview



Inventory demand is the most erratic component of GDP, reflecting the pro-cyclical, speculative nature of private sector accumulation during booms and decumulation during downturns. The forces that drive the five nonfarm inventory categories are changes in spending, short-term interest rates and expected inflation, surges in imports, and changes in capacity utilization or the speed of vendor deliveries. 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 (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. (See Table A3)

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 DRI-WEFA 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 downpayment. “Lever variables" allow the model user to specify the extent to which mortgage interest payments, property taxes, and depreciation allowances (for rental properties) produce tax deductions that reduce the effective cost.

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

Spending--Government: The last sector of domestic demand for goods and services, that of the government, is largely exogenous (user-determined) at the federal level and endogenous (equation-determined) at the state and local level. The user sets the real level of federal nondefense and defense purchases (for compensation, consumption of fixed capital, 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 (agrigricultural, housing, and other) are also specified by the user, but in nominal dollars. One category of federal government spending –net interest payments -- is determined within the model because of its dependence on the model’s financial

and tax sectors. Net federal interest payments are determined by the level of privately-held federal debt , short and long-term interest rates, and the maturity of the debt. (See Table A4.)

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

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

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

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

Taxes: Since post-tax rather than pre-tax incomes drive expenditures, each income category must be taxed at an appropriate rate; the model therefore tracks personal, corporate, payroll, and excise taxes separately. Users may set federal tax rates; tax revenues are then simultaneously forecast as the product of the rate and the associated pre-tax income components. However, the model automatically adjusts the effective average personal tax rate for variations in inflation and income per household, and the effective average corporate rate for credits earned on equipment, utility structures, and R&D. Substitutions or additions of “flat” taxes and value-added taxes for existing taxes are accomplished with specific tax rates and new definitions of tax bases. As appropriate, these are aggregated into personal, corporate or excise tax totals.

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

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

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

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

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

The reactions of overseas prices, interest rates and GDP to U.S. development are robust and automatic. In the case of a dollar depreciation, for example, U.S. activity may expand at the expense of foreign activity and U.S. inflation may rise while the rate in other countries slows.

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

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

If the reaction function is chosen as the monetary policy instrument, the federal funds rate is determined in response to changes in such policy concerns as inflation and unemployment. The reaction function recognizes that monetary policy seeks to stabilize prices (or to sustain a low inflation rate) and to keep the unemployment rate as close to the natural rate as is consistent with the price objective. A scenario designed to display the impact of a fiscal 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 DRI-WEFA 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-eight interest rates are covered in order to meet client needs regarding investment and financial allocation strategies. (See Table A10.)

Inflation: Inflation (VI) is modeled as a carefully-controlled, interactive process involving wages, prices, and market conditions. Equations embodying a near accelerationist point of view produce substantial secondary inflation effects from any initial impetus such as a change in wage demands or a rise in foreign oil prices. Unless the Federal Reserve expands the supply of credit, real liquidity is reduced by any such shock; given the real-financial interactions described above, this can significantly reduce growth. The process also works in reverse: a spending shock can significantly change wage-price prospects and then have important secondary impacts on financial conditions. Inspection of the simulation properties of the DRI-WEFA 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 DRI-WEFA Model; indeed, substantial emphasis on this side of the economy (VII) was incorporated as early as 1976. In the DRI-WEFA Model, aggregate supply (or potential GDP excluding the energy sector) is estimated by a Cobb-Douglas production function that combines factor input growth and improvements in total factor productivity. Factor input equals a weighted average of labor, business fixed capital, public infrastructure, and energy provided by the energy sector. Based upon each factor's historical share of total input costs, the elasticity of potential output with respect to labor is 0.64 (i.e., a 1% increase in the labor supply increases potential GDP 0.64%); the business capital elasticity is 0.26; the infrastructure elasticity is 0.02; and the energy elasticity is 0.07. Factor supplies are defined by estimates of the full employment labor force, the full employment capital stock, end-use energy demand, and the stock of infrastructure. Total factor productivity depends upon the stock of research and development capital and trend technological change. The energy sector employs its own capital and labor. Potential GDP is the sum of the energy and non-energy sector outputs less energy imports.

Taxation and other government policies influences labor supply and all investment decisions, thereby linking tax changes to changes in potential GDP. An expansion of potential first reduces prices and then credit costs, and thus spurs demand. Demand rises until it equilibrates with the potential output. Thus, the growth of aggregate supply is the fundamental constraint on the long-term growth of demand.

Inflation, created by demand that exceeds potential GDP or by a supply-side shock or excise tax increase, raises credit costs and weakens consumer sentiment, thus putting the brakes on aggregate demand.

Expectations: The contributions to the 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 DRI-WEFA 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.

Quantitative Properties and Policy Lessons

To demonstrate the interrelationships of the sectors and their responses to traditional policy initiatives, two basic shocks were introduced into simulations of the US2001A version of the model: the first is a $20 billion deficit reduction package that increases taxes and cuts real expenditures (with the change in each tax and expenditure component proportional to its 2001 level); the second is a sustained reduction in nonborrowed reserves. The cut in reserves has been scaled to have the same full model impact on real GDP as the fiscal policy shock for quarters five to eight of the simulations: this interval was selected because the peak GDP impacts occur five quarters after the introduction of the fiscal shock and seven quarters after the credit restraint.

The six graphs presented as Chart 2 summarize the direct and indirect changes in fiscal and monetary policy indicators in the two shock simulations. Note that the indirect effects are substantial, and that these have been reliably, automatically calculated by the Model.

For example, pure monetary restraint does raise federal spending (interest costs) and substantially cuts federal tax receipts (lower nominal GDP and particularly weak profits). These impacts on the deficit are much greater than the savings from general lower inflation: as a result, within two years, a 0.6% reduction in the money supply raises the federal government's annual deficit by $19 billion.

Fiscal restraint, on the other hand, produces a significant reduction in interest. The reduction is assisted further by the Federal Reserves response to higher unemployment and lower inflation rates. Moreover, the public's demand for money (often mistakenlyreferred to as "the money supply") is reduced because weaker income and spending discourages usage of currency and checks to a greater extent than the lower interest rates encourage such usage.

A switch to either restrictive monetary or fiscal policy produces a sharp cycle in the economy. There are notable differences in the responses, however (Charts 3A, 3B; Tables 1, 2). First, as just noted, the greatest impact on real GDP from the composite fiscal shock occurs within five quarters while the greatest impact from the monetary shock takes seven or more quarters. The

quicker fiscal response is logical given the immediacy of the cuts in government purchases and the evidence of relatively prompt private sector responses to lower after-tax income. In contrast, changes in monetary policy affect spending with several delays: lower reserves induce higher long-term credit costs with a lag; higher interest rates in turn inhibit housing and consumer durables with a one-to-two quarter lag, and then business fixed investment with a longer lag. The feedbacks to these reactions cause the full GDP impact to build for almost two full years before the benefits of lower inflation begin to bring the economy back toward equilibrium.

Second, the relative strength of specific GDP components is quite sensitive to the type of policy restriction. Fiscal restraint has sharp and immediate negative impacts on consumption and imports: investment initially drops due to weaker output but then recovers strongly in response to lower interest rates. Housing is first trimmed modestly due to lower income but then leads the way to a general recovery in response to lower interest rates. Inflation is reduced as the gains from weaker labor and product markets are offset by the costs of a lower exchange rate. The exchange rate decliens as U.S. interest rates fall more than foreign rates.

Monetary restraint significantly curbs all sectors within two years, with housing and business capital spending cut back promptly and significantly. Inflation drops in response to weaker demand, and a stronger foreign exchange value of the dollar. By year three, the lower spending level implies nominal money and credit demand reductions which are roughly proportional to the initial credit supply restraint; interest rates thus retreat back to baseline levels and the real economy begins to bounce back. These patterns resemble monetarist conclusions that real output losses are largely transitory and that the price level will drop by about the same percentage as the decline in the the nominal supply; but these findings are tempered by the growth model lesson that capital formation losses will also occur, and these imply persistent real production restraints and hence real income losses.

An important goal of the DRI-WEFA Model of the U.S. Economy is the provision of policy insights and guidance. Restrictive monetary policy is clearly the strategy of last resort for slowing the economy, even if inflation is the highest priority problem. The long-term consequences of restricted credit growth are clearly adverse: business investment and housing are significantly weaker, entailing a permanent reduction in the nation's capital stock and labor productivity. Also important is the real appreciation of the dollar, leading to expanded imports and lost exports. The best cure for inflation is a carefully targeted reduction in federal spending.

Chart 2
Simulation Results: Indicators of Policy Changes

FISCAL
($billion change from base case)

MONETARY
(Percent difference from base case)

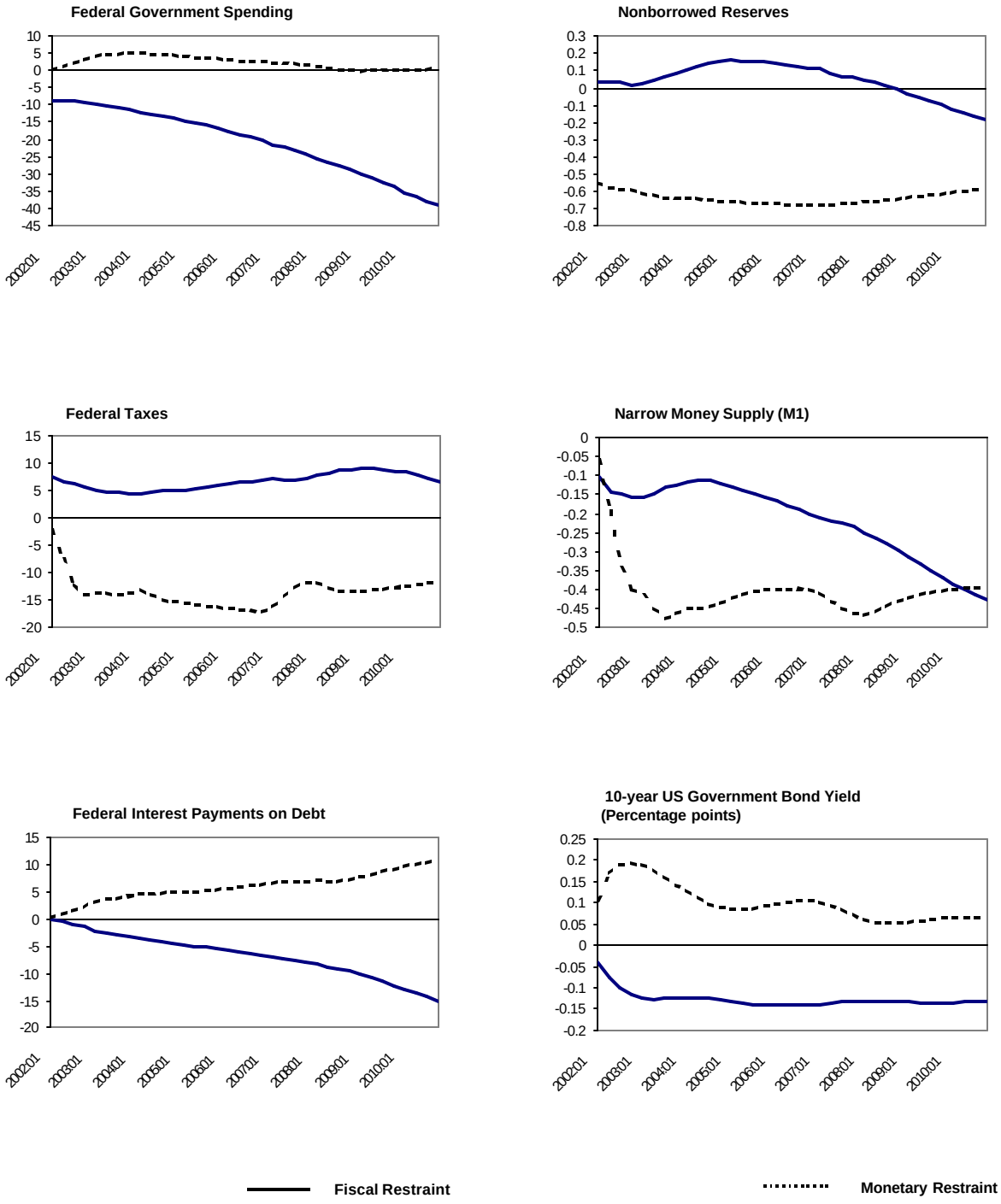


Chart 3A
Simulation Results: Macroeconomic Responses to Fiscal and Monetary Policy Changes
(Percent difference from base case)

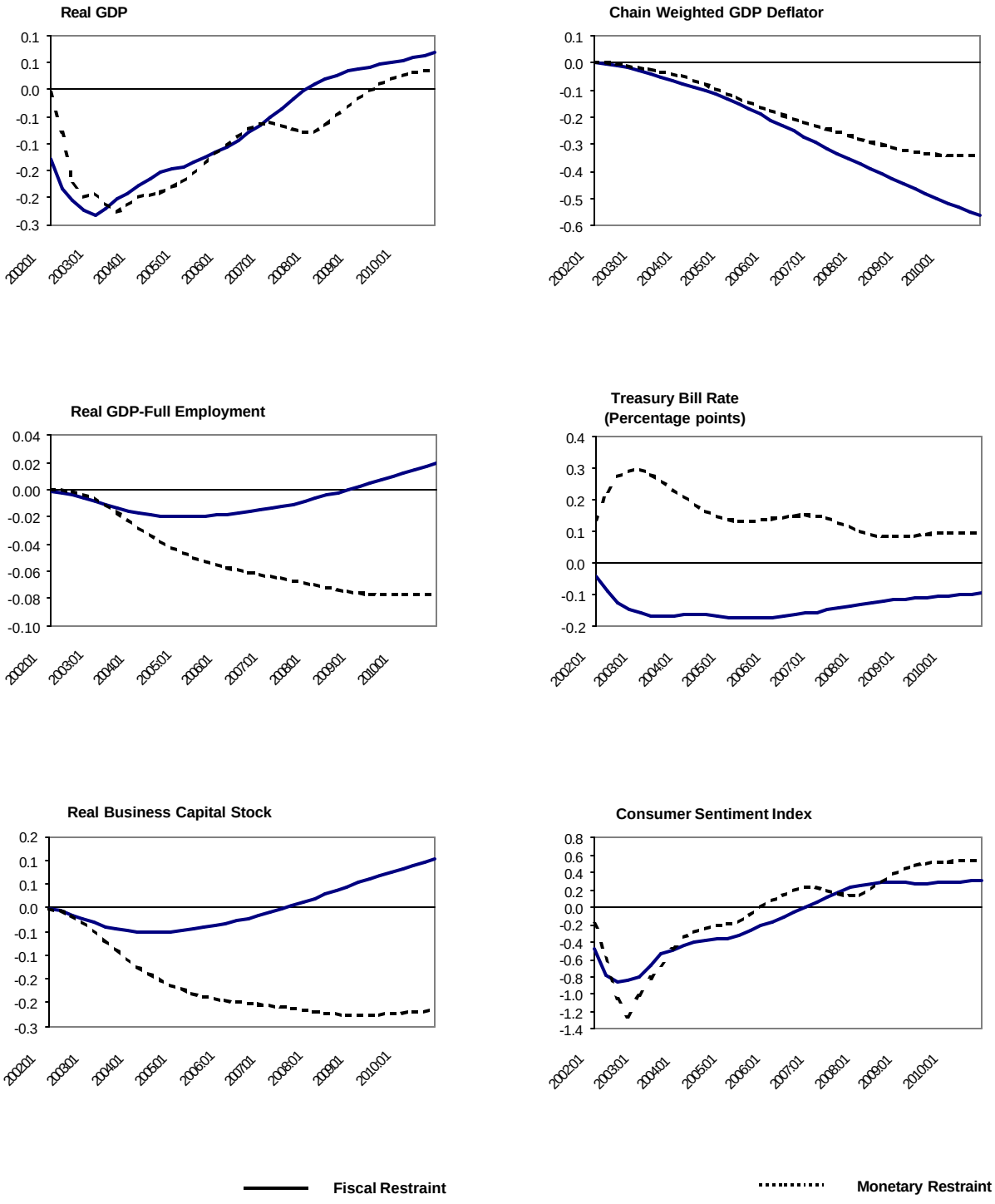


Chart 3B
Simulation Results: Macroeconomic Responses to Fiscal and Monetary Policy Changes
(Percent difference from base case)

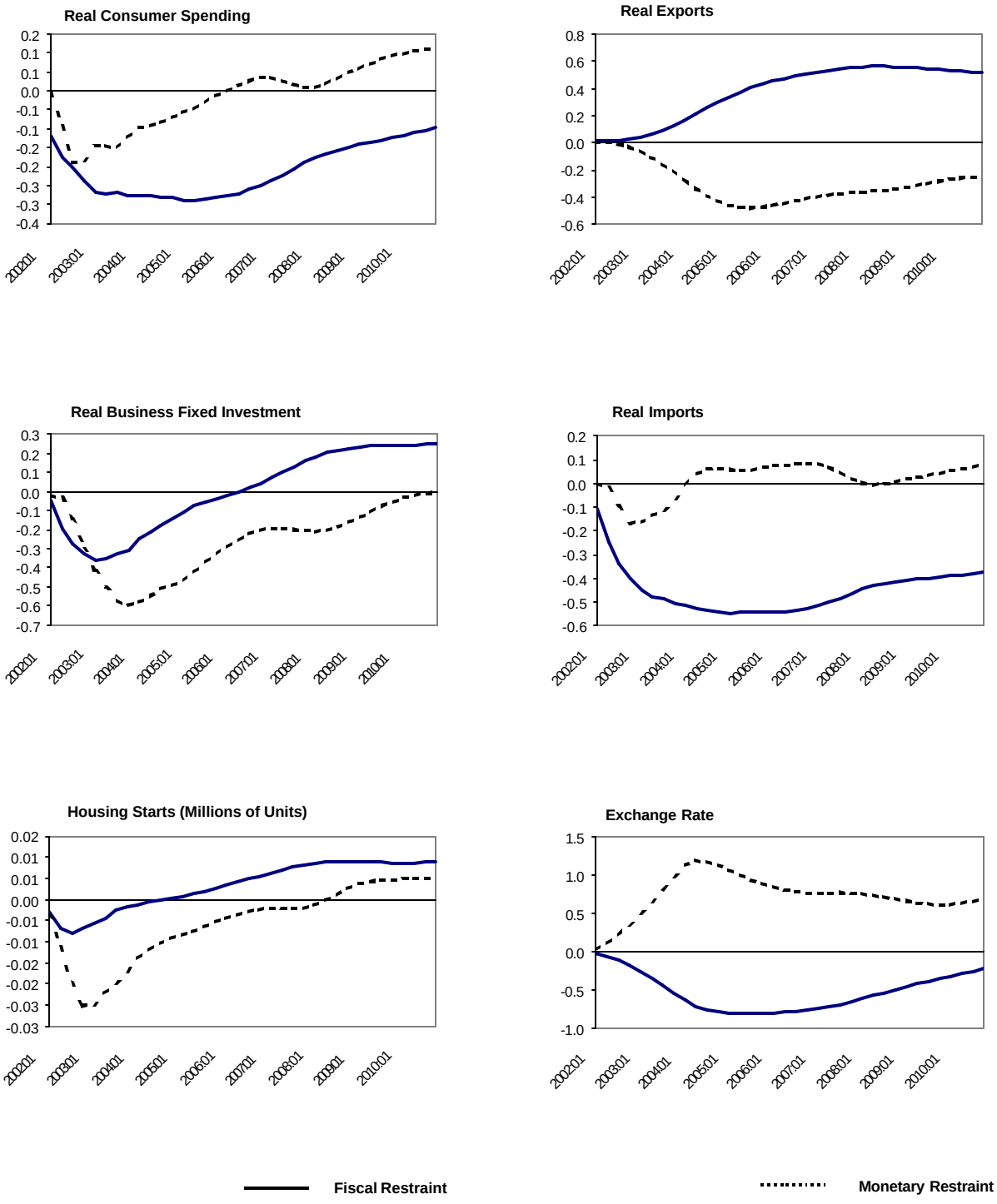


Table 1. Impacts of a Fiscal Restraint Package
(Percent difference from baseline unless otherwise indicated)

	2002	2003	2004	2005	2006	2007	2008
Supply							
Business Capital Stock	-0.01	-0.04	-0.05	-0.04	-0.03	0.00	0.03
Housing Stock	0.00	-0.01	-0.01	-0.01	-0.01	0.00	0.00
Full Employment Real GDP	0.00	-0.01	-0.02	-0.02	-0.02	-0.01	0.00
Nonfarm Productivity	-0.08	-0.02	0.00	0.00	0.00	0.01	0.01
Demand							
Real Cons.Spending	-0.18	-0.27	-0.28	-0.29	-0.27	-0.21	-0.16
Real Fixed Investment	-0.24	-0.32	-0.17	-0.06	0.03	0.14	0.23
Residential	-0.32	-0.27	-0.12	-0.05	0.06	0.19	0.27
Nonresidential	-0.21	-0.34	-0.19	-0.07	0.01	0.12	0.21
Equipment	-0.21	-0.27	-0.07	0.03	0.08	0.14	0.19
Construction	-0.23	-0.56	-0.60	-0.43	-0.28	-0.04	0.19
Real Exports	0.02	0.08	0.23	0.39	0.48	0.54	0.56
Real Imports	-0.27	-0.48	-0.53	-0.54	-0.54	-0.49	-0.43
Real GDP	-0.19	-0.21	-0.16	-0.13	-0.09	-0.03	0.02
Nominal GDP	-0.19	-0.26	-0.26	-0.29	-0.33	-0.35	-0.38
Wages & Prices							
Nonfarm Compensation	0.01	-0.05	-0.12	-0.19	-0.28	-0.35	-0.42
Consumer Prices	0.00	-0.02	-0.05	-0.10	-0.18	-0.26	-0.34
Producer Industrial Prices	-0.02	-0.07	-0.09	-0.14	-0.20	-0.26	-0.32
Financial Conditions							
S&P 500 Index	0.52	-0.43	-0.65	0.13	1.02	1.57	2.14
Prime Rate	-2.01	-2.54	-2.23	-2.29	-2.17	-1.86	-1.55
30-Yr. Fixed Mtg. Rate	-0.99	-1.74	-1.77	-2.01	-2.10	-2.07	-2.03
Aaa Bond Yield	-1.13	-1.78	-1.83	-2.08	-2.16	-2.15	-2.14
After-Tax Profits	-0.95	0.03	0.49	0.81	1.03	1.14	1.10
Corporate Cash Flow	-0.32	0.05	0.17	0.26	0.28	0.28	0.23
M2	0.02	0.08	0.14	0.19	0.24	0.26	0.26
Exchange Rate	-0.08	-0.39	-0.72	-0.79	-0.78	-0.69	-0.55
Unemployment Rate (*)	0.07	0.11	0.09	0.07	0.05	0.02	0.00
Hshld.Employment	-0.08	-0.14	-0.13	-0.11	-0.08	-0.04	-0.01
Industrial Production	-0.20	-0.23	-0.10	-0.06	-0.02	0.03	0.06
Factory Operating Rate	-0.28	-0.34	-0.24	-0.19	-0.12	-0.03	0.04
	Difference, billions of dollars						
Federal Budget							
Tax Receipts	6.5	4.7	4.8	5.5	6.6	7.1	8.4
Personal Tax Receipts	5.1	2.8	2.1	2.9	4.4	5.1	7.1
Corporate Tax Receipts	(1.9)	(0.3)	0.7	1.0	1.0	1.1	0.6
Expenditures	(8.9)	(10.6)	(13.0)	(15.6)	(18.9)	(22.9)	(27.1)
Net Interest	(0.7)	(2.7)	(3.9)	(5.1)	(6.3)	(7.6)	(9.0)
Budget Balance	15.4	15.3	17.8	21.1	25.5	30.0	35.5
(*) Difference in percentage points.							

Table 2. Impacts of a Monetary Restraint Package
(Percent difference from baseline unless otherwise indicated)

	2002	2003	2004	2005	2006	2007	2008
Supply							
Business Capital Stock	-0.01	-0.04	-0.05	-0.04	-0.03	0.00	0.03
Housing Stock	0.00	-0.01	-0.01	-0.01	-0.01	0.00	0.00
Full Employment Real GDP	0.00	-0.01	-0.02	-0.02	-0.02	-0.01	0.00
Nonfarm Productivity	-0.08	-0.02	0.00	0.00	0.00	0.01	0.01
Demand							
Real Cons.Spending	-0.18	-0.27	-0.28	-0.29	-0.27	-0.21	-0.16
Real Fixed Investment	-0.24	-0.32	-0.17	-0.06	0.03	0.14	0.23
Residential	-0.32	-0.27	-0.12	-0.05	0.06	0.19	0.27
Nonresidential	-0.21	-0.34	-0.19	-0.07	0.01	0.12	0.21
Equipment	-0.21	-0.27	-0.07	0.03	0.08	0.14	0.19
Construction	-0.23	-0.56	-0.60	-0.43	-0.28	-0.04	0.19
Real Exports	0.02	0.08	0.23	0.39	0.48	0.54	0.56
Real Imports	-0.27	-0.48	-0.53	-0.54	-0.54	-0.49	-0.43
Real GDP	-0.19	-0.21	-0.16	-0.13	-0.09	-0.03	0.02
Nominal GDP	-0.19	-0.26	-0.26	-0.29	-0.33	-0.35	-0.38
Wages & Prices							
Nonfarm Compensation	0.01	-0.05	-0.12	-0.19	-0.28	-0.35	-0.42
Consumer Prices	0.00	-0.02	-0.05	-0.10	-0.18	-0.26	-0.34
Producer Industrial Prices	-0.02	-0.07	-0.09	-0.14	-0.20	-0.26	-0.32
Financial Conditions							
S&P 500 Index	0.52	-0.43	-0.65	0.13	1.02	1.57	2.14
Prime Rate	-2.01	-2.54	-2.23	-2.29	-2.17	-1.86	-1.55
30-Yr. Fixed Mtg. Rate	-0.99	-1.74	-1.77	-2.01	-2.10	-2.07	-2.03
Aaa Bond Yield	-1.13	-1.78	-1.83	-2.08	-2.16	-2.15	-2.14
After-Tax Profits	-0.95	0.03	0.49	0.81	1.03	1.14	1.10
Corporate Cash Flow	-0.32	0.05	0.17	0.26	0.28	0.28	0.23
M2	0.02	0.08	0.14	0.19	0.24	0.26	0.26
Exchange Rate	-0.08	-0.39	-0.72	-0.79	-0.78	-0.69	-0.55
Unemployment Rate (*)	0.07	0.11	0.09	0.07	0.05	0.02	0.00
Hshld.Employment	-0.08	-0.14	-0.13	-0.11	-0.08	-0.04	-0.01
Industrial Production	-0.20	-0.23	-0.10	-0.06	-0.02	0.03	0.06
Factory Operating Rate	-0.28	-0.34	-0.24	-0.19	-0.12	-0.03	0.04
	Difference, billions of dollars						
Federal Budget							
Tax Receipts	6.5	4.7	4.8	5.5	6.6	7.1	8.4
Personal Tax Receipts	5.1	2.8	2.1	2.9	4.4	5.1	7.1
Corporate Tax Receipts	(1.9)	(0.3)	0.7	1.0	1.0	1.1	0.6
Expenditures	(8.9)	(10.6)	(13.0)	(15.6)	(18.9)	(22.9)	(27.1)
Net Interest	(0.7)	(2.7)	(3.9)	(5.1)	(6.3)	(7.6)	(9.0)
Budget Balance	15.4	15.3	17.8	21.1	25.5	30.0	35.5
(*) Difference in percentage points.							