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TAX POLICY AND CORE INFLATION

A STUDY

PREPARED FOR THE USE OF THE

JOINT ECONOMIC COMMITTEE

CONGRESS OF THE UNITED STATES

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LETTERS OF TRANSMITTAL

APRIL 4, 1980.

To the Members of the Joint Economic Committee:

Transmitted herewith for the use of the Joint Economic Committee and other Members of Congress is a study entitled "Tax Policy and Core Inflation." The study was prepared by Dr. Otto Eckstein of Data Resources, Inc.

One of the major reasons why policymakers have not viewed tax reductions as important devices to improve the structure of the economy has been the absence of economic models capable of adequately assessing the effects of supply-side economics. In addition, the work which has been done has often been bogged down by the impact of tax reductions on the size of the Federal deficit. This paper represents a major step toward remedying both problems. The new model developed in this paper shows that tax policies, such as depreciation schedule adjustments, can lower the inflation rate substantially over the decade. It also demonstrates that all of this can be done without increasing the size of the budget deficit. Further, the model shows that the only way demand-management policies alone can lower the inflation rate substantially is by maintaining unemployment at near-depression levels throughout the decade. This new model is an important tool which will help policymakers analyze and implement the supply-side policies recommended in the 1980 Joint Economic Report.

The views expressed in this study are those of the author and do not necessarily represent the views of the Joint Economic Committee or its individual members.

Sincerely,

LLOYD BENTSEN,
Chairman, Joint Economic Committee.

APRIL 1, 1980.

Hon. LLOYD BENTSEN,
Chairman, Joint Economic Committee, Congress of the United States,
Washington, D.C.

DEAR MR. CHAIRMAN: Transmitted herewith is a study entitled "Tax Policy and Core Inflation," by Otto Eckstein, president, Data Resources, Inc. This paper contains the technical background material used by the Joint Economic Committee in the preparation of its 1980 annual report.

The primary focus of this paper is in expanding the supply side of the Data Resources, Inc., econometric model of the U.S. economy. By adding new equations and by modifying old ones, this model is now able to capture more fully the impact of policy changes on the supply side of the economy. The material contained in this paper

represents a substantial advance in economic modeling and should be extremely useful to the Joint Economic Committee and the Congress.

The views expressed in this study are those of the author and do not necessarily represent the views of the members of the Joint Economic Committee.

Sincerely,

JOHN M. ALBERTINE,
Executive Director, Joint Economic Committee.

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The author is deeply grateful to Robin Siegel who shared in the technical work of developing the core model and closely reviewed the manuscript, to Frank Cooper who made the modifications of the DRI model and ran the simulations, and to Diana Rigoli who produced the manuscript.

TAX POLICY AND CORE INFLATION

By Otto Eckstein

Chapter 1. INTRODUCTION AND SUMMARY

Inflation has been building up for 15 years and has brought the economy to a very difficult juncture. Even as the economy slides into recession, double-digit inflation continues. Further, while past recessions have brought some relief, each succeeding business cycle finds the upswing starting from a higher base of inflation. This report presents a new quantitative analysis of the inflation process of the last 15 years. It decomposes the inflation into (1) the classic demand factor, (2) shocks such as food, energy and micro policies, and (3) the core component which has gradually become deeply embedded in the cost trends for labor and capital.

The analysis shows how we have reached the present condition. Long periods of excess demand raised the core inflation rate to 4 percent during the Vietnam war. Food and energy shocks added several more points in the mid-1970's. New shocks and more excess demand drove the core inflation rate to more than 8 percent during 1979, and is moving it toward 10 percent in 1980. The brief intervals of relief created by the recessions and good food prices fooled monetary and fiscal policymakers into a sense of improvement, when, beneath the surface, core inflation kept getting worse.

Is there a way out of the deteriorating inflation picture? This study uses the 800-equation DRI Macro Model in tandem with a new Core Inflation Model to explore the possible benefits of more cautious monetary and fiscal policies and major new tax policies to provide stronger incentives for business capital formation.

CHART 1.—Core, Shock, and Demand Inflation (Year-over-year percent change, seasonally adjusted)

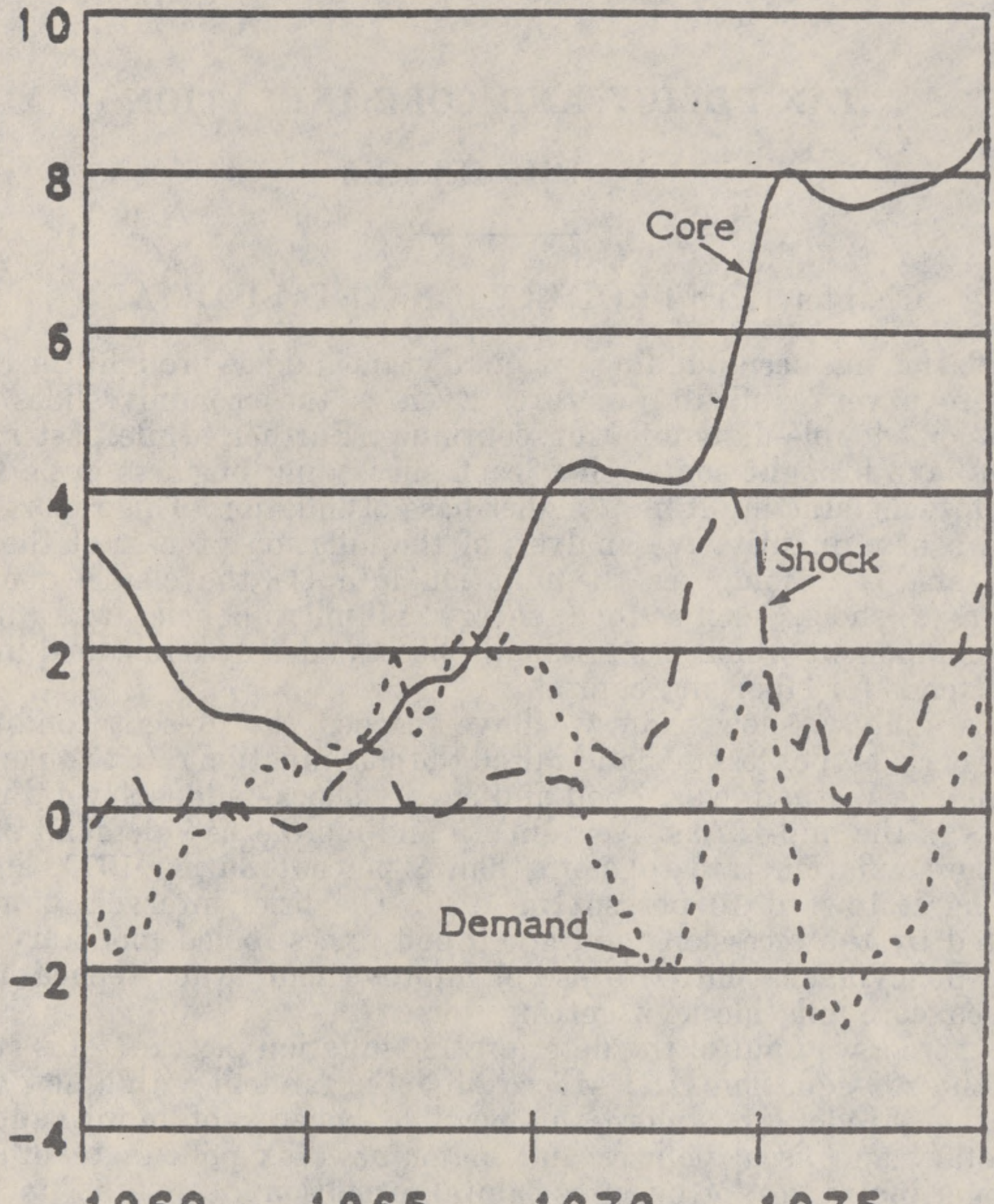


TABLE 1.—CORE, SHOCK, AND DEMAND INFLATION

[Average annual rates of change]

	1960 to 1965	1965 to 1970	1970 to 1973	1973 to 1979
Unit labor cost trend (weight 0.65)	2.2	2.0	4.0	6.6
'Equilibrium' wage gains	4.2	4.8	5.8	7.8
Actual wage gains	3.1	5.8	6.6	7.9
Price expectations	1.8	2.3	3.8	6.0
Unemployment rate (level)	5.5	4.0	5.3	6.5
Productivity trend	2.0	2.7	1.7	1.1
Actual productivity gains	3.1	1.4	2.8	0.5
+Capital cost trend (weight 0.35)	0.4	2.4	4.9	8.6
Actual rental price of capital	−0.2	5.9	4.6	11.3
Prime rate (level)	4.56	6.32	6.72	8.87
New high-grade corporation bond rate (level)	4.42	6.40	7.67	8.68
Price expectations	1.7	2.5	4.1	6.2
=Core inflation rate	1.5	2.0	4.2	7.1
Shock inflation rate	0.0	0.3	1.2	1.8
WPI—Farm products	0.2	2.4	16.7	5.4
WPI—Fuels	0.0	2.2	8.1	20.4
Trade-weighted exchange rate	0.6	−0.8	−5.0	−0.3
Social security tax rate (difference)	0.002	0.003	0.006	0.004
Minimum wage (dollars per hour)	1.147	1.445	1.600	2.245
Demand inflation rate	−0.3	1.5	−0.5	−0.7
Capacity utilization in manufacturing (level)	0.829	0.887	0.822	0.823
Unemployment rate (level)	5.5	4.0	5.3	6.5
Consumer price index	1.3	4.3	4.6	8.5

The principal conclusions of the study are these:

(1) The prospect for core inflation is not good. With productivity lagging and wages likely to accelerate in response to 1979's double-digit inflation results, unit labor costs will be advancing very rapidly. Capital costs also will continue high and rising, now that long-term interest rates more fully reflect the inflation record and the cost of equity capital is pushed up by the poor stock market performance. If the United States does not change its approach to economic policy, there is every reason to believe that core inflation will continue to become worse.

(2) Shocks will continue to be an important source of inflation. The current round of OPEC price increases and the impending boosts in social security tax rates will create a shock inflation rate averaging 2 percent over the next 3 years. Under DRI's (perhaps sanguine) assumption of future OPEC price increases at a real rate of 4 percent, with domestic energy being gradually deregulated and with other shocks likely to make at least a small contribution, the probable rate of the 1980's is near 1 percent even if our luck improves. This continuing push from shocks makes it difficult to achieve a permanent downturn in the core inflation rate through the traditional methods.

(3) Careful monetary and fiscal policies are a prerequisite for any approach to inflation control. In order to stabilize the core inflation rate near an 8½ percent plateau in the first half of the 1980's, demand management would have to aim at an unemployment rate of 8 percent following the small 1980–81 recession. To bring the core inflation rate down significantly through fiscal and monetary policies alone would require a prolonged period of deep recession, bordering on depression, with the average unemployment rate held above 10 percent. This is clearly not a feasible approach to the problem.

(4) To achieve better progress on inflation, it is necessary to turn to the supply side of policy. Table 2 summarizes the simulation results of adopting a sizable package of tax incentive programs to liberalize both the investment tax credit and depreciation allowances. The investment tax credit is assumed to be boosted by 2.7 points beginning in 1980. The depreciation change is a 4-year reduction in the economic lives of equipment. The direct revenue effect of this package is $10.3 billion at the time of adoption, growing to $32 billion by 1990.

Despite the rather large reduction in corporate income taxes, the Federal budget surplus is larger at the end of the decade than it otherwise would be. This is the result of (*a*) greater economic activity, producing additional revenues and (*b*) an explicit assumption that aggregate demand is held constant by offsetting the tax cuts with spending cuts and tighter monetary policy. Tax cuts alone will not produce an increase in the Federal budget surplus.

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TABLE 2.—REDUCING CORE INFLATION THROUGH INVESTMENT TAX CREDITS AND LIBERALIZED DEPRECIATION

[Difference from baseline path]

	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
Policy (difference in level):											
Average tax lifetime (years): Producer's durable equipment	−4.0	−4.0	−4.0	−4.0	−4.0	−4.0	−4.0	−4.0	−4.0	−4.0	−4.0
Investment tax credit (rate)	0.027	0.027	0.027	0.027	0.027	0.027	0.027	0.027	0.027	0.027	0.027
Corporate profit: Tax accruals (percent difference)	−15.7	−15.4	−17.9	−24.1	−24.7	−22.3	−25.4	−26.6	−27.8	−31.0	−32.7
Macroeconomic effects (percent difference):											
Real GNP	0.1	0.3	0.3	0.2	0.7	1.2	1.4	1.8	2.7	3.3	3.7
Total consumption	0.1	0.3	0.2	0.0	0.4	0.7	0.7	0.9	1.4	1.8	2.1
Nonresidential fixed investment	0.4	5.7	8.5	7.0	7.5	9.8	10.2	10.6	12.5	14.6	15.6
Investment in residential structures	1.2	5.6	1.5	−4.5	0.0	4.6	2.2	2.5	7.2	10.1	9.9
Net exports	1.5	1.0	5.2	11.3	11.6	14.1	20.4	27.1	32.6	34.1	35.7
Government purchases	−0.3	−3.7	−4.8	−2.9	−3.3	−4.3	−3.8	−3.4	−3.4	−3.3	−2.9
Long-run supply (percent difference):											
Labor force	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.1
Capital stock	0.0	0.7	1.6	2.2	2.7	3.4	4.1	4.7	5.5	6.4	7.2
Output per hour	0.0	0.2	0.2	0.2	0.8	1.2	1.4	1.9	2.4	2.8	3.3
Potential GNP	0.0	0.0	0.2	0.5	0.8	1.1	1.4	1.6	1.9	2.2	2.6
Inflation and unemployment (percent difference):											
Core inflation rate[1]	−0.2	−0.7	−0.7	−0.8	−1.0	−1.0	−1.0	−1.1	−1.3	−1.3	−1.3
Consumer price index	−0.1	−0.3	−0.4	−0.6	−1.0	−1.4	−1.9	−2.5	−3.0	−3.5	−4.0
Average hourly earnings	0.0	0.0	−0.1	−0.2	−0.4	−0.7	−1.0	−1.4	−1.7	−2.0	−2.2
Real wages	0.1	0.2	0.3	0.4	0.6	0.9	1.1	1.3	1.6	2.0	2.3
Unemployment rate (difference in level)	0.0	−0.1	−0.1	0.1	0.1	0.0	0.0	0.0	−0.2	−0.4	−0.4
Capacity utilization (difference in level)	−0.010	−0.013	−0.017	−0.032	−0.030	−0.027	−0.038	−0.043	−0.039	−0.042	−0.053
Financial markets (difference in level):											
Rental price of capital (percent difference)	−7.1	−7.5	−7.1	−9.8	−12.1	−12.5	−14.4	−17.0	−18.8	−20.0	−21.4
Prime rate	−0.51	−0.30	1.09	0.96	−0.07	0.27	0.62	−0.11	−0.63	−0.56	−0.58
New high-grade corporate bond rate	−0.04	−0.10	−0.08	−0.14	−0.31	−0.43	−0.44	−0.49	−0.56	−0.53	−0.46

[1] Difference in rate of change.

Highlights of the effects of this simulation are:

Real business fixed investment is up by 9.8 percent by 1985 and 15.6 percent by 1990, raising the capital stock by 3.4 percent by 1985 and 7.2 percent by 1990.

The enlarged supply of capital boosts potential GNP by 1.1 percent by 1985, and elevates the growth rate of potential by 0.2 percentage points per year for the entire decade.

The improved capital-labor ratio adds a similar 0.2 points per year to the rate of productivity growth.

Real wages are up an extra 0.9 percent by 1985 helping to produce a 0.7 percent increase in real consumption. Housing activity is diminished slightly over this period because the increased level of business capital formation crowds out some mortgage supplies.

The reduction in the core inflation rate in this simulation is 1.0 percentage points in 1985, and 1.3 points by the closing years of the decade, an average reduction for the whole period of 0.9 percentage points.

(5) While a full point reduction of the core inflation rate would be a major achievement and would firmly put the economy on a path of improvement as compared to its present unfortunate trajectory, the policies are clearly insufficient to bring the inflation rate down to acceptable levels. To make further progress, other avenues of policy must be explored. They include a renewed effort to build up the stock of technical and scientific knowledge through investment in research and development, changes in the personal tax burden which may augment the supply of labor at least to a small degree and encourage productivity, and measures to enlarge the total supply of capital to the economy through increased personal saving. Measures that would reduce the unemployment rate of disadvantaged groups also would help in the struggle against inflation both by adding to the effective labor supply and by making it acceptable to manage aggregate demand in a more cautious fashion.

Chapter 2. CORE INFLATION: THEORY AND MODEL

Inflation has proved to be the most stubborn problem confronting economists, impossible to forecast with acceptable accuracy or to devise effective cures. This study advances a method to decompose inflation into its main causes, and to express it as a fully quantified econometric model. The new method is then applied to the historical record and used to quantify policy choices to reduce the inflation rate.

The conclusions are not optimistic. The analysis supports the viewpoint that inflation is indeed very stubborn and cannot be fully eradicated in a timespan as short as 5 years. But the analysis also shows that our society is not helpless: it is possible to bring the inflation rate down substantially provided we have the wisdom and the political will to take the proper steps.

The Conceptual Framework: Core, Demand, and Shock Inflation

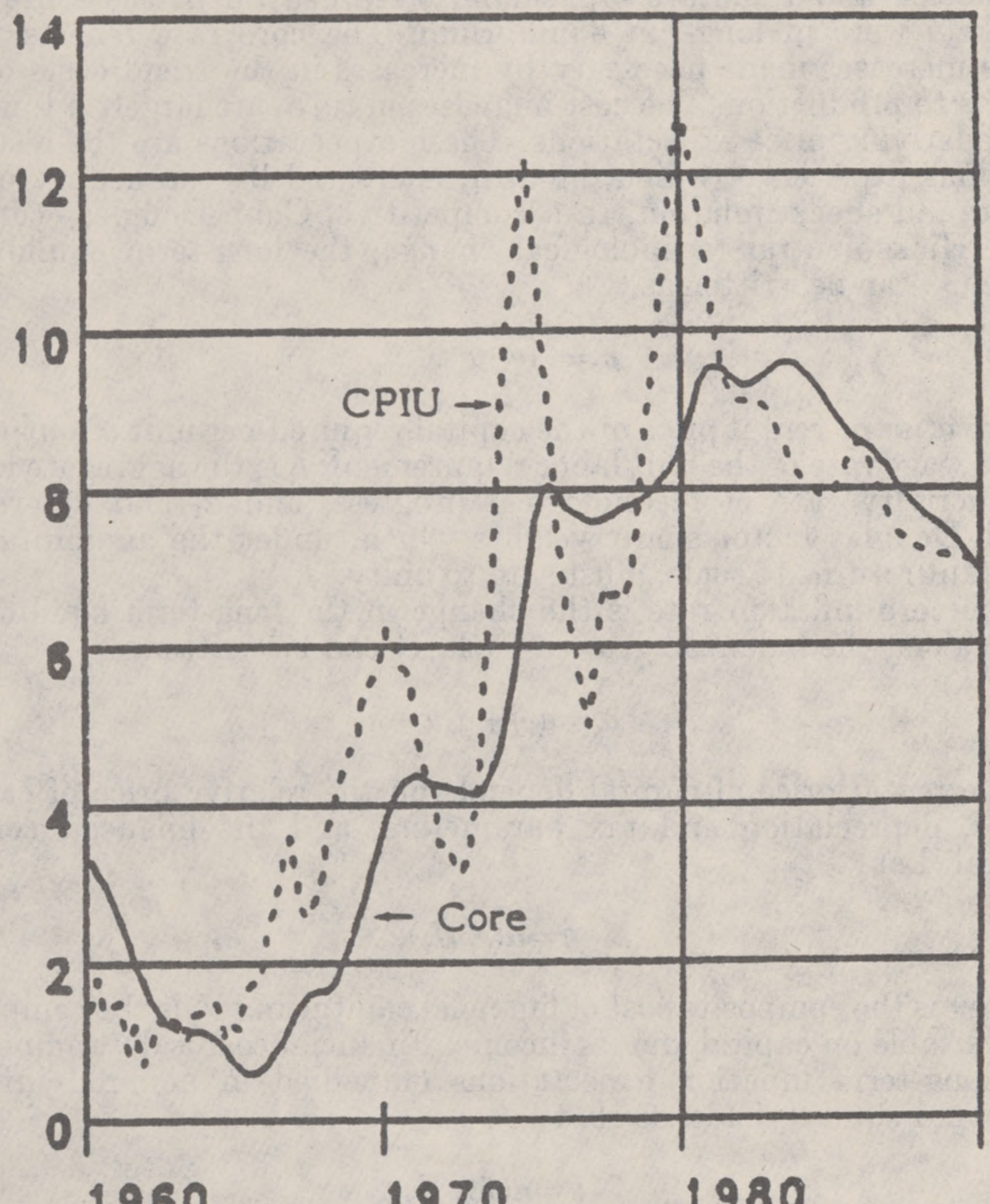
The aggregate inflation rate has proved volatile and dominated by "surprises." Variations in aggregate demand have long been known to affect the price level, yet other factors have frequently obscured this relationship. Such shocks as energy and food price explosions or government micro policies of regulation and taxation have been seen as alternative theories of inflation. In truth, a conceptual structure is needed which brings the several inflation mechanisms together into a coherent, logical theory.

A satisfactory theory of the inflationary process must make room for three kinds of effects. First, the state of demand affects short-term price behavior. Second, shocks, i.e., sudden changes in particular costs, can add to the short-term inflation rate. Third, the succession of short-term demand and shock effects produces a core inflation rate which has a great propensity to persist.

The core rate is the trend increase of the cost of the factors of production. It originates in the long-term expectations of inflation in the minds of households and businesses, in the contractual arrangements which sustain the wage-price momentum and in the tax system. Core inflation can be made better or worse by the particular circumstances of any short period, but it can only be modified gradually because no brief experience will undo the cumulative effects of previous reality.

Chart 2 shows the core inflation rate since the early 1960's. It can be seen that it improved early in the period and was almost eliminated by 1964. Since then, it has deteriorated almost steadily, even in the years when the measured inflation rate showed dramatic improvement.

CHART 2.—The Core Inflation Rate and The Consumer Price Index (Year-over-year percent change, seasonally adjusted)



The conceptual structure can be set out as follows. Let the total inflation rate of a period be equal to the sum of the three separate inflation sources: core, demand, and shock.

$$\dot{p}=\dot{p}_c+\dot{p}_d+\dot{p}_s, \tag{1}$$

where

$\dot{p}$=inflation rate,
$\dot{p}_c$=core rate,
$\dot{p}_d$=demand rate, and
$\dot{p}_s$=shock rate.

The core rate of inflation can be viewed as the rate that would occur on the economy's long-term growth path, provided the path were free of shocks, and the state of demand were neutral in the sense that markets were in long-run equilibrium. The core rate reflects those price increases made necessary by increases in the trend costs of the inputs to production. The cost increases in turn, are largely a function of underlying price expectations. These expectations are the result of previous experience, which, in turn, is created by the history of demand and shock inflation. In a competitive, Cobb-Douglas economy with Hicks-neutral technological change, the long-term equilibrium price, p_c, can be written as,[1]

$$p_c = A q^{a_1} w^{a_2} e^{-ht}, \tag{2}$$

where q is the rental price of the capital required per unit of output, w is the wage rate of the unit labor requirement, h is the aggregate factor productivity rate of technological progress, and a_1 and a_2 are the Cobb-Douglas factor share weights which, under the assumption of constant returns to scale, must sum to unity.

The core inflation rate is the change in the long-term equilibrium price along the balanced growth path. It can be written

$$\dot{p}_c = a_1 \dot{q} + a_2 \dot{w} - h. \tag{3}$$

The rental price of capital depends on the relative price of capital goods, depreciation and tax parameters, and the financial cost of capital. Let

$$\dot{q} = \alpha(r, J_q), \tag{4}$$

where r is the composite cost of financial capital and J_q is the composite tax variable on capital and its income. Financial cost is determined by the long-term inflation expectations embodied in nominal interest rates and equity yields, so that

$$\dot{q} = \alpha(\dot{p}^e_q, J_q). \tag{5}$$

Similarly, wages on the equilibrium path are determined by the price expectations underlying wage claims and possible tax effects J_w, or

$$\dot{w} = \beta(\dot{p}^e_w, J_w). \tag{6}$$

Therefore, the core rate of inflation depends on long-term price expectations in labor and capital markets, tax provisions, and factor productivity, i.e.,

$$\dot{p}_c = a_1 \alpha(\dot{p}^e_q, J_q) + a_2 \beta(\dot{p}^e_w, J_w) - h. \tag{7}$$

---

[1] For a fuller theoretical treatment of equilibrium price in this particular macro context, see William D. Nordhaus, "Recent Developments in Price Dynamics," in Otto Eckstein, ed., *The Econometrics of Price Dctermination*, Federal Reserve Board, 1972, pp. 28–30, and James Tobin, "The Wage-Price Mechanism: Overview of the Conference," *ibid*, pp. 5–7. Nordhaus shows the equilibrium price results under various production functions besides the standard Cobb-Douglas case.

Price expectations are formed on the basis of inflation experience, as measured by distributed lags on actual prices, and need not be the same for bond buyers as for workers. Thus,

$$\dot{p}_c=a_1\alpha\left(\left(\sum_{t=0}^{-\infty}\lambda_t\dot{p}_t\right),\ J_q\right)+a_2\beta\left(\left(\sum_{t=0}^{-\infty}\mu_t\dot{p}_t\right),\ J_w\right)-h. \tag{8}$$

Since the actual inflation of a period, t, is composed of the three components,

$$\dot{p}_t=\dot{p}_{c_t}+\dot{p}_{d_t}+\dot{p}_{s_t}, \tag{9}$$

and the core inflation rate is affected by the actual record of inflation as processed into current expectations, the core inflation rate can be written in terms of previous demand and shock inflation, productivity and taxes,

$$\dot{p}_{c_t}=\delta(\dot{p}_{d_t},\ \dot{p}_{d_{t-1}}\ldots,\ \dot{p}_{s_t},\ \dot{p}_{s_{t-1}}\ldots,\ h_t,\ h_{t-1}\ldots,\ J_{q_t},\ J_{q_{t-1}}\ldots,\ J_{w_t},\ J_{w_{t-1}}\ldots). \tag{10}$$

The demand inflation rate will depend on utilization rates of resources derived from the level of aggregate demand and factor supplies. Presumably both the unemployment rate and the operating rate of physical capital are pertinent, and the effects are nonlinear. Thus,

$$\dot{p}_d=\gamma(u_1,\ u_{cap}). \tag{11}$$

The shock inflation rate is, by definition, exogenous to the analysis. While, in fact, such shocks as OPEC and food prices are in part endogenous with aggregate demand playing the conventional price-lifting role, they are considered here to be determined primarily by noncontrollable conditions: OPEC political-economic decisions in one case, weather and crop conditions in the other. Government shocks, such as payroll taxes, are exogenous because they are considered to be policy levers.

Core inflation can be expressed, then, in terms of the previous history of aggregate demand, shocks, and productivity, where the latter two factors are mainly expressions of supply-side phenomena and exogenous cost shifts. Thus,

$$\dot{p}_{c_t}=f(ul_t,\ u_{l_{t-1}},\ \ldots,\ u_{cap_t},\ u_{cap_{t-1}},\ \ldots,\ \dot{p}_{s_t},\ \dot{p}_{s_{t-1}},\ \ldots,\ h_t,\ h_{t-1},\ \ldots,\ J_{q_t},\ J_{q_{t-1}}\ldots,\ J_{w_t},\ J_{w_{t-1}}\ldots). \tag{12}$$

Some basic relationships can be clarified through a two-period analysis. Suppose the two periods are the present, t_o, and the past, t_{-1}. Also, suppose price expectations are formed in the same way by the suppliers of labor and capital. Then

$$\dot{p}_o=\dot{p}_{c_o}+\dot{p}_{d_o}+\dot{p}_{s_o}. \tag{13}$$

(14) $$\dot{p}_{c_o}=\alpha\dot{p}^e_o=\alpha\beta\dot{p}_{-1},$$

or

(15) $$\dot{p}_o=\alpha\beta\dot{p}_{-1}+\dot{p}_{d_o}+\dot{p}_{s_o}.$$

Then

(16) $$\frac{\dot{p}_o}{\dot{p}_{-1}}=\alpha\beta+\frac{\dot{p}_{d_o}}{\dot{p}_{-1}}+\frac{\dot{p}_{s_o}}{\dot{p}_{-1}}.$$

Suppose $\dot{p}_{d_o}=0$ and $\dot{p}_{s_o}=0$.

Then,

(17) $$\frac{\dot{p}_o}{\dot{p}_{-1}}=\alpha\beta.$$

Under a unit elasticity of expectations which would be rational in some circumstances,

(18) $\alpha\beta=1$, so $\dot{p}_o=\dot{p}_{-1}$, or the inflation rate remains unchanged.

Suppose

(19) $\dot{p}_d=\gamma(u^*-u)$ where u^* is the natural rate of unemployment based on friction and search phenomena in the labor market. Then,

(20) $$\frac{\dot{p}_o}{\dot{p}_{-1}}=\alpha\beta+\frac{\gamma(u^*-u)}{\dot{p}_{-1}}+\frac{\dot{p}_{s_o}}{\dot{p}_{-1}}.$$

In order to leave the inflation rate unchanged,

(21) $$\gamma(u^*-u)=\dot{p}_{s_o}, \text{ or } u^{**}=\dot{p}_{s_o}+u^*,$$

where u^{**} is the unemployment rate that holds inflation constant.

Thus, the unemployment rate necessary to hold inflation constant under conditions of shocks must exceed the natural rate of unemployment. To distinguish between the two "natural" rates of unemployment, let us call u^{**} the "stable inflation" rate of unemployment, leaving the natural rate u^* to be the "full employment" rate of unemployment.

The various inflation components must be pursued further to their root causes. The productivity trend in the core inflation rate is partly determined by the rate of capital formation, human resource investment, and technological progress. The resource utilization rates depend on private spending propensities and fiscal and monetary policies which determine aggregate demand. A theory of investment is needed for capital supply, a theory of labor-force participation for labor supply.

To trace fully the three components of inflation to their causes requires a full description of the economy such as is represented in a complete macroeconomic model. As will be seen in the discussion of the empirical treatment below, the core inflation model is drawn almost entirely out of the 800-equation DRI Quarterly Econometric Model of the U.S. Economy. Thus, there is no need to develop a special purpose theoretical or empirical model to conduct a full core inflation analysis.[2]

The DRI model is an eclectic, highly detailed empirical representation of the economy. While the core inflation analysis could as easily be tied into a monetarist model, in which aggregate spending is driven exclusively by the monetary factor, a monetarist model is not appropriate for tax policy analysis.

Apart from the particular decomposition of the problem into its three components to provide analytical focus, the core model makes strong empirical statements only in one crucial regard: the formation of price expectations for determining long-run capital and labor costs is a gradual learning process rather than a quick response to policies or other particular events. The theory is consistent with a weak form of the rational expectations viewpoint that price expectations are free of bias in the long run, but it is inconsistent with the stronger viewpoint that these price expectations are formed quickly from particular policy announcements or exogenous events.

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[2] The core inflation analysis can also be treated as a stand-alone analytical device in which its inputs—the level of aggregate demand, the shock rate, the rental price of capital, the rates of wage productivity increase—are treated as exogenous.

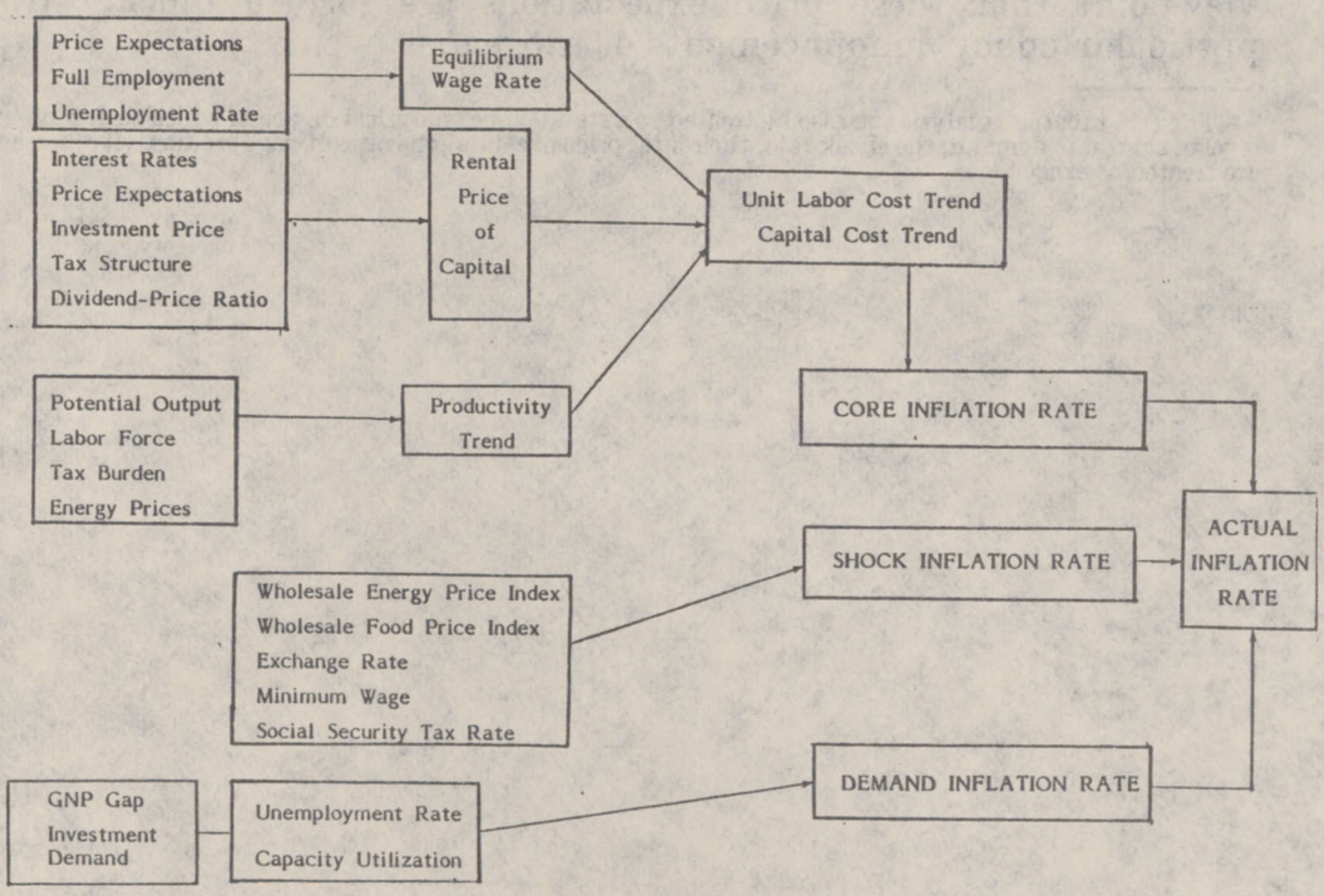
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Chapter 3. THE EMPIRICAL MODEL OF CORE INFLATION

The empirical execution of the core inflation analysis consists of two tasks: (1) Development of a small model defining and relating the concepts of the core inflation analysis; and (2) the development of the DRI model to represent more fully the critical supply effects that help determine potential output and productivity. The formal links between the two models are summarized in Chart 3.

In this study, inflation is equated with movements in the consumer price index, the index considered by the public to be the indicator of inflation. This index currently suffers from an upward bias due to its treatment of homeownership costs. To make sure that the analysis does not depend on the choice of index, it was tested on the deflator for consumer expenditures and found to be little changed.

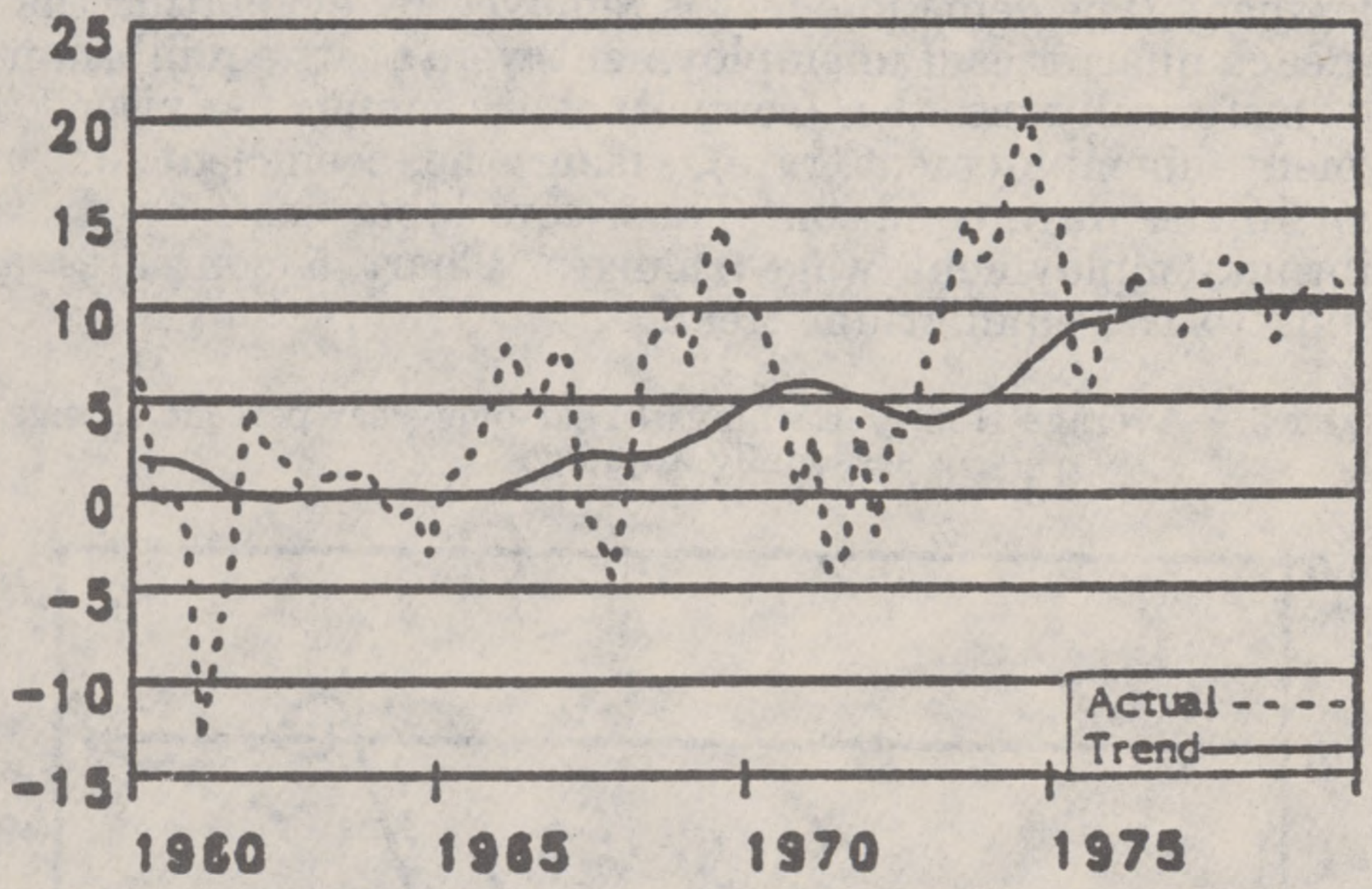
CHART 3.—DRI Macro Model of the U.S. Economy—Core Inflation Model



MEASURING THE CORE INFLATION RATE

The core inflation rate, or the trend in the aggregate supply price, is the weighted average of the trend rates of increase of the rental price of capital and unit labor cost trend. Chart 4 shows the historical record of the rental price of capital and of its trend. The raw series is quite volatile, principally because of the short-term variations in interest rates and stock yields created by financial conditions, monetary policy, and various other short-term market factors. The calculated trend lets the fundamental force emerge, and is a more appropriate measure of capital costs because of the extended lag structure for investment, corporate financing, and pricing.

CHART 4.—The Rental Price of Capital (Year-over-year percent change, seasonally adjusted)



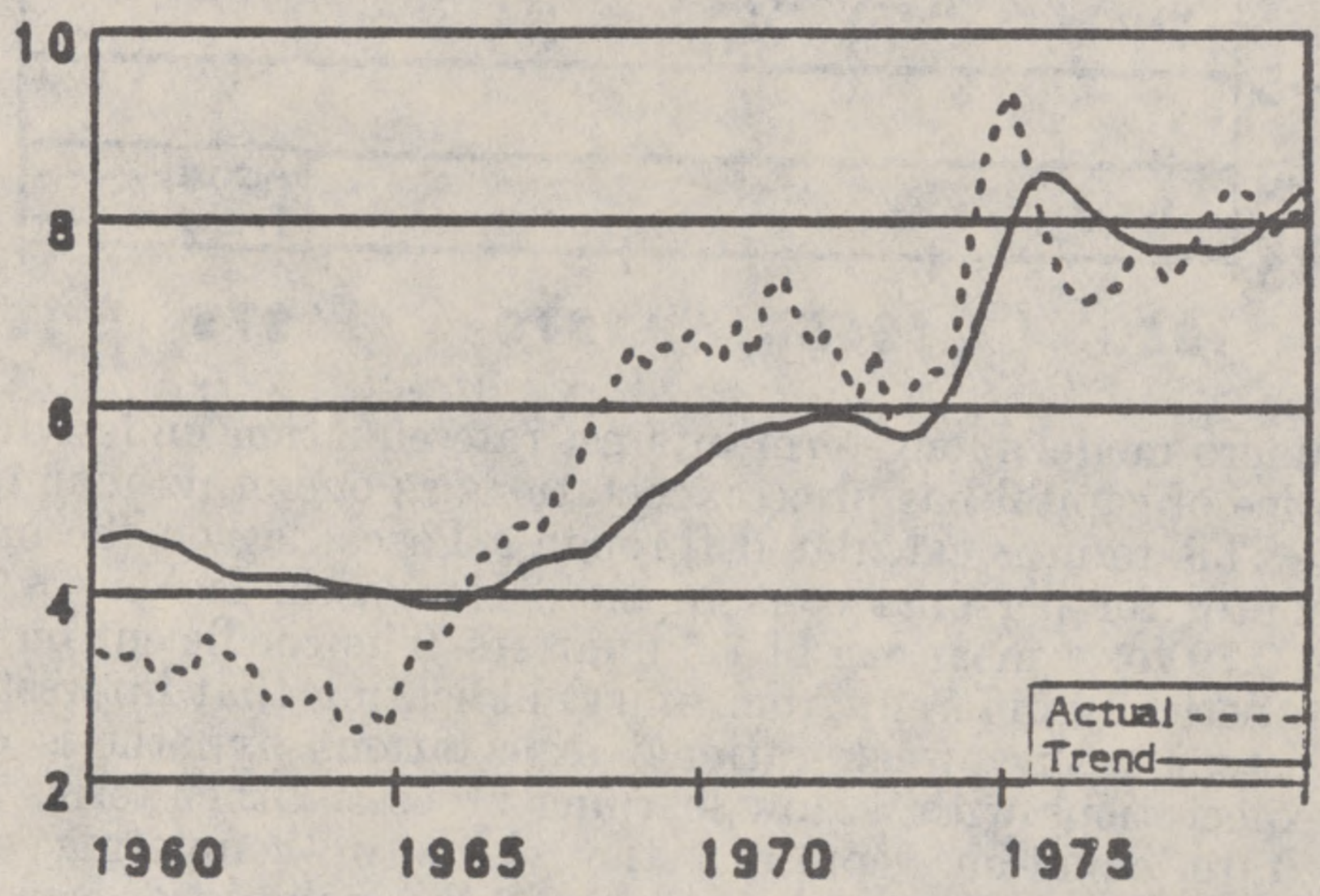
The macro model's long-term interest rate equation underlying the rental price of capital has price expectations as one of its main determinants. This term is calculated through a Pascal lag on the implicit price deflator for personal consumption. Its Pascal lag has a decay factor of 0.79 for a mean lag of 7.5 quarters. The coefficient on prices is not statistically different from unity, indicating that interest rates are consistent with a weak rational expectations hypothesis of unbiased expectations with a slow learning process. Other terms in the interest rate equation represent the yields in competing capital markets including stocks and mortgages, the volume of new bond issues, and the supply of bank reserves as an indication of the economy's liquidity and of monetary policy. The interest rate equation, along with the other equations discussed in this chapter, is shown in the technical appendix.

The wage component of unit labor costs is measured by the Bureau of Labor Statistics' hourly earnings index which is adjusted for overtime and industrial mix. Hourly earnings rather than total compensation are used because payroll taxes, which account for much of the difference between the two series, are included in the "shocks" created by government policies.

The wage equation in the macro model contains two price expectations terms: The first is the rate of consumer price increase of the preceding four quarters, which reflects the impact of near-term inflation on wages through cost-of-living escalators and the more sensitive wages of unorganized workers; the second is a long-term price expectations factor based on a Pascal lag with a decay factor of 0.85, or a mean lag of 11.3 quarters. Of the two price expectations terms, the long-term variable has the larger weight. They sum to near unity, indicating that wages too are consistent with a rational expectations hypothesis, one in which short-term price changes are discounted to be partly nonrecurring and perhaps reversible, but long-term price behavior is fully reflected in wages.

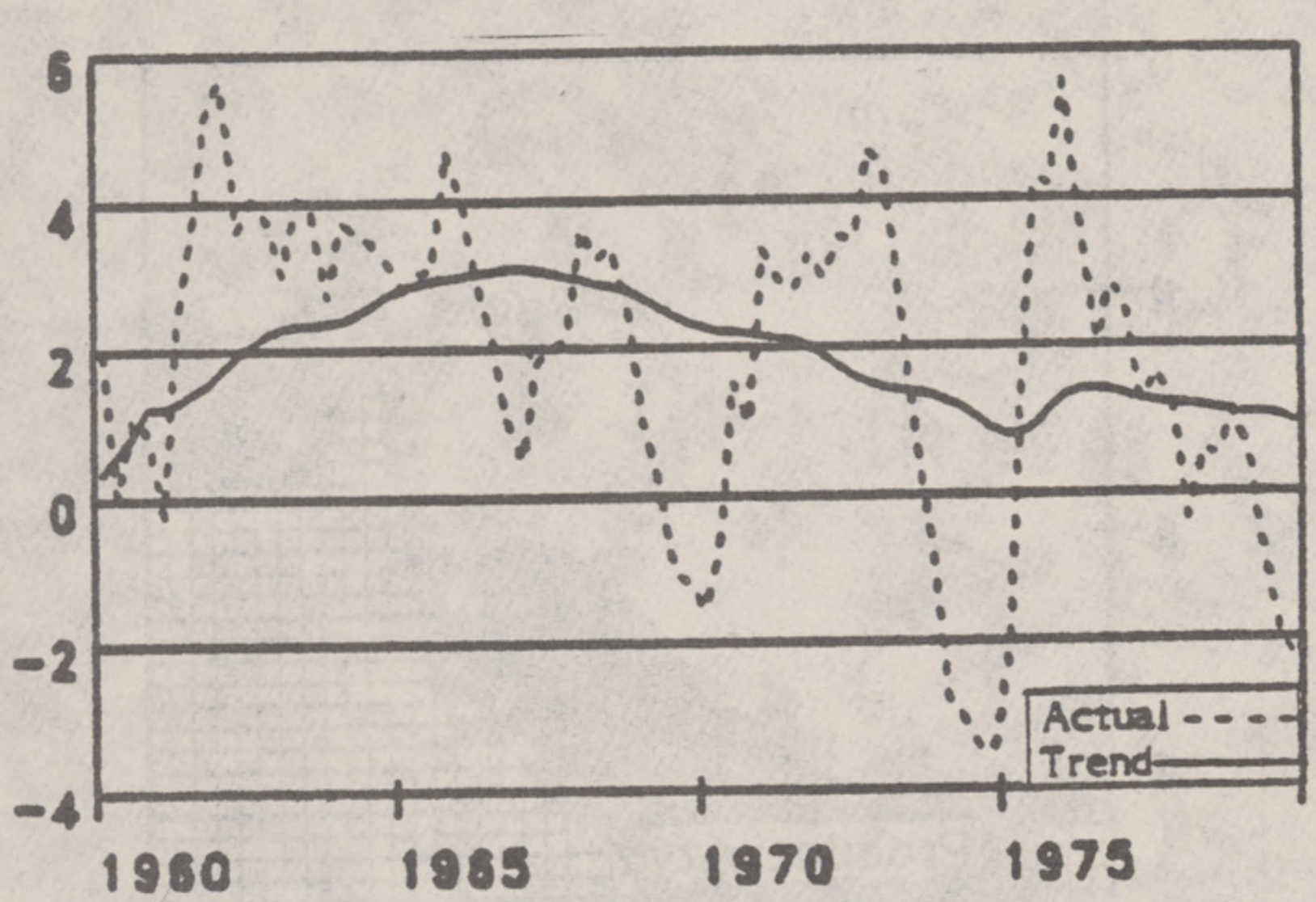
Because wages are affected by short-term labor market demand conditions, the definition of the core wage rate requires correction for unemployment. The demand effect is removed by evaluating the wage term for each quarter as if unemployment were at its equilibrium level (defined historically as the Council of Economic Advisers' high-employment unemployment rate), using the coefficient on unemployment in the wage equation. Thus, core labor costs are based on equibilibrium-employment wage changes. Chart 5 compares actual wage gains to the equilibrium trend.

CHART 5.—Average Hourly Earnings (Year-over-year percent change, seasonally adjusted)



Wages are corrected by the labor productivity trend to derive the unit labor cost component of core inflation. Productivity is estimated in the macro model as a function of potential productivity (potential output relative to full employment labor supply) adjusted for cyclical variation in utilization levels. The productivity equation also includes terms to capture the effects of the tax burden and the relative price of energy. The productivity trend is derived by setting the cycle variables at their equilibrium levels, and smoothing the resulting series with a Pascal lag with a decay factor of 0.79. (See Chart 6.) The relative weights attached to labor and capital are derived from the extended Cobb-Douglas production function in the model, yielding coefficients of 0.65 on labor and 0.35 on capital.

CHART 6.—Labor Productivity (Year-over-year percent change, seasonally adjusted)



THE SHOCK INFLATION RATE

It is beyond the current state of empirical economics to model fully the various shocks to the price level which originate with government and other exogenous forces. They include, in principle, any shift in the aggregate supply function. Only those elements that are already represented in the DRI model have been used in the empirical definition of the shock variable. This list contains energy and agricultural prices, the exchange rate of the dollar, payroll taxes, and the minimum wage. Government regulation was not modelled at this stage, because there are no indices of regulation of sufficient accuracy to allow a serious econometric analysis.

CHART 7.—The Unit Labor Cost Trend: Wage Trend − Productivity Trend = Unit Labor Cost Trend (Year-over-year percent change, seasonally adjusted)

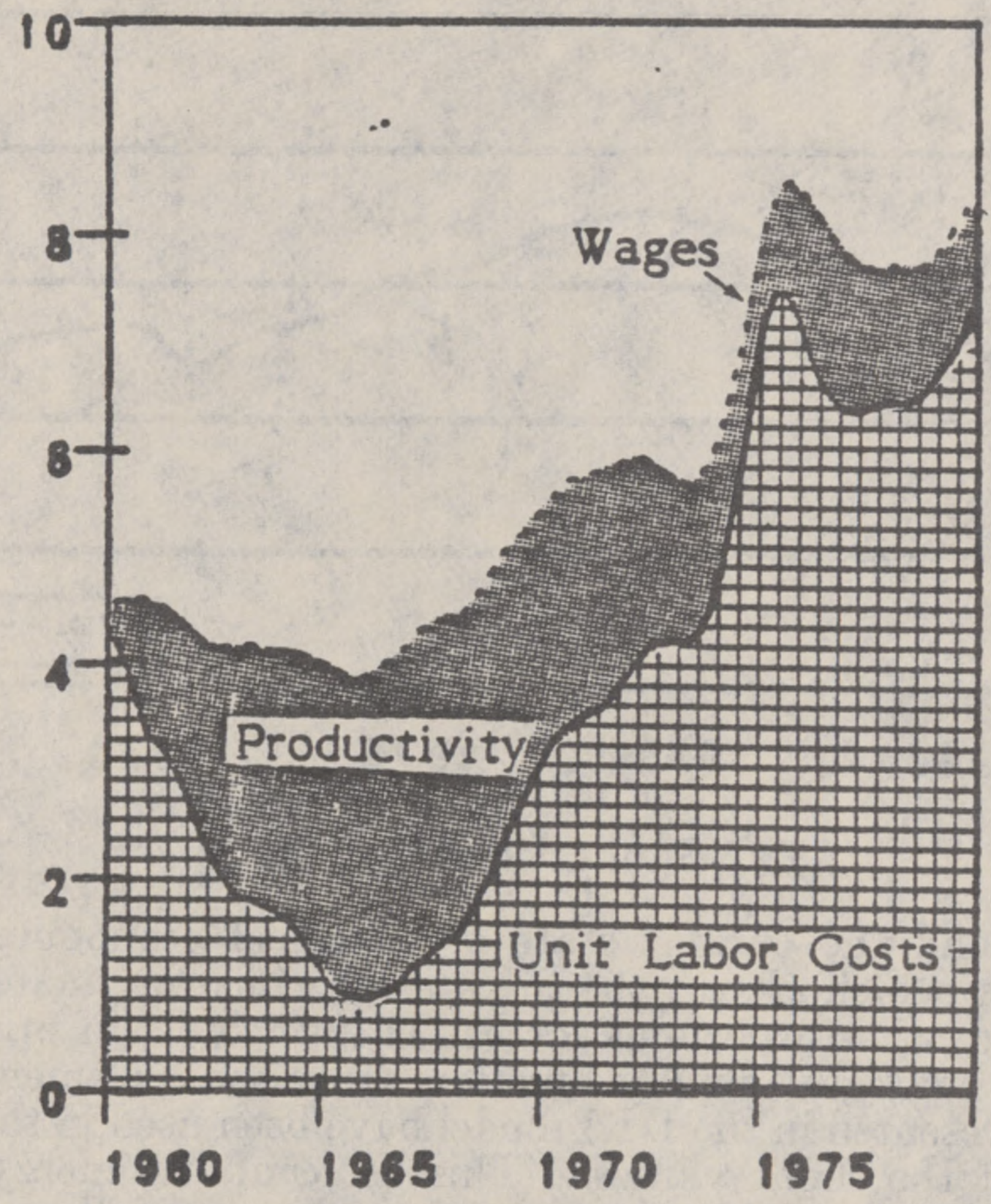
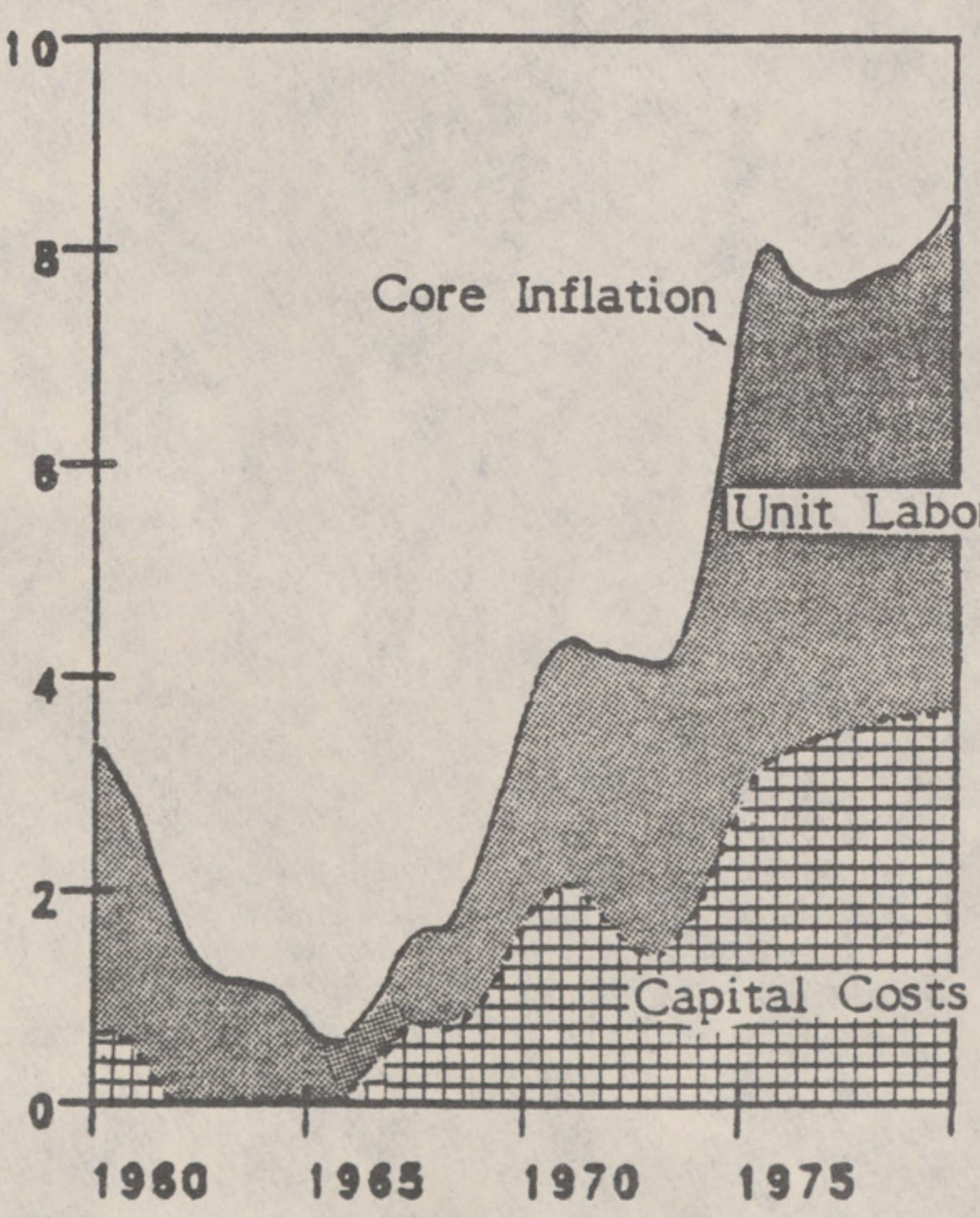


CHART 8.—The Core Inflation Rate: Unit Labor Cost Trend (Weight = 0.65) + Capital Cost Trend (Weight = 0.35) = Core Inflation Rate (Year-over-year percent change, seasonally adjusted)



In order to isolate the components of the shock variable, full model simulations were run to measure reduced-form impacts on the price level. The relationships identified through the model runs yield time series which are combined with historical values for the exogenous variables to derive the shock effects. Chart 9 shows the historical record of such an exercise. Equations (22–26) represent the "reduced form" estimates drawn from the model simulations. The relationships linking the energy, agriculture, and exchange rate changes to the consumer price index are

$$(22)\quad \dot{p}_{s_{\mathrm{WPI05}}} = 0.008*\Delta\mathrm{WPI05} + 0.013*\Delta\mathrm{WPI05}_{-1} + 0.014*\Delta\mathrm{WPI05}_{-2} + 0.015*\Delta\mathrm{WPI05}_{-3}$$

$$(23)\quad \dot{p}_{s_{\mathrm{WPI01}}} = 0.007*\Delta\mathrm{WPI01} + 0.012*\Delta\mathrm{WPI01}_{-1} + 0.014*\Delta\mathrm{WPI01}_{-2} + 0.014*\Delta\mathrm{WPI01}_{-3}$$

and

$$(24)\quad \dot{p}_{s_{\mathrm{EXCH}}} = -0.001*\Delta\mathrm{EXCH} - 0.003*\Delta\mathrm{EXCH}_{-1} - 0.005*\Delta\mathrm{EXCH}_{-2} - 0.008*\Delta\mathrm{EXCH}_{-3}$$

where WPI05 is the wholesale price index for fuels, related products and power, WPI01 is the wholesale price index for farm products, and EXCH is the Morgan Guaranty Trust trade-weighted index of the exchange rate for the U.S. dollar. The effects of payroll taxes and minimum wages are modelled as follows,

$$(25)\quad \dot{p}_{s_{\mathrm{RTWGF}}} = 15.4*\Delta\mathrm{RTWGF} + 16.8*\Delta\mathrm{RTWGF}_{-1} + 9.5*\Delta\mathrm{RTWGF}_{-2} + 0.9*\Delta\mathrm{RTWGF}_{-3}$$

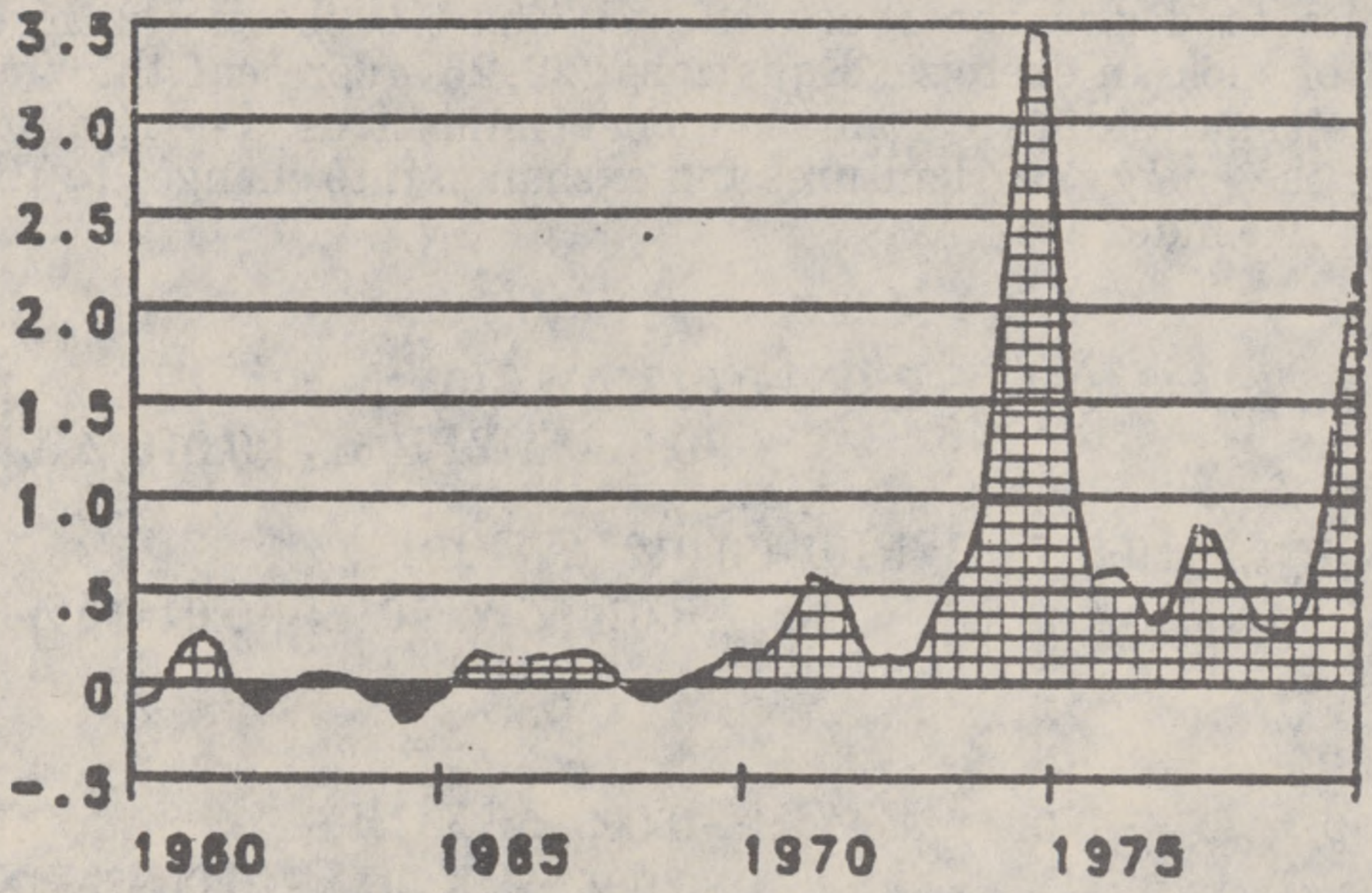
and

$$(26)\quad \dot{p}_{s_{\mathrm{MINWAGE}}} = 0.0004*\Delta\mathrm{MINWAGE} + 0.001*\Delta\mathrm{MINWAGE}_{-1} + 0.002*\Delta\mathrm{MINWAGE}_{-2} + 0.003*\Delta\mathrm{MINWAGE}_{-3},$$

where RTWGF is the tax rate for Federal social security contributions, and MINWAGE is the Federal minimum wage. The composite shock rate of inflation is calculated by combining (22) to (26).

CHART 9.—The Shock Contribution to Inflation (Year-over-year percent change, seasonally adjusted)

A. Energy



B. Food

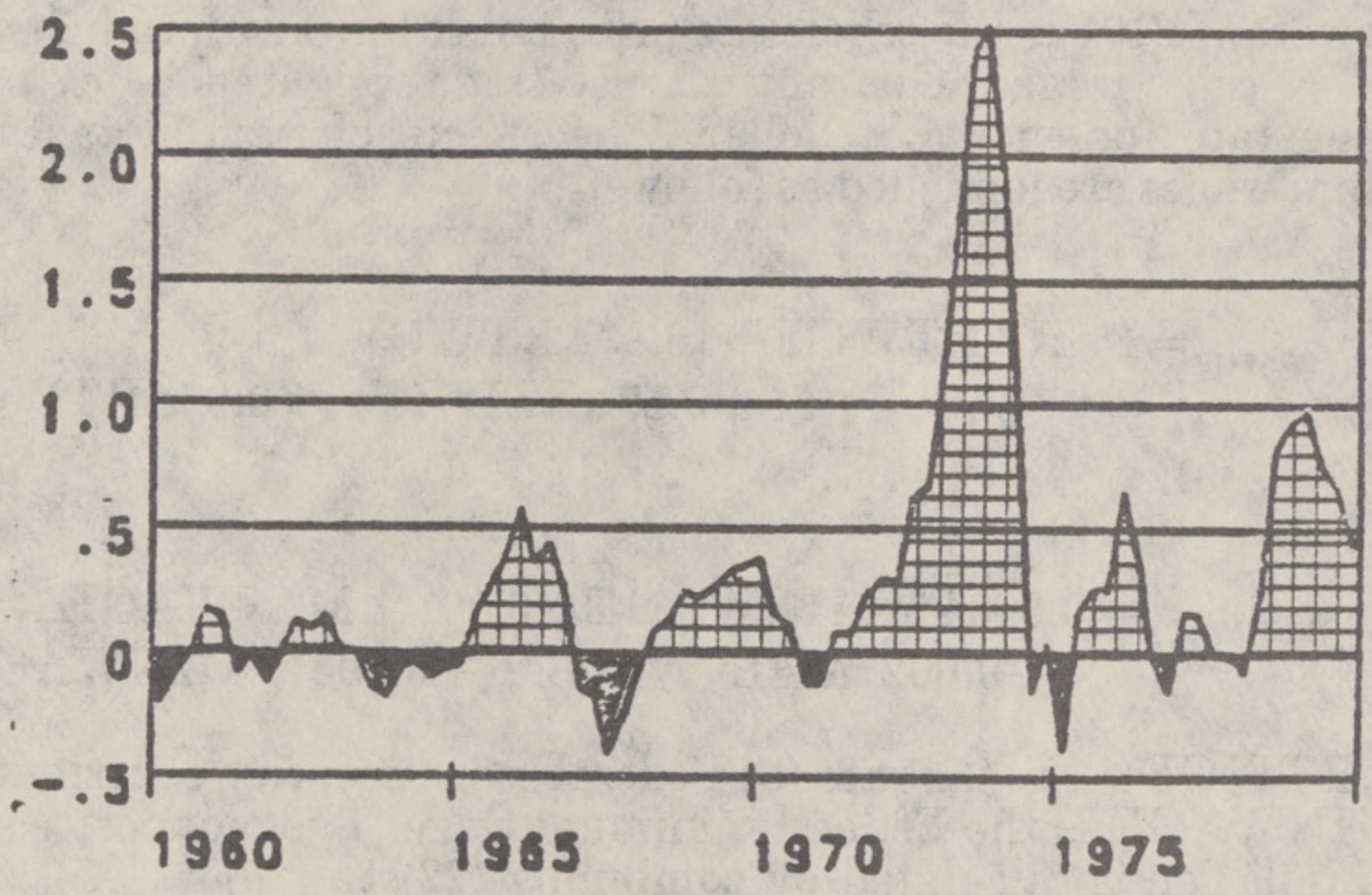
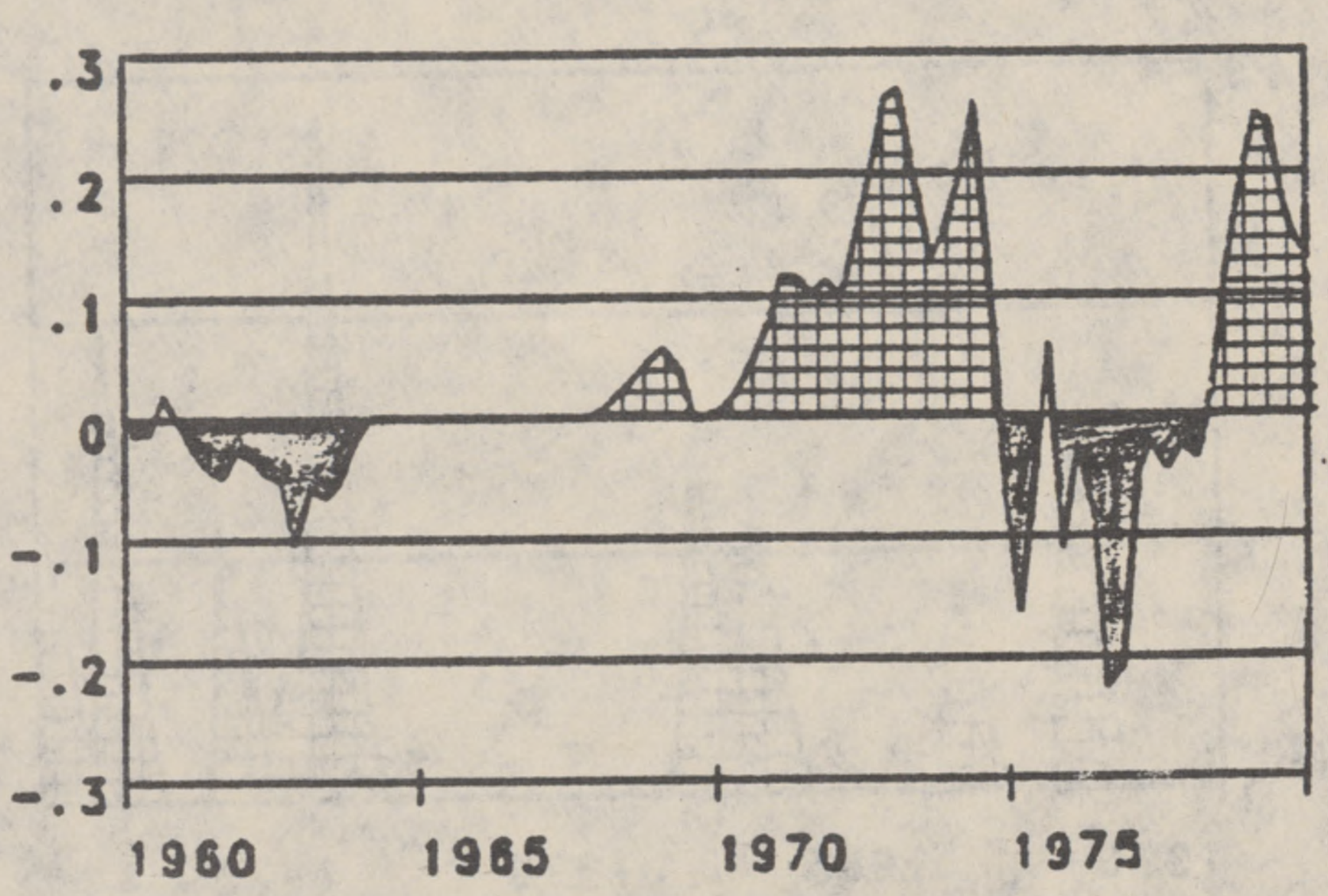
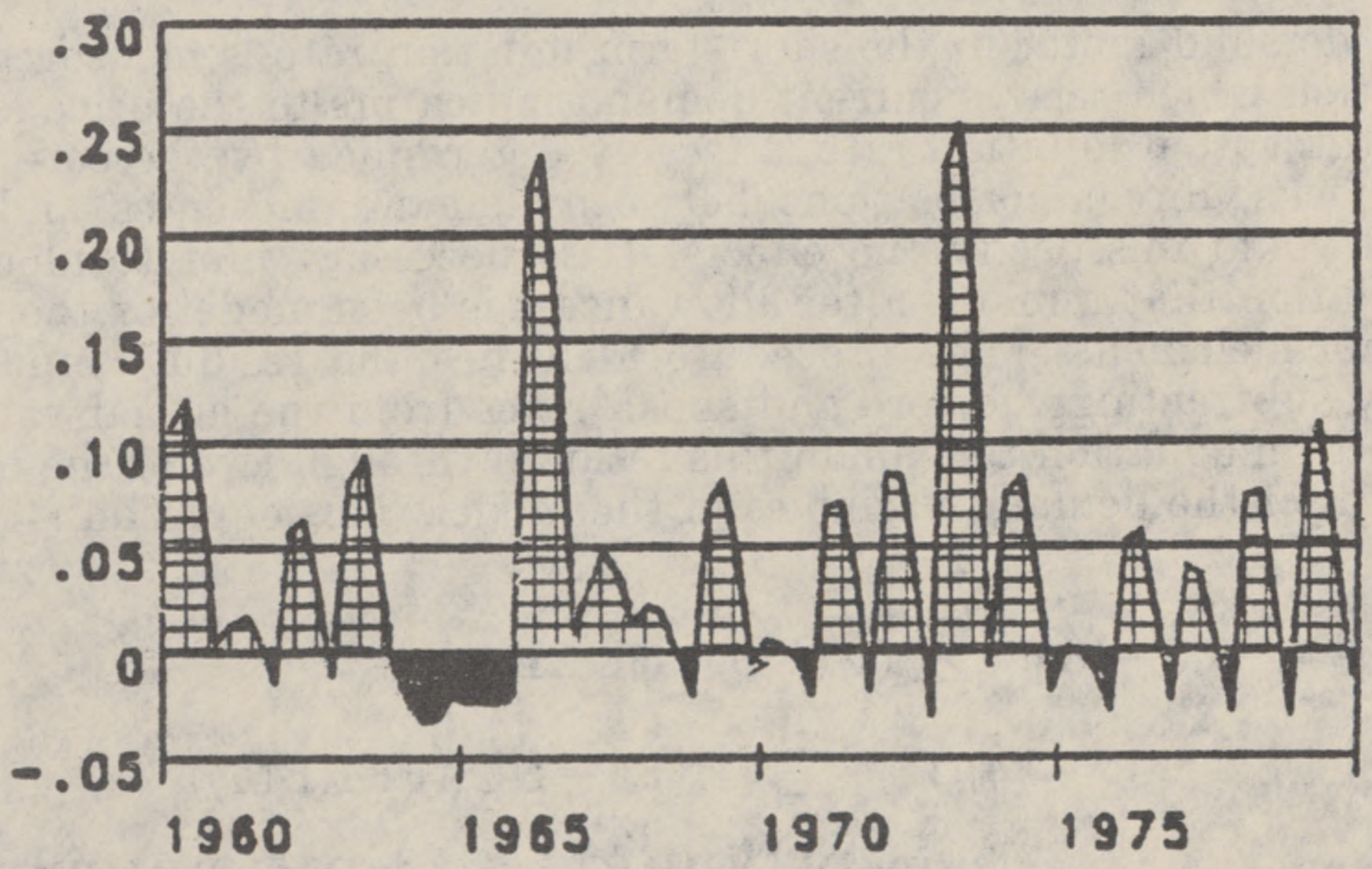


CHART 9.—The Shock Contribution to Inflation (Year-over-year percent change, seasonally adjusted)—Continued

C. Exchange Rate



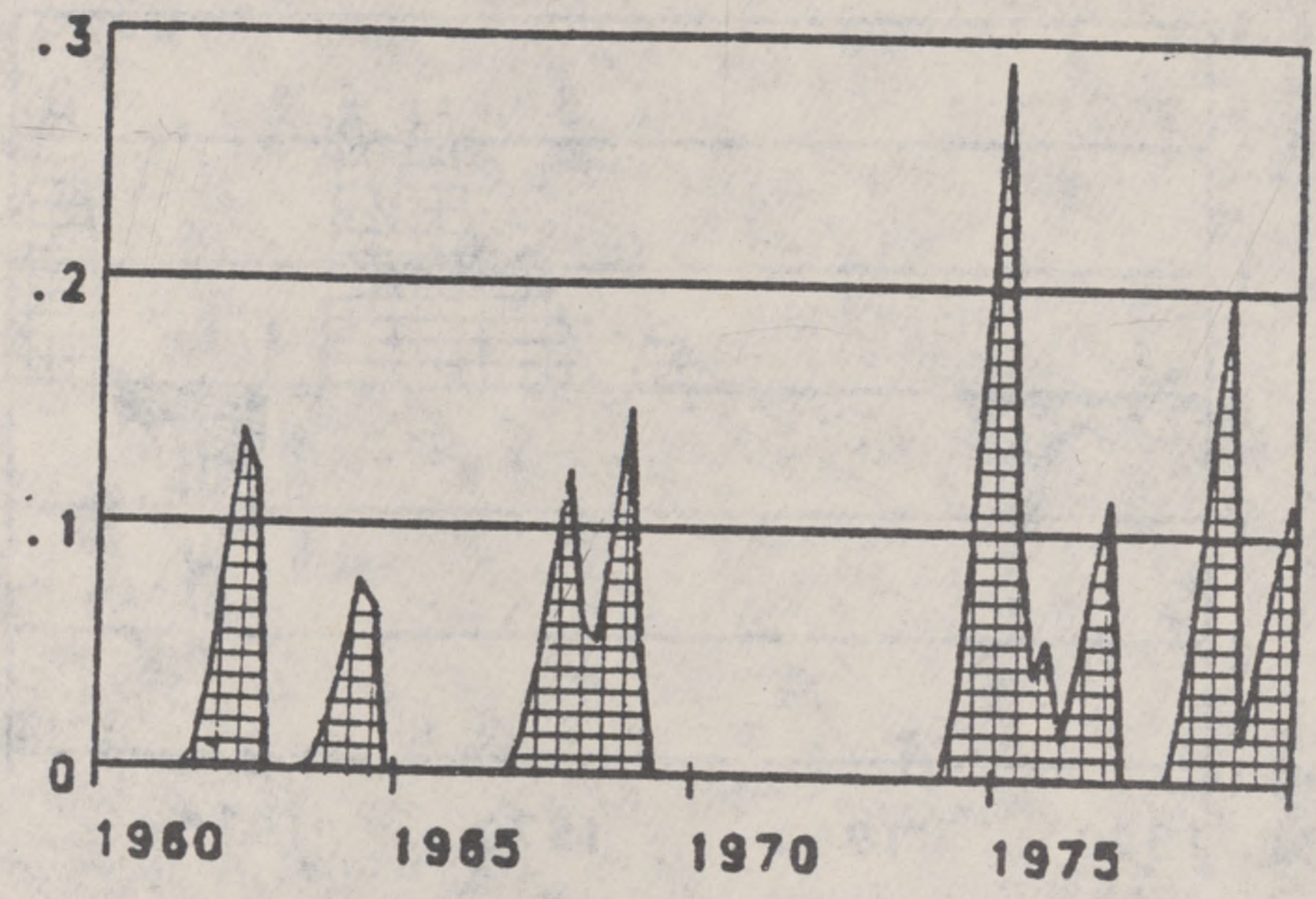
D. Social Security Tax Rate



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CHART 9.—The Shock Contribution to Inflation (Year-over-year percent change, seasonally adjusted)—Continued

E. Minimum Wage



DEMAND INFLATION

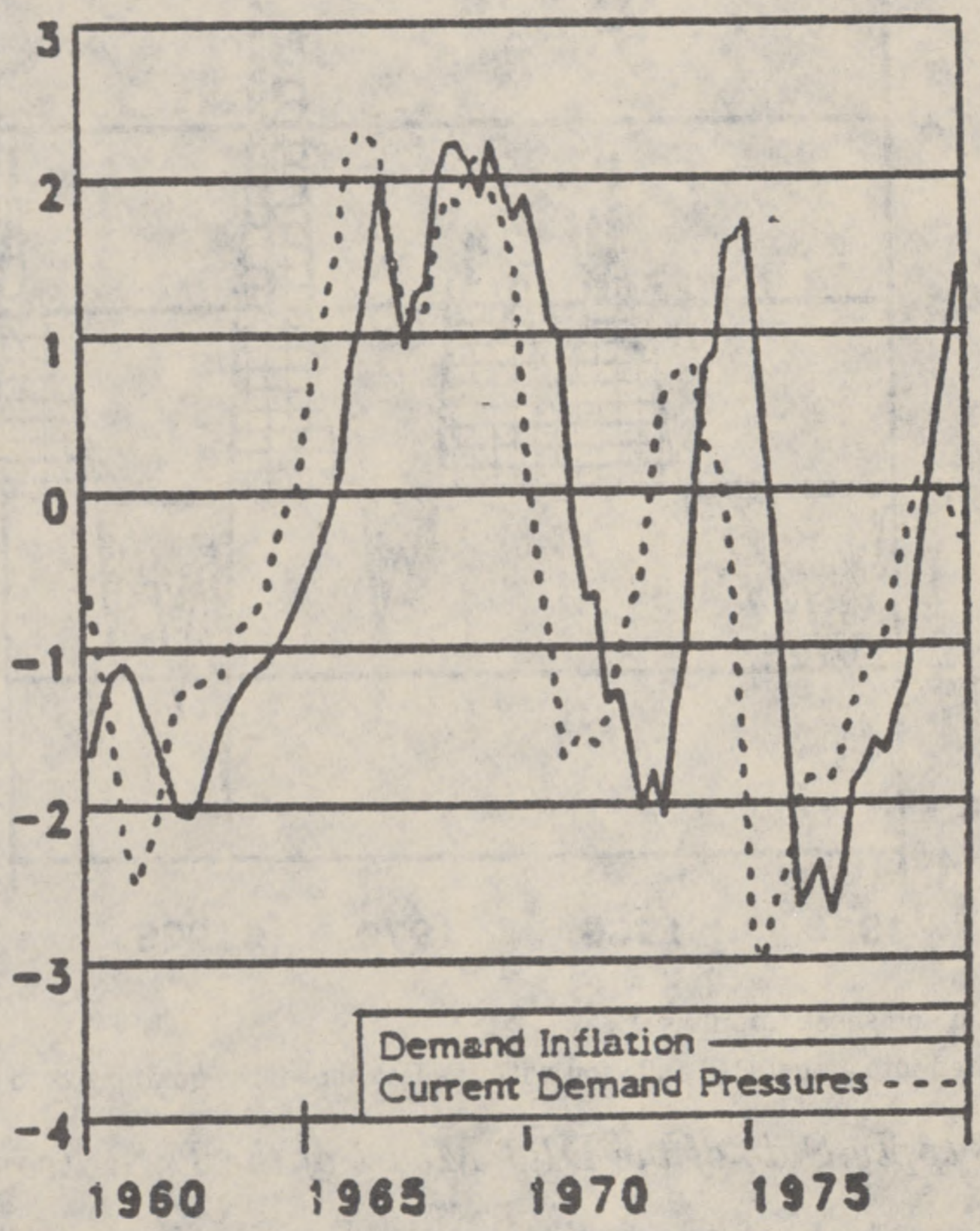
The demand factor in the short-term inflation rate is measured by a function which relates current demand indicators to the price level. Since the actual inflation rate is largely determined by the core rate and shocks, direct correlations between demand measures and inflation would misspecify the effects. It is necessary first to identify the inflation that remains after allowance has been made for the core and shock elements. The procedure identifies the residual inflation rate by subtracting the core and shock rates from the actual values, and uses an equation to explain this residual through two of the more powerful of the demand variables in the model. This equation is

$$(27)\quad p_d = -7.5 + 13.6^* \sum_{t-7}^{t-1} (1/(\mathrm{RU}-\mathrm{RUADJ})) + 1.1^* \sum_{t-7}^{t-1} (1/(1.1-\mathrm{UCAPFRBM})) + 0.19^*\mathrm{DMYPRICE} - 0.07^*\mathrm{DMYPRICECUM}$$

where UCAPFRBM is capacity utilization in manufacturing, RU is the unemployment rate, RUADJ is an adjustment for demographic changes, and DMYPRICE and DMYPRICECUM are dummy variables to capture the effects of the price controls of the early 1970's. The results are captured in Chart 10.

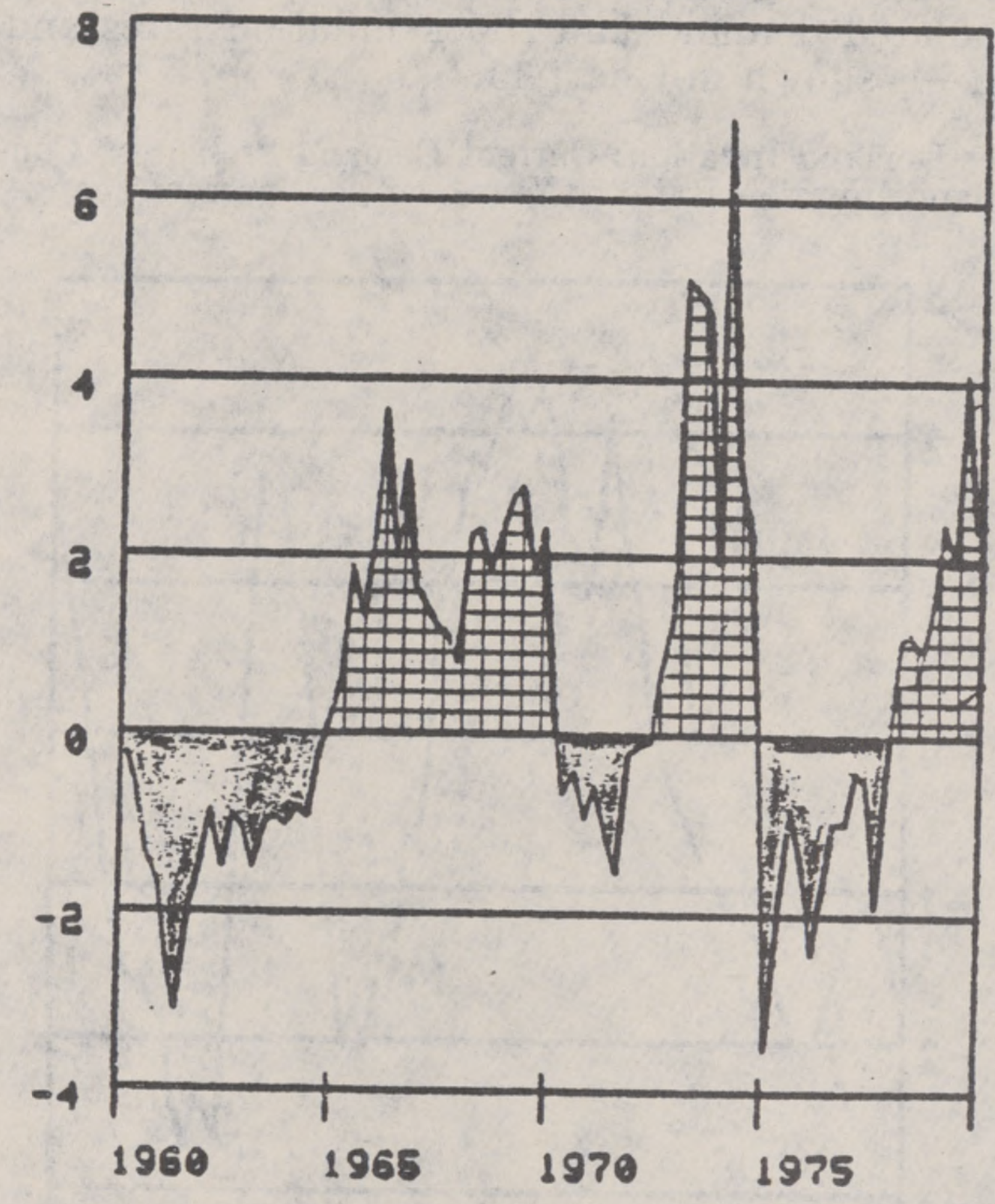
The total "inflation impulse" curve—the current demand and current shock pressures which, with the appropriate lags, translate first into the calculated demand and shock inflation rates and then into core inflation—is shown in Chart 11.

CHART 10.—Demand Inflation: Current Demand Pressures* Compared to Demand Inflation Rate** (Year-over-year percent change)



*Weighted average of current unemployment and current capacity pressures on inflation.
**Current pressures are translated into the demand inflation rate with an average lag of four quarters.

CHART 11.—The Inflation Impulse Curve* (Percent change)



The sum of demand and shock impulses.

* They are translated into actual CPI inflation with the lags shown in equations 22 to 27.

The Supply Side of the DRI Model of the U.S. Economy

Full representation of the inflation process in the spirit of the core analysis required careful modelling of the supply side of the economy. While it is impossible to provide a complete description of the model here,[1] the principal features relating to supply and inflation are summarized. The main equations are printed in the technical appendix.

POTENTIAL GNP

Potential GNP, the supply measure of the economy's ability to produce goods and services, is estimated by an aggregate production function. The factors treated explicitly are capital, labor, energy, and the stock of research and development capital. R. & D. is partly capital enhancing and partly labor enhancing. To reflect the influence of embodied technology future, the average age of the capital stock helps determine potential output. The cyclical influence on factor use is measured by the utilization rate of manufacturing capacity and by the change in average hours worked. The deleterious effect of the tax system on productivity is measured by the average effective rate of personal and payroll taxes.

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[1] For a fuller description of the DRI Macro Model, see Otto Eckstein and Allen Sinai, editors, *The DRI Model of the U.S. Economy,* preliminary version available from DRI, to be published 1980.

To measure potential output, the cyclical variables are set at their full employment values, which for this purpose are defined to be a manufacturing workweek of 40¾ hours, a full employment unemployment rate following the Council of Economic Advisers definition, and a utilization rate of manufacturing capacity of 87 percent. The resultant series is still too volatile, and therefore is smoothed by a second-order Pascal lag with a decay factor of 0.7.

The aggregate supply of labor is derived from an age and sex specific analysis of the participation rates of the population as modified by the unemployment rate, the personal and payroll tax burden and transfer payment disincentive. The demographic aspect of the analysis is external to the macro model, but the modification of the demographic baseline by unemployment and the tax burden is part of the simultaneous block of the model.

The supply of capital is determined by the model's investment equations, with the capital stock depreciated at annual rates of 14.4 percent for producers durable equipment and 5.5 percent for nonresidential structures. Investment spending is calculated from a considerably modified version of the Jorgenson theory.

The supply of research and development capital is estimated in similar fashion. Investment in R. & D. is determined by the cost of capital and the growth of expected output, with depreciation on the stock of R. & D. set equal to 10 percent; technical, industrial knowledge has value for 10 years, no more according to this viewpoint. In a competitive world, deterioration of a fixed stock of knowledge is a realistic viewpoint.

The aggregate supply of energy is exogenous to the model. The demand for energy is calculated from end uses and relative prices. The domestic supply, an exogenous variable, is drawn from the DRI energy model. The residual energy gap is met by inventory variations and imports of foreign oil. Curtailment of world oil supplies requires calculation of model solutions that do not violate the energy supply constraint, or in the event policy fails to accomplish this goal, the calculation of the distorting effects created by the resultant shortages and queues.

Industrial Capacity and Other Supply Effects

Shortages of industrial capacity in materials industries proved to be an effective supply constraint in 1971–73 and 1978–79. The DRI model estimates the capacities of manufacturing, materials, primary processing, and advanced processing industries from the investment estimates of the pertinent two-digit manufacturing industries. Through the embedded input-output table, the model calculates production for these sectors of manufacturing, which are then combined with the capacity estimates to calculate the utilization rates.

The impact of utilization rates on the economy is felt through several channels: First, they are the demand variables in several of the price equations in the stage-of-processing sector of the model. Second, utilization rates are important determinants of vendor performance, a measure of delivery conditions in industrial markets. Vendor performance, in turn, has important effects on industrial prices as well as

on inventory policies which, in turn, strongly affect the demand for industrial output. Thus, there is a significant subloop in the model from industrial capacity to prices to inventories and back to prices. Finally, utilization affects profitability and productivity, and thereby affects the economy as a whole.

Among other supply-oriented features of the DRI model, the supply of finance should be singled out. The behavior of the mortage market, which itself is mainly moved by the supply of personal saving and the partly policy-determined structure of interest rates, strongly affects the housing industry. Nonresidential fixed investment is also affected by the supply of finance, mainly through disequilibria in the balance sheets of the corporate sector.

Effect of Rental Price of Capital on Output Prices

Some modifications have been introduced into the macro model to reflect the findings of the core inflation analysis. The principal innovation is the use of the rental price of capital in the equations for wholesale prices in the stage-of-processing sector. As is well known, most econometric price equations have suffered from a bias, systematically underpredicting the inflation of the last dozen years. The introduction of the rental price of capital reduces this bias. Core inflation is converted into actual inflation through this channel.

Chapter 4. HISTORICAL REVIEW OF CORE INFLATION

A historical analysis of the core inflation rate can help to explain the mechanisms and the reasons for the deteriorating performance of the last 15 years. The actual inflation record has been very volatile. There have been periods of dramatic improvement, such as the near-halving of the inflation rate between 1974 and 1976. But once the record is analyzed through the concepts of core, demand and shock inflation, the periods of improvement prove to be almost entirely due to chance and temporary factors. Conversely, the periods of the worst inflation in 1974–75 and in 1979–80 are also seen to be temporary deviations above fundamental forces.

Core Inflation at the End of the 1950's

The Korean war of 1950–53 and the cost push-sectoral demand inflation of the mid-1950's left a legacy of a core inflation rate of 3.6 percent in 1957. The actual inflation rate also peaked at 3.6 percent in the second quarter of that year, but this figure contained some temporarily bad agricultural price performance and the lagged effects of the high demand that prevailed from late 1955 until early 1957.

For the years 1957 to 1960, the rise in trend unit labor costs averaged 3.1 percent. Equilibrium wage gains averaged 4.6 percent, fueled by the inflation experienced earlier in the decade. The extraordinary wage settlements of 1955–56 kept actual wage costs rising by 4 percent even during the severe 1958 recession. Productivity gave an average performance, averaging 1.5 percent trend growth, though decelerating over those 4 years and pushing unit labor cost gains to 3.8 percent in 1960.

TABLE 3.—CORE, SHOCK, AND DEMAND INFLATION: 1957–60

[Percent change]

	1957	1958	1959	1960
Unit labor cost trend (weight 0.65)	2.8	3.1	2.8	3.8
'Equilibrium' wage gains	4.6	4.8	4.6	4.6
Actual wage gains	5.0	4.0	3.7	3.3
Price expectations	2.0	2.2	2.2	2.1
Unemployment rate (level)	4.3	6.8	5.4	5.5
Productivity trend	1.8	1.7	1.7	0.8
Actual productivity gains	1.9	1.8	3.3	1.0
+Capital cost trend (weight 0.35)	5.0	3.8	2.1	1.8
Actual rental price of capital	4.4	−6.7	3.4	1.0
Aftertax cost of capital	−0.5	−13.4	4.8	1.6
Prime rate (level)	4.20	3.83	4.48	4.82
New high-grade corporation bond rate (level)	4.45	4.02	4.77	4.68
Price expectations	1.9	2.3	2.2	2.1
Dividend-price ratio-S. & P. 500 (level)	4.0	3.8	3.1	3.5
Price deflator-nonresidential investment	5.5	−0.1	1.9	0.4
=Core inflation rate	3.6	3.3	2.6	3.1
Shock inflation rate	0.6	0.1	−0.3	0.1
WPI—Farm products	2.7	4.4	−6.1	−0.3
WPI—Fuels	5.4	−3.9	−0.1	1.0
Trade-weighted exchange rate			0.2	0.4
Social security tax rate (difference)	0.005	0.000	0.006	0.007
Minimum wage (dollars per hour)	1.000	1.000	1.000	1.000
Demand inflation rate	−0.6	−0.5	−1.2	−1.6
Capacity utilization in manufacturing (level)	0.836	0.750	0.816	0.801
Unemployment rate (level)	4.3	6.8	5.4	5.5
Consumer price index	3.4	2.7	0.9	1.5

Capital costs also rose considerably, particularly early in the period. Long-term interest rates rose mainly under the influence of tough policies even though inflation was moderate, producing relatively high real interest rates. Tax policy contained no significant moves during this period. The stock market rose, cutting dividend yields, and thereby lowering the cost of equity capital. The price deflator for nonresidential investment, however, did show significant improvement over those 4 years. As a result, the capital cost trend slowed from a 5.0 percent rate in 1957 to a 1.8 percent rate in 1960.

The shock factor in inflation was mildly helpful in this period. Food prices fell after their unfortunate surge during the trough of the 1958 recession, a surge which produced the first cries of "stagflation." During the recovery of 1959–60, farm prices dropped by over 10 percent. Energy prices drifted lower. The dollar was still strong, even though the first serious payments deficits were emerging. Social security taxes provided periodic shocks. But the total of shock inflation was near zero.

It was the demand factor that pushed the actual inflation results below the core rate. The recession of 1958 was quite severe, with unemployment peaking at 7.4 percent and the utilization rate of manufacturing averaging only 75 percent for the year. The recovery of 1959–60 was modest, holding unemployment above full employment levels and avoiding high industrial utilization rates. These weak demand conditions lowered the inflation rate by over a full percentage point per year between 1957 and 1960.

Ending Core Inflation: Balanced Growth of the Early 1960's

By 1961, the core inflation rate was down to 2.1 percent and edging lower. It eventually dipped below 1 percent in 1965.

How was this achieved? Given the current high core rate and the keen desire to reduce it, the accomplishment of the early 1960's is worthy of careful study. These years, which at the time were not considered years of outstanding economic performance, can now be seen more clearly as a kind of golden age for economic policy.

The elimination of core inflation had several ingredients. First, productivity performance was outstanding between 1960 and 1965. Labor productivity rose at an average rate of 3.5 percent, the best result of the entire postwar period. Once out of the recession of 1960–61, this was an era of strong investment growth and steady increases in the capital-labor ratio. The healthy economic recovery also prevented any cyclical dampening of output per hour. The average annual rate of wage increase, perhaps aided by President Kennedy's guidepost principles, fell to just above 3 percent. It was helped by an unemployment rate which was above normal until the final year of the period, and further affected by the previous record of price stability which kept inflation expectations low. The price expectations variable in the wage equation showed an average value of 1.7 percent for these years.

The trend in capital costs showed an equally positive and striking pattern. The improved inflation record and relatively accommodating monetary policies kept long-term interest rates stable and even left short-term rates at rather low levels in a rising economy. The stock market experienced a boom in the opening years of the decade which helped lower the cost of equity capital, but the crash of 1962 temporarily lost this particular benefit before the market resumed its rise.

TABLE 4.—CORE, SHOCK, AND DEMAND INFLATION: 1960–65

[Percent change]

	1960	1961	1962	1963	1964	1965
Unit labor cost trend (weight 0.65)	3.8	3.0	2.1	1.8	1.4	0.9
'Equilibrium' wage gains	4.6	4.4	4.2	4.1	4.0	3.9
Actual wage gains	3.3	3.2	3.2	2.9	2.6	3.4
Price expectations	2.1	2.0	1.7	1.6	1.6	1.5
Unemployment rate (level)	5.5	6.7	5.6	5.6	5.2	4.5
Productivity trend	0.8	1.4	2.0	2.3	2.6	2.9
Actual productivity gains	1.0	2.8	4.3	3.4	3.5	3.4
+Capital cost trend (weight 0.35)	1.8	0.5	−0.1	0.0	0.1	0.0
Actual rental price of capital	1.0	−5.0	1.3	1.0	−1.5	2.2
Aftertax cost of capital	1.6	−8.6	11.3	2.9	3.1	5.3
Prime rate (level)	4.82	4.50	4.50	4.50	4.50	4.54
New high-grade corporation bond rate (level)	4.68	4.42	4.23	4.25	4.40	4.54
Price expectations	2.1	1.8	1.5	1.5	1.5	1.5
Dividend-Price ratio-S. & P. 500 (level)	3.5	3.0	3.4	3.2	3.0	3.0
Price deflator-nonresidential investment	0.4	−0.7	0.7	0.9	0.9	1.3
=Core inflation rate	3.1	2.1	1.3	1.1	1.0	0.6
Shock inflation rate	0.1	0.0	0.1	−0.1	−0.2	0.3
WPI—Farm products	−0.3	−1.0	1.8	−2.1	−1.5	4.4
WPI—Fuels	1.0	1.1	−0.5	−0.4	−2.7	1.8
Trade-weighted exchange rate	0.4	0.9	1.9	0.4	0.0	0.0
Social security tax rate (difference)	0.007	0.001	0.003	0.005	−0.002	−0.002
Minimum wage (dollars per hour)	1.000	1.049	1.150	1.183	1.250	1.250
Demand inflation rate	−1.6	−1.1	−0.3	0.2	0.5	0.7
Capacity utilization in manufacturing (level)	0.801	0.773	0.814	0.835	0.857	0.895
Unemployment rate (level)	5.5	6.7	5.6	5.6	5.2	4.5
Consumer price index	1.5	1.1	1.2	1.2	1.3	1.6

In addition to low external costs for capital, the Government undertook several major new policies which helped to lower the cost of internally financed capital. The introduction of the investment tax credit and liberalized depreciation methods in 1962 reduced the rental price of capital by 3.3 percent. By 1964, these tax incentive measures also began to show effects in terms of increased investment outlays which further helped productivity performance.

Capital costs contributed nothing to core inflation, being precisely stable. This left labor productivity gains free to offset the wage advances, and gradually to remove the core inflation rate of 3 percent inherited at the beginning of the period. The unit labor cost trend fell to 0.9 percent by early 1965.

The demand factor was mixed during these years. The 1960–61 recession weakened markets, holding manufacturing utilization rates at an average of 79 percent, and pushing the unemployment rate to 6.7 percent for the year 1961. In the years 1963–65, however, the demand factor began to add to inflation, as above-potential growth in real output began to tighten both capital and labor markets. Demand inflation averaged −0.3 percent per year over the entire period.

Shock inflation was absent in those happy years. The price of energy was stable, indeed edging lower. Food prices also showed little change, except for small drops in 1963 and 1964. The exchange rate rose, as the pound and various other currencies fell, to more than offset the appreciation of the German D-mark. The dollar was kept firmly pegged despite payments deficits. On the Government side, payroll taxes were boosted substantially in 1962 and 1963, and the minimum wage also showed some upward revision. But putting together all the measured shock factors, the net contribution for the entire 6-year span was almost precisely zero.

Could this "golden age" have been sustained through the rest of the 1960's? As the following section shows, historical forces began to take over and the happy period of balanced growth, with a slow closing of the gap of unutilized resources, was bound to come to an end.

Core Inflation Begins Again: 1966 to 1970

If core inflation was almost eliminated in 1965, it had deteriorated to 4.1 percent by 1970. The process which destroyed price stability is clear enough: the military expenditures for the Vietnam war, which took on major dimensions in late 1965 and 1966, raised the level of demand to highly inflationary levels. The demand component of inflation had begun to reappear by late 1962, and was running at a 0.7 percent rate of 1965. Thereafter is jumped to 1.4 percent, and averaged 1.6 percent through the end of the decade. This demand component accounts for most of the deterioration of inflation in the early part of the period. Shock inflation remained small, averaging only 0.3 percent a year, mainly due to a large 1966 jump in payroll taxes, a 7.3 percent jump of food prices in 1966 (partly in response to military buying), and significant upward movements of the minimum wage in 1967 and 1968.

As the actual inflation rate began to be driven up by demand forces, price expectations started to deteriorate. Between 1965 and 1968, the deterioration was still small. Price expectations as shown in wage behavior rose from 1.5 percent to 2.4 percent; price expectations as they enter long-term interest rates advanced from 1.5 percent to 2.7 percent. Thereafter expectations speeded up. By the end of 1970, price expectations of labor had jumped to 3.4 percent, of lenders to 3.9 percent.

Productivity began to show the first serious signs of retardation in 1967, growing at an average annual rate of only 1.2 percent for the years 1966–70. The escalation of expenditures on pollution abatement equipment seems to have had a particularly deleterious impact on productivity performance at that time. Productivity provided little offset for the accelerating wage gains, and helped push the unit labor costs trend from 0.9 percent in 1965 to 3.3 percent in 1970.

TABLE 5.—CORE, SHOCK, AND DEMAND INFLATION: 1965–70

[Percent change]

	1965	1966	1967	1968	1969	1970
Unit labor cost trend (weight 0.65)	0.9	1.0	1.3	1.7	2.6	3.3
'Equilibrium' wage gains	3.9	4.0	4.4	4.6	5.2	5.6
Actual wage gains	3.4	4.4	4.9	6.2	6.7	6.7
Price expectations	1.5	1.7	2.0	2.4	2.9	3.4
Unemployment rate (level)	4.5	3.8	3.8	3.6	3.5	5.0
Productivity trend	2.9	3.1	3.0	2.9	2.5	2.2
Actual productivity gains	3.4	2.5	1.6	3.2	−0.2	0.1
+ Capital cost trend (weight 0.35)	0.0	0.9	2.1	2.2	3.7	5.6
Actual rental price of capital	2.2	6.4	0.1	6.8	11.1	5.6
Aftertax cost of capital	5.3	3.8	−6.3	1.7	−1.3	−3.7
Prime rate (level)	4.54	5.63	5.63	6.28	7.95	7.91
New high-grade corporate bond rate (level)	4.54	5.44	5.77	6.48	7.68	8.50
Price expectations	1.5	1.8	2.2	2.7	3.3	3.9
Dividend-price ratio-S. & P. 500 (level)	3.0	3.3	3.2	3.1	3.2	3.8
Price deflator-nonresidential investment	1.3	3.0	3.3	4.2	4.7	5.4
= Core inflation rate	0.6	0.9	1.6	1.9	3.0	4.1
Shock inflation rate	0.3	0.7	0.0	0.2	0.5	0.4
WPI—Farm products	4.4	7.3	−5.6	2.5	6.4	1.7
WPI—Fuels	1.8	2.5	2.3	−1.1	2.0	5.3
Trade-weighted exchange rate	0.0	0.0	−0.1	−1.3	−0.1	−2.5
Social security tax rate (difference)	−0.002	0.014	0.003	0.001	0.004	0.000
Minimum wage (dollars per hour)	1.250	1.250	1.387	1.583	1.600	1.600
Demand inflation rate	0.7	1.4	1.2	2.1	2.0	1.4
Capacity utilization in manufacturing (level)	0.895	0.911	0.869	0.870	0.862	0.794
Unemployment rate (level)	4.5	3.8	3.8	3.6	3.5	5.0
Consumer price index	1.6	3.0	2.8	4.2	5.4	5.9

The rental price of capital also began to rise more rapidly under pressure from the response of long-term interest rates to inflation, war-induced strains on the financial system, dramatic stop-go monetary policies in 1966 and 1969–70, and the two-stage collapse of the stock market in association with those credit crunch episodes. As a result, the core inflation rate was up to 4.1 percent by 1970, while the actual inflation rate reached a substantially worse figure of 5.9 percent, principally due to the inflationary excess demand levels of 1968 and 1969.

Slow Deterioration: 1970–73

The core inflation rate edged up slightly from 4.1 percent in 1970 to 4.4 percent in 1973. This performance was overshadowed by President Nixon's price controls program of August 1971, which improved the actual inflation record from 1970's 5.9 percent bulge to a trough figure of 3.3 percent in 1972.

Worsening core inflation was in large part due to the persistence phenomena injected by price expectations into wages and capital costs. Even though unemployment rose to 6 percent as a result of the 1970 recession, wages kept rising near 7 percent rates because inflation expectations had taken root in the period of excess demand. Wage controls seem to have made little difference.

TABLE 6.—CORE, SHOCK, AND DEMAND INFLATION: 1970–73

[Percent Change]

	1970	1971	1972	1973
Unit labor cost trend (weight 0.65)	3.3	3.7	4.1	4.3
'Equilibrium' wage gains	5.6	5.8	5.9	5.8
Actual wage gains	6.7	7.1	6.5	6.2
Price expectations	3.4	3.8	4.0	4.0
Unemployment rate (level)	5.0	6.0	5.6	4.9
Productivity trend	2.2	2.1	1.7	1.4
Actual productivity gains	0.1	3.1	3.6	1.7
+ Captial cost trend (weight 0.35)	5.6	5.5	4.3	4.4
Actual rental price of capital	5.6	−0.1	2.6	11.8
Aftertax cost of capital	−3.7	−0.8	3.1	12.0
Prime rate (level)	7.91	5.70	5.25	8.02
New high-grade corporate bond rate (level)	8.50	7.36	7.16	7.65
Price expectations	3.9	4.2	4.1	4.1
Dividend-price ratio-S. & P. 500 (level)	3.8	3.1	2.8	3.0
Price deflator-nonresidential investment	5.4	5.6	3.8	3.8
= Core inflation rate	4.1	4.3	4.2	4.4
Shock inflation rate	0.4	0.7	0.8	2.9
WPI—Farm products	1.7	1.7	10.7	41.0
WPI—Fuels	5.3	8.5	3.0	13.2
Trade-weighted exchange rate	−2.5	−2.9	−6.1	−5.9
Social security tax rate (difference)	0.0	0.004	0.004	0.014
Minimum wage (dollars per hour)	1.600	1.600	1.600	1.600
Demand inflation rate	1.4	−0.7	−1.7	−1.1
Capacity utilization in manufacturing (level)	0.794	0.784	0.835	0.876
Unemployment rate (level)	5.0	6.0	5.6	4.9
Consumer price index	5.9	4.3	3.3	6.2

The trend of capital costs also remained unfavorable. It had reached the 2-to-4 percent range in the years 1967 to 1969, surged in 1970 under the impact of the credit crunch and the collapse of the stock market, and then showed some small improvement to 4.4 percent in 1972–73. Only the tax cuts of 1971–72, including the restoration of the investment credit, helped to hold down the rental price of capital. .

Actual productivity benefited from a cyclical upswing, averaging 3.4 percent annual gains in 1971–72. However, the productivity trend continued the downward path that had begun in the mid-1960's.

Excess demand became a problem once more in 1972 and 1973. Industrial utilization rates were driven up by domestic strength following the President's new economic policy and the worldwide boom of industrial countries. Unemployment reached full employment levels, but not an excess demand rate.

The actual inflation experience was considerably more variable than the behavior of the core rate. In 1971 and 1972, the price controls held down actual prices, while the shock inflation rate averaged a modest 0.7 percent. By 1973, the volatile elements took over, and the explosion of food prices following disappointing crops and the mammoth Russian wheat sales, helped contribute to the creation of a 2.9 percent shock factor for that year. The other major shock of this period was the beginning of the end of the stable foreign exchange rate. In August 1971, the dollar lost its traditional parity, and the subsequent drop boosted the prices of imported materials and finished goods. The year 1973 also saw a large 1.4-percentage-point boost in social security tax rates, and the first alarming signs appeared in world oil markets to set the stage for the dramatic OPEC events at the end of that year.

The interval 1970–73, when the economic burden of the Vietnam war had passed its peak, created an opportunity for reversing the disturbing trend of the core inflation rate. The opportunity was missed. Capital costs created by the credit crunch of 1969–70 and the learning process determining wage claims boosted core inflation. The weakening productivity trend also was a factor. Demand inflation was hidden by price controls, but the supressed inflation turned into catch-up inflation in 1974–75, after the controls collapsed as a byproduct of Watergate and the Presidential turnover. The food shock and the beginnings of the oil shock also helped set the stage for the dramatically worse experience in the following period.

Core Inflation Explodes, 1974–79

If the development of a core inflation rate of 4.4 percent in the years 1965 to 1973 was disturbing, the subsequent surge to over 8 percent by early 1979 was more worrisome. From 1973 on, the shock factors took over, initially worsening the actual inflation rate, but gradually also driving up the core inflation rate through their impact on expectations.

The rate of wage increase accelerated from 6.2 percent in 1973 to 7.2 percent by 1976. In the succeeding 3 years, it showed only a small further increase, as workers found themselves unable to maintain their real purchasing power in the face of the OPEC price increases. The moderation of wages was due to the high unemployment of the Great Recession of 1974–75 and the large labor force growth which kept unemployment high until 1978. Labor markets were fairly loose, and increasing economic uncertainties seem to have had a cautionary effect on union demands. President Carter's price and pay policy begun in October 1978 may also have had some moderating effect on the wages of unorganized workers.

TABLE 7.—CORE, SHOCK, AND DEMAND INFLATION: 1973–79

[Percent change]

	1973	1974	1975	1976	1977	1978	1979
Unit labor cost trend (weight 0.65)	4.3	5.7	7.4	6.6	6.4	6.5	7.0
'Equilibrium' wage gains	5.8	6.9	8.4	8.1	7.7	7.7	8.1
Actual wage gains	6.2	8.0	8.3	7.2	7.6	8.1	8.1
Price expectations	4.0	5.0	6.5	6.8	6.6	6.4	6.7
Unemployment rate (level)	4.9	5.6	8.5	7.7	7.0	6.0	5.8
Productivity trend	1.4	1.1	0.9	1.4	1.2	1.2	1.0
Actual productivity gains	1.7	−3.2	1.9	3.5	1.6	0.5	−1.2
+ Capital cost trend (weight 0.35)	4.4	6.6	8.9	9.7	10.0	10.3	10.4
Actual rental price of capital	11.8	16.8	8.9	10.3	10.9	10.4	10.5
Aftertax cost of capital	12.0	9.5	−4.1	7.2	6.3	5.4	7.2
Prime rate (level)	8.02	10.80	7.86	6.84	6.82	9.06	12.67
New high-grade corporate bond rate (level)	7.65	8.96	9.01	8.33	8.06	8.88	9.86
Price expectations	4.1	5.6	7.4	7.1	6.4	6.1	6.6
Dividend-price ratio—S. & P. 500 (level)	3.0	4.3	4.3	3.8	4.5	5.2	5.3
Price deflator-nonresidential investment	3.8	11.1	14.7	4.8	5.8	7.7	8.5
= Core inflation rate	4.4	6.0	7.9	7.7	7.7	7.8	8.2
Shock inflation rate	2.9	3.8	1.2	0.6	0.8	1.0	2.3
WPI—Farm products	41.0	6.5	−0.5	2.3	0.7	10.5	13.5
WPI—Fuels	13.2	55.0	17.7	8.3	13.8	6.7	26.6
Trade-weighted exchange rate	−5.9	1.2	0.7	2.8	0.8	−6.0	−1.0
Social security tax rate (difference)	0.014	0.004	−0.001	0.003	0.001	0.003	0.006
Minimum wage (dollars per hour)	1.600	1.867	2.100	2.300	2.300	2.650	2.900
Demand inflation rate	−1.1	1.2	0.1	−2.6	−1.9	−1.2	0.7
Capacity utilization in manufacturing (level)	0.876	0.838	0.729	0.795	0.819	0.844	0.857
Unemployment rate (level)	4.9	5.6	8.5	7.7	7.0	6.0	5.8
Consumer price index	6.2	11.0	9.2	5.7	6.5	7.7	11.2

While wages were moderate, the productivity offset was disastrous. Productivity growth could not hold up under the burden of energy costs and a stagnation in the growth in the capital stock. The gain in labor productivity from 1973 to 1979 was below 1 percent a year, so that the acceleration in the unit labor cost trend became extraordinary, moving from the 3.9 percent average of the previous interval to 6.6 percent for the later years.

The acceleration of capital costs was even more dramatic. The extended history of inflation was now beginning to work its way more extensively into long-term interest rates and price-earnings ratios. The capital cost trend, which had been rising by 4.4 percent in 1973, was rising at 10.3 percent in 1978 and 10.4 percent in 1979. Tax policy had done nothing to lower capital costs, indeed the temporary tightening of capital gains taxation probably served to raise equity capital costs even further. The changes in statutory corporate tax rates were small.

In the years 1976 to 1978, the actual inflation rate was below the core rate. The demand factor turned dramatically negative in the recession, lowering utilization rates to an average of 78 percent for 1975–77 and boosting unemployment to an average 7.7 percent. Shock inflation also backed away from the extreme values associated with the food and OPEC price explosions of 1973 and 1974. The improvement in food prices, which rose at only a 0.9 percent rate from 1974 to 1977, and a temporary recovery of the dollar associated with the dramatic improvement in our international trade position during the recession, also helped to bring about the extraordinarily sharp improvement of inflation performance to a 6.1 percent average for the first 2 years of the recovery, 1976–77.

Better actual performance led policymakers into believing that the inflationary danger was reduced and that the double-digit experience of 1974 was a one-time phenomenon that could be identified with

OPEC. But the experience of 1978–79, when the inflation rate surged ahead of the core rate again, was a sharp reminder that there really had been no improvement in the fundamentals. The core rate was flat at 7.8 percent, until it resumed its rise to reach a late-1979 peak level of 8.4 percent.

Capital costs were the most dramatic factor in the deterioration. As long-term interest rates kept rising, the stock market kept falling in relation to earnings, and tax moves were not particularly helpful. The rental price of capital accelerated from its 1974 trend of 6.6 percent to a sharply higher 1975 result of 8.9 percent and a 1979 figure of 10.4 percent. Labor costs, on the other hand, did not make a big contribution.

The year 1979 saw another round of worsening core inflation. OPEC increases together with the runup of food prices made for a 1979 shock factor of 2.3 percent. Demand also reached inflationary levels late in 1978, with utilization rates approaching 87 percent. Inadequate capital formation had led to high utilization rates as excessively easy fiscal and monetary policies drove demand against the ceiling of productive potential. Thus, as the year 1979 closed, the core rate was at an alltime peak of 8.4 percent. Prospects were grim with more OPEC increases occurring and payroll tax increases ahead.

Chapter 5. IMPROVING CORE INFLATION: LIMITS OF DEMAND MANAGEMENT IN A WORLD OF SHOCKS

The last 14 years of worsening core inflation provide a discouraging background for discussion of the Nation's inflation prospects. But there is the happy experience of the early 1960's, when the core inflation rate was completely removed over a period of 5 years. Have we lost the recipe for improvement? It would be premature to reach that conclusion when efforts to reverse the situation have just begun.

Baseline Prospects for the Economy

What are the prospects for the U.S. economy if policies are little changed? A DRI model solution has been developed which makes the following assumptions:

OPEC prices increase 4 percent a year in real terms, i.e., oil rises by the U.S. inflation rate plus 4 percent;

The statutory increases in social security taxes are allowed to occur, i.e., there is no rollback of the huge jumps in the income base and rate in 1981, and there are further modest increases throughout the course of the decade;

The Federal budget grows by an average of 2.1 percent a year in real terms from 1979 to 1990, with transfer payments to persons growing somewhat more rapidly but grants-in-aid to States showing little increase. The defense budget in these assumptions rises by 2.6 percent a year;

Tax policy includes modest 1981 reductions of personal taxes and the beginnings of depreciation reform. Thereafter across-the-board personal income tax cuts slow the rate of increase in the real burden of income taxation from the 1.2 percent of the last decade to 0.6 percent for the first half of the 1980's;

Monetary policy expands nonborrowed bank reserves at 6.0 percent a year, which is sufficient to avoid credit disturbances while holding the growth of monetary aggregates to mildly disinflationary rates; and

The 1980–81 recession is relatively mild, with unemployment rising only to 7.6 percent and dropping to 6.5 percent in the succeeding 2½ years of recovery. Personal saving remains at historically low figures, averaging just 4.0 percent for the decade.

What would be the prospects for productivity, capital formation, core and actual inflation, financial markets, international trade position, and real activity under these baseline assumptions? Table 8 summarizes the results of a DRI model solution. Highlights for the years 1980–90 include:

Potential GNP advances by 2.7 percent, a sharp contrast to the 3.5 percent average of the preceding 20 years;

The capital stock increases at a 3.2 percent rate, up from the 2.5 percent rate of the last 5 years but still well below the 4 percent long-term average;

Productivity growth remains sluggish, averaging a 1.8 percent rate of advance;

The core inflation rate shows no improvement, indeed worsens to over 9 percent for most of the next 5 years; the actual inflation rate (CPI) escapes from the current double-digit territory but still remains in the high 8.5–9 percent range through the mid-1980's. Some deceleration in both the core and actual inflation rates occurs over the rest of the decade;

The investment ratio, the percent of nominal GNP ploughed back into nonresidential fixed investment averages 10.7 percent;

Real disposable income advances at a 2.8 percent rate, while real income per capita advances 1.9 percent;

Housing starts average 2.05 million units, which produces an increase in the Nation's housing stock of just 1.6 percent a year;

The Government deficit averages $14.9 billion a year, 1980–84, then turns to an average annual surplus of $35.6 billion, 1985–90;

Long-term interest rates, reflecting the high inflation, average 11.06 percent as measured by AA utility bonds; and

Short-term interest rates remain very high as well, with the bank prime rate averaging 11.62 percent.

TABLE 8.—BASELINE PROSPECTS FOR THE U.S. ECONOMY

SUMMARY

	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
Policy (billions of current dollars):												
Average tax lifetime (years) producer's durable equipment	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1
Investment tax credit (rate)	0.084	0.086	0.086	0.086	0.086	0.086	0.086	0.086	0.086	0.086	0.086	0.086
Corporate profit tax accruals	77.9	75.1	83.5	97.5	105.2	112.1	139.9	163.7	189.2	195.1	197.4	224.3
Macroeconomic effects (percent change):												
Real GNP	2.3	−0.7	2.3	4.3	3.1	2.6	3.2	3.9	4.7	2.7	2.2	3.0
Total consumption	2.6	0.4	1.6	3.8	3.3	2.7	3.1	3.2	4.6	3.4	2.7	2.7
Nonresidential fixed investment	5.8	−1.9	−1.1	4.4	3.9	1.6	4.1	8.2	8.1	3.3	1.6	4.2
Investment in residential structures	−6.2	−17.1	11.4	15.4	2.9	2.2	3.9	11.8	4.9	−6.1	−5.1	2.6
Net exports (billions of dollars)	17.8	24.2	27.3	27.4	28.6	32.5	34.1	33.6	33.6	33.2	35.3	38.4
Government purchases	0.3	1.2	1.3	2.2	2.0	2.2	2.4	2.5	2.5	2.5	2.6	2.4
Long-run supply (percent change):												
Labor force	2.5	1.8	1.8	2.1	1.7	1.4	1.3	1.3	1.3	1.3	1.3	1.0
Capital stock	3.8	3.0	2.5	2.7	2.8	2.7	2.8	3.4	4.0	3.8	3.5	3.5
Output per hour	−1.1	−2.0	0.4	1.6	1.6	1.9	2.5	3.3	3.9	2.3	1.8	2.6
Potential GNP	3.3	2.9	2.7	2.7	2.7	2.7	2.7	2.6	2.6	2.6	2.6	2.6
Inflation and unemployment (percent change):												
Core inflation rate	8.2	9.1	9.5	9.4	9.6	9.3	8.8	8.4	7.9	7.6	7.2	6.6
Consumer price index	11.2	11.7	9.5	9.1	8.5	8.0	8.3	8.1	7.3	7.2	7.1	7.2
Average hourly earnings	8.0	8.7	9.4	9.5	9.7	9.7	9.6	9.2	9.0	9.0	8.7	8.5
Real wages	−0.8	−1.7	0.0	0.7	1.4	1.7	1.5	1.5	1.9	2.1	2.0	1.8
Unemployment rate (rate)	5.8	6.8	7.5	7.0	6.7	6.7	6.5	6.3	5.6	5.3	5.4	5.4
Capacity utilization (level)	0.857	0.808	0.811	0.851	0.858	0.850	0.862	0.879	0.882	0.869	0.855	0.865
Financial markets (percent change):												
Rental price of capital	10.4	7.6	12.8	15.9	11.9	7.8	8.2	8.2	8.5	7.3	4.2	6.1
Prime rate (rate)	12.67	13.55	11.12	11.73	12.14	12.21	11.48	10.95	11.12	11.78	11.21	10.47
New high-grade corporate bond rate (rate)	9.86	11.22	10.54	10.84	11.03	10.87	10.76	10.66	10.53	10.39	10.14	9.97

CORE INFLATION

	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
Unit labor cost trend (weight 0.65)	8.6	9.2	8.6	8.3	7.9	7.6	7.5	7.1	6.8	6.6	6.3
'Equilibrium' wage gains	9.1	9.8	9.9	9.9	9.7	9.5	9.4	9.1	8.8	8.6	8.4
Actual wage gains	8.7	9.4	9.5	9.7	9.7	9.6	9.2	9.0	9.0	8.7	8.5
Price expectations	7.7	8.5	8.7	8.7	8.6	8.4	8.2	7.9	7.5	7.2	7.0
Unemployment rate (level)	6.8	7.5	7.0	6.7	6.7	6.5	6.3	5.6	5.3	5.4	5.4
Productivity trend	0.5	0.6	1.2	1.5	1.7	1.8	1.8	1.9	1.9	1.9	1.9
Actual productivity gains	−1.9	0.4	1.6	1.6	1.9	2.5	3.3	3.9	2.3	1.8	2.6
+Capital cost trend (weight 0.35)	10.2	9.9	10.8	12.0	11.9	10.9	10.1	9.5	9.0	8.2	7.2
Actual rental price of capital	7.6	12.8	15.9	11.9	7.8	8.2	8.2	8.5	7.3	4.2	6.1
Aftertax cost of capital	−1.7	3.0	7.4	3.0	−0.9	−0.8	0.1	1.3	0.2	−3.3	−1.1
Prime rate (level)	13.6	11.1	11.7	12.1	12.2	11.5	11.0	11.1	11.8	11.2	10.5
New high-grade corporate bond rate (level)	11.2	10.5	10.8	11.0	10.9	10.8	10.7	10.5	10.4	10.1	10.0
Price expectations	7.8	8.7	8.8	8.6	8.3	8.0	7.8	7.5	7.1	6.8	6.6
Dividend-price ratio-S&P 500 (level)	5.5	5.9	6.7	7.3	7.0	6.1	5.6	5.6	6.0	5.5	5.2
Price deflator-nonresidential investment	8.7	10.0	9.8	9.3	8.3	8.2	7.5	6.8	6.6	6.2	6.2
=Core inflation rate	9.1	9.5	9.4	9.6	9.3	8.8	8.4	7.9	7.6	7.2	6.6

This baseline simulation may appear pessimistic in terms of some of the long-term trends embodied in it, but it is optimistic in its assumptions about energy and other unpredictable factors. OPEC prices and supplies, agricultural prices, unpredictable elements in consumer and business spending, stop-go policies by the Federal Reserve or the Federal budget, regulatory policies, runs on the dollar and other such factors could make the path more unstable and thereby also deteriorate the trends significantly. Thus, it is not a worst case, just a mildly optimistic trend projection in the absence of major shocks with policies which aim at relatively high resource utilization and do not focus on productivity or capital formation.

TABLE 9.—SHOCK INFLATION: 1980–85, AN OPTIMISTIC VIEWPOINT

[Percent change]

	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
Shock inflation rate	2.6	1.9	1.4	1.1	1.0	1.3	0.9	0.9	0.9	0.8	0.8
WPI—Farm products	1.9	8.2	7.8	7.2	6.8	7.2	7.0	6.5	6.2	6.0	6.1
WPI—Fuels	46.5	25.6	18.7	12.9	11.4	17.6	10.7	10.4	11.0	10.3	10.3
Trade-weighted exchange rate	−1.4	−1.5	−1.5	−0.5	−0.3	0.2	0.2	0.0	0.0	0.0	0.0
Social security tax rate (difference)	0.002	0.008	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
Minimum wage (dollars per hour)	3.10	3.35	3.60	3.85	4.10	4.40	4.70	5.00	5.35	5.70	6.05

Limits of Demand Management

What would it take to reduce the core inflation rate through tougher demand management alone, given the apparently inescapable push from shock inflation? Table 10 summarizes a model solution in which the core inflation rate is brought down by 1 percentage point by 1985. To achieve this gain in the core inflation rate requires an increment of average unemployment of over 2 percent by 1985. Thus, demand management would have to aim at an unemployment rate of 8 percent following the small 1980–81 recession.

TABLE 10.—EFFECTS OF DEMAND MANAGEMENT ON CORE INFLATION

[Difference from baseline path]

	1980	1981	1982	1983	1984	1985
Core inflation rate (difference in rate of change)	0.0	−0.1	−0.3	−0.6	−0.9	−1.0
Percent difference:						
Real GNP (1972 dollars)	−1.0	−3.0	−4.0	−4.6	−5.1	−6.0
Total consumption	−0.7	−2.5	−3.8	−4.7	−5.5	−6.5
Nonresidential fixed investment	−0.5	−2.4	−3.4	−2.4	−1.3	−1.0
Investment in residential structures	−0.2	0.6	6.2	15.0	21.3	20.3
Net exports	−0.8	10.1	31.4	39.9	40.1	46.0
Government purchases	−2.1	−5.4	−8.7	−11.8	−14.4	−16.8
Imported fuel price	0.0	0.0	−0.3	−0.9	−1.6	−2.5
Personal consumption deflator	0.0	0.0	−0.3	−0.9	−1.6	−2.5
Output per hour	−0.4	−1.2	−1.4	−1.2	−1.2	−1.5
Potential GNP	0.0	−0.1	−0.2	−0.4	−0.6	−0.7
Unemployment rate [1]	0.2	0.9	1.4	1.6	1.8	2.1
Capacity utilization [1]	0−.01	−0.04	−0.04	−0.03	−0.03	−0.04

[1] Difference in level.

It is disappointing that the trade-off between unemployment and core inflation is only 2 to 1 even after 5 years, but it should not be all that surprising in light of the analysis. The economy's problems are not really solved except for the elimination of excessively aggressive fiscal and monetary policies. The imbalance between the suppy of labor and capital continues so that the utilization rate of industry averages 82 percent in the years 1982–85, even though unemployment averages 7.9 percent. The unemployment level is clearly deflationary, but the utilization rate of physical capital is not far from its equilibrium rate. In other words, the imbalance in the structure of production, in which there is an inadequate supply of basic industrial capacity compared to the supply of labor, continues to be damaging and limits the benefits of holding down aggregate demand. Lack of improvement is also due to the continuing shocks to the system from energy which indirectly serve to raise the noninflationary rate of unemployment.

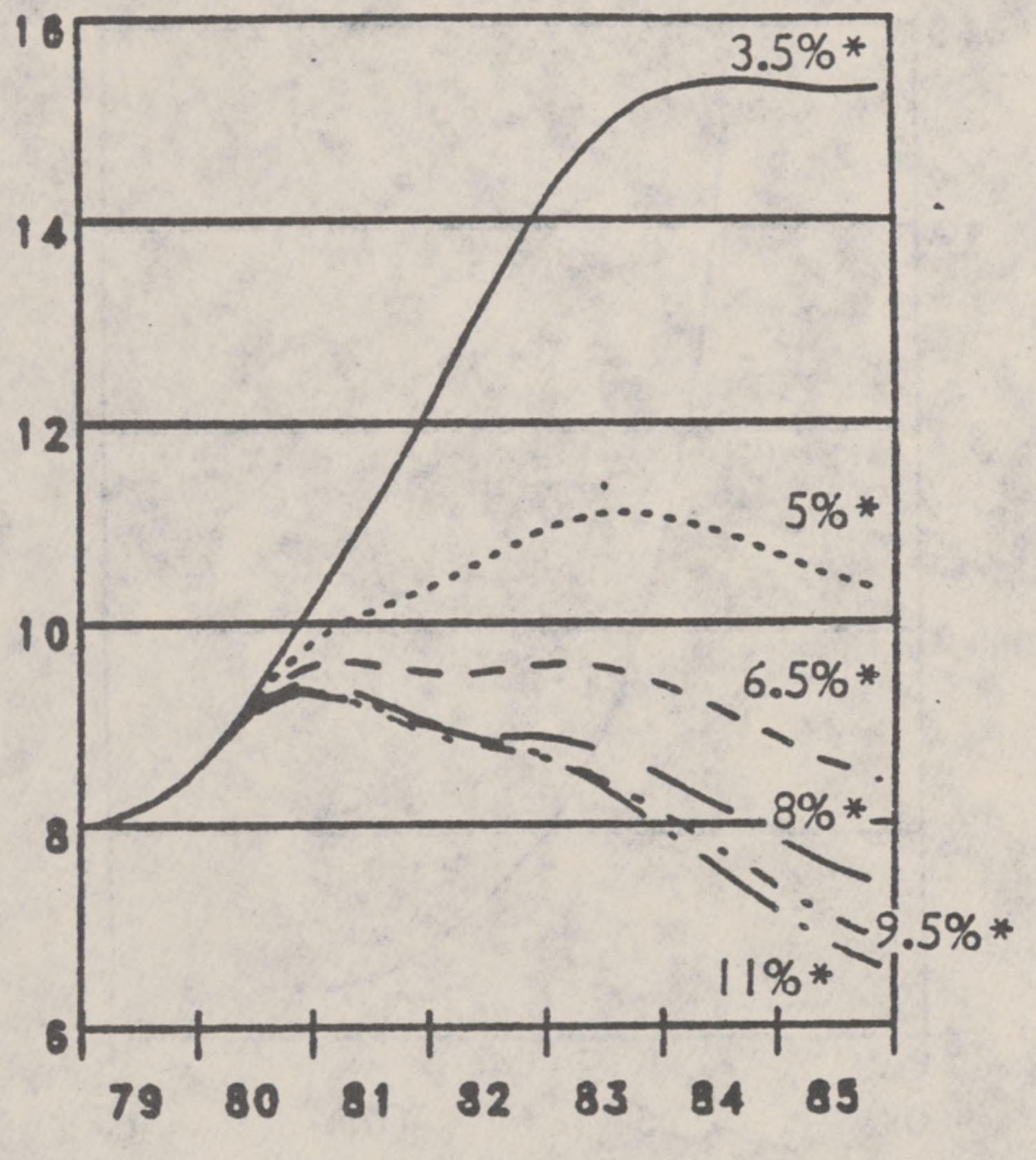
The perpetual state of recession required by this approach also has direct costs in terms of productivity and potential growth. Low output discourages investment, so that the capital stock loses 0.4 percentage points of baseline growth. Productivity is off by 1.5 percent by 1980, and potential is down by 0.7 percent. Labor supply would be 0.1 percent smaller as workers become discouraged and cease to look for jobs.

Chart 12 shows the results of other simulations to define the 1985 trade-off between demand management and inflation. The reader may be surprised to find a curve that still looks suspiciously like a Phillips curve. It should be noted, however, that with the traditional aggressive demand management policies which aim to hold unemployment below 6 percent, there is virtually no trade-off. In this region, the inflation rate deteriorates very dramatically so that the Phillips curve ultimately does become vertical. However, at the more moderate demand management ranges, a trade-off remains even after 5 years: the increase in the price level is controlled by the level of aggregate demand in relation to aggregate supply, and policy retains the ability to vary aggregate demand in accordance with the permitted increase in bank reserves and money supply and the degree of stimulus originating in the Federal budget.

The curve shows that the achievement of a dramatically lower core inflation by 1985, to the 6 percent area, requires the maintenance of near depression conditions. Unemployment would have to be well over 10 percent from now until then, an economic condition which would seriously damage the economy in other ways, probably radicalize the electorate, and thereby imperil the capitalist system as we know it. Even to achieve more moderate anti-inflation goals through demand management alone poses only discouraging prospects. If the unemployment rate were maintained near 8 percent from now to 1985, inflation would be improved, but the core rate would still be near 7.5 percent at the end of the experiment.

CHART 12.—The Effect of Demand Management on Core Inflation

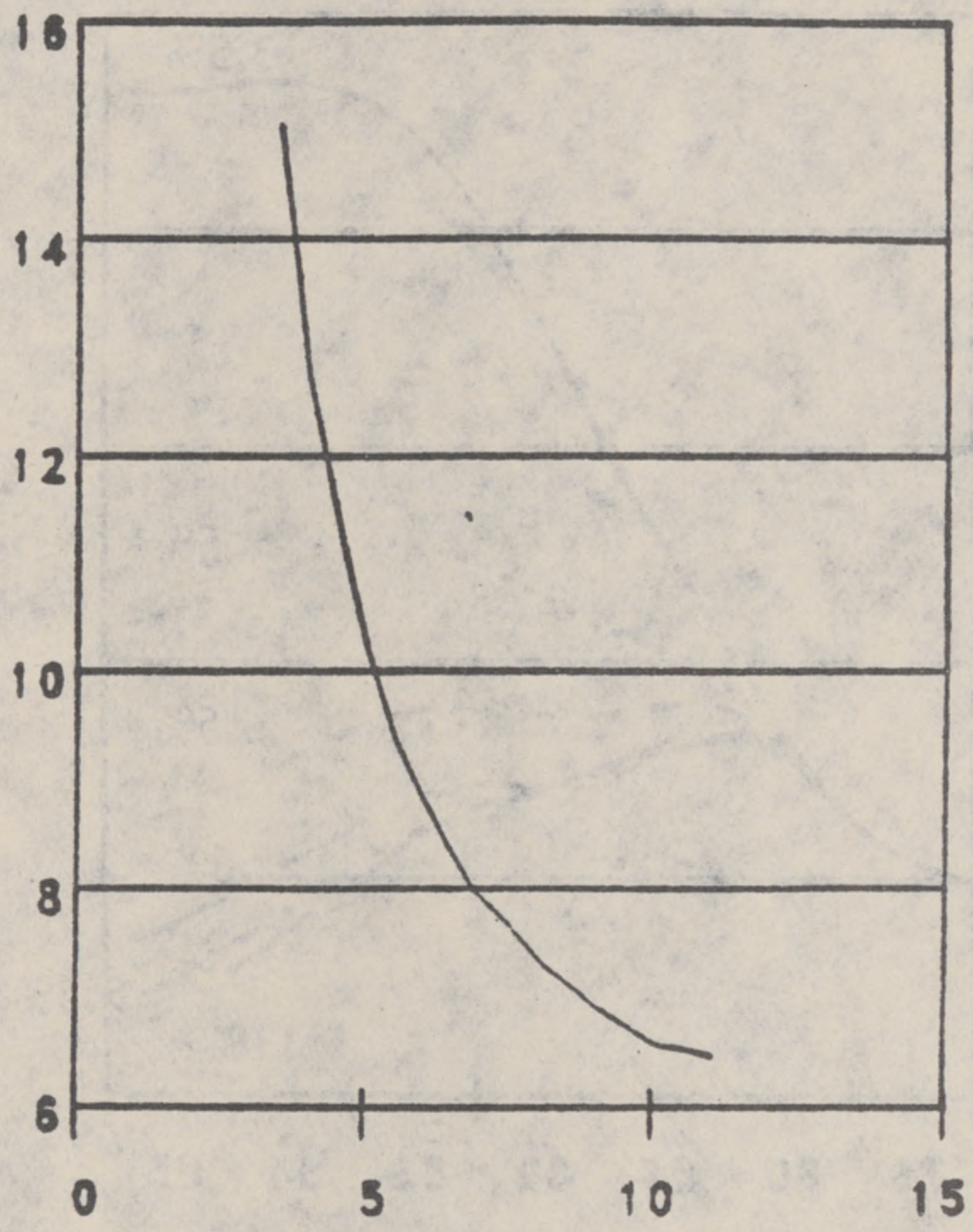
Core Inflation Rate Under Different Economic Conditions



* Average unemployment rate, 1980–85.

CHART 12.—The Effect of Demand Management on Core Inflation—Continued

Core Inflation in 1985—The Inflation-Unemployment Tradeoff



Actual inflation rates would be slightly more sensitive to the higher unemployment than the core, because of the more immediate offset provided by the demand component of inflation. However, actual inflation also includes shock pressures, and although the weaker domestic economy might tone down the OPEC pricing strategy modestly, the energy problem could hardly be expected to disappear. Thus, with 8 percent unemployment, the consumer price index still increases at a 7 percent rate; even 10 percent unemployment does not produce less than a 6 percent rise in the CPI. It is very dubious that the political process would accept such a political strategy, regardless of who was president or which party controls the Congress.

In summary, the fiscal and monetary policies which the Government employs to manage aggregate demand must create a constructive environment in which inflation can be improved, but they cannot, by themselves, solve the problem. Aggressive demand management, aiming at unemployment rates averaging 6 percent or less every year, make it impossible to have any other policy succeed. The inflation will simply become worse and worse—until the public despairs and forces politicians to adopt price controls. But even if demand management sets its gauges to achieve unemployment in the 6½-to-7 percent area, the inflation problem is not solved. Indeed, given the probable shocks from energy, with a real OPEC increase of 4 percent a year, there would be no improvement in the core inflation rate. These exercises demonstrate that demand management must be careful and somewhat more conservative than it has been, but that it is beyond its capacities to accomplish an adequate improvement of inflation.

Chapter 6. REDUCING CORE INFLATION THROUGH HIGHER CAPITAL FORMATION AND BETTER PRODUCTIVITY

If demand management offers no satisfactory choices, can better results be achieved by actions on the supply side? Can capital accumulation be hastened and productivity performance improved? Can the rental price of capital be lowered? If sufficient benefits could be garnered from these sources, both the core rate of inflation and the actual rate would be improved. Combining such measures with fiscal and monetary policies that would hold aggregate demand to levels that would hold the core inflation rate stable, the result could be a reduction in the core inflation rate and a gradual reversal of the 15-year process which has brought us to the current impasse.

To explore these possibilities and to derive quantitative estimates, a series of DRI and core model simulations have been run. They show that it is possible to make significant progress by this method, but that it must be a long-term strategy followed for several years before results can be seen.

Three model solutions were developed: The first enlarges the investment tax credit, the second liberalizes depreciation methods for tax purposes, and the third combines these two measures. To identify the supply effects, most of the Keynesian multiplier associated with general stimulus is removed by tighter monetary policy and lessened government expenditures. Aggregate demand is allowed to expand along with the rise of potential, so that unemployment is little different in the comparisons. Thus the supply policies raise potential and actual output, creating the inflation improvement through lower costs. It is possible to make other choices: demand could be kept unchanged, so that the extra potential output creates a slacker economy and additional gains on inflation. Conversely, demand could be allowed to rise more than the gain in potential, so that the inflation improvement is lost as a result of the tighter demand situation. Since the Keynesian multiplier does apply to the investment stimulated by the tax incentives, unless offset by tightly disciplined demand policies, there is considerable danger of the latter outcome.

The total improvement in core inflation which can be achieved over 10 years, assuming the combined tax incentive policies and the tougher demand management policies, is 1.3 percent. While still far from a full solution to the inflation problem, it is major progress. To achieve even better results, it will be necessary to work on the shock inflation rate and its roots in the energy crisis, find additional policies to improve the supply of labor and capital, restore growth in the stock of knowledge created by research and development, and improve labor productivity.

A More Generous Investment Tax Credit

In this simulation, the effective investment tax credit is raised by 2.7 percentage points in 1980 and thereafter. This would boost nominal business spending on plant and equipment by almost $25 billion by the end of those 10 years. The rental price of capital would be lowered immediately which would begin to trigger extra business spending for equipment. The credit also would augment the cash flow of corporations and would thereby facilitate the financing of the extra outlays.

Table 11 summarizes the results of this simulation. It can be seen that the capital stock is boosted by an extra 2.7 percent by 1990, increasing the level of potential output by 1.0 percent, thereby also boosting the average growth of potential by 0.1 percentage point a year for the decade. The improved potential output creates a 0.1 point gain in the average rate of productivity growth and an average annual acceleration in real wages of 0.2 points.

TABLE 11.—REDUCING CORE INFLATION THROUGH INVESTMENT TAX CREDITS

[Difference from baseline path]

	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
Policy (difference in level):											
Average tax lifetime (years) producer's durable equipment	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Investment tax credit (rate)	0.027	0.027	0.027	0.027	0.027	0.027	0.027	0.027	0.027	0.027	0.027
Corporate profit tax accruals (percent difference)	−6.6	−7.0	−8.1	−9.4	−10.8	−10.4	−11.9	−12.5	−12.9	−14.2	−15.6
Macroeconomic effects (percent difference):											
Real GNP	0.1	0.0	0.0	0.2	0.2	0.5	0.5	0.5	0.8	1.1	1.2
Total consumption	0.1	0.1	0.1	0.2	0.2	0.4	0.4	0.4	0.6	0.8	0.8
Nonresidential fixed investment	0.2	2.3	3.3	3.2	3.3	3.6	3.8	3.9	4.5	5.2	5.5
Investment in residential structures	0.4	1.8	1.2	0.3	0.9	2.1	2.5	3.5	5.3	6.6	5.4
Net exports	0.6	0.8	2.6	4.5	5.6	7.4	10.9	16.3	21.0	21.8	22.5
Government purchases	0.0	−1.8	−2.5	−1.9	−2.4	−2.1	−3.1	−3.9	−3.8	−3.7	−3.6
Long-run supply (percent difference):											
Labor force	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Capital stock	0.0	0.3	0.6	0.9	1.2	1.4	1.6	1.9	2.1	2.4	2.7
Output per hour	0.0	0.0	0.0	0.1	0.2	0.4	0.3	0.4	0.7	0.8	0.8
Potential GNP	0.0	0.0	0.1	0.2	0.3	0.5	0.6	0.7	0.8	0.9	1.0
Inflation and unemployment (percent difference):											
Core inflation rate[1]	−0.1	−0.3	−0.3	−0.3	−0.4	−0.4	−0.5	−0.5	−0.6	−0.7	−0.7
Consumer price index	0.0	−0.1	−0.2	−0.3	−0.4	−0.6	−0.9	−1.2	−1.5	−1.9	−2.2
Average hourly earnings	0.0	0.0	−0.1	−0.1	−0.2	−0.3	−0.5	−0.7	−0.9	−1.2	−1.4
Real wages	0.0	0.1	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.9	1.0
Unemployment rate (difference in level)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	−0.1	−0.1
Capacity utilization (difference in level)	−0.002	−0.005	−0.009	−0.012	−0.015	−0.018	−0.023	−0.024	−0.022	−0.022	−0.028
Financial markets (difference in level):											
Rental price of capital (percent difference)	−2.9	−2.9	−3.1	−3.7	−4.6	−5.3	−6.5	−7.8	−8.9	−9.7	−10.5
Prime rate	−0.16	−0.11	0.19	0.19	0.04	0.01	−0.03	−0.16	−0.27	−0.23	−0.06
New high-grade corporation bond rate	0.0	−0.04	−0.06	−0.09	−0.14	−0.20	−0.25	−0.32	−0.37	−0.38	−0.37

[1] Difference in rate of change.

The gain in real business fixed investment would average 2.6 percent a year for the years 1980 to 1985, and 4.6 percent a year for 1986 to 1990. There would be some spillover into higher consumption through the greater real purchasing power of consumers. Housing activity would be slightly hurt because the investment credit is such a strong incentive for purchasing equipment that it creates a greater need for financing than its direct cash flow benefits.

The reduction in the core inflation rate by 1990 is 0.7 percent. Much of this improvement comes very quickly when the investment tax credit is introduced because of its direct and major impact on the rental price of capital. This was the feature of the credit that had proved so helpful in 1962, when it played an important role in ridding the economy of core inflation.

More Liberal Depreciation

In the second simulation, the average tax lifetime of producers durable equipment is reduced by 4 years, beginning in 1980. This directly lowers corporate profit tax accruals by $5.7 billion immediately, and by $17.8 billion by the end of the decade. The liberalized tax laws also have a strong impact on capital costs. The rental price of capital is lowered by 4.4 percent in 1980 and continues to be lowered at a rate of an additional full percentage point a year between 1980 and 1990. As a result, nominal spending on plant and equipment is boosted by $7.1 billion in 1981 and $44.3 billion by 1990. The long-run impact on supply is modestly greater than the investment tax credit case. The capital stock is raised by 4.3 percent by 1990, and potential output by 1.5 percent.

TABLE 12.—REDUCING CORE INFLATION THROUGH LIBERALIZED DEPRECIATION

[Difference from baseline path]

	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
Policy (difference in Level):											
Average tax lifetime (years) producer's durable equipment	−4.0	−4.0	−4.0	−4.0	−4.0	−4.0	−4.0	−4.0	−4.0	−4.0	−4.0
Investment tax credit (rate)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Corporate profit tax accruals (percent difference)	−8.5	−7.1	−8.8	−13.8	−14.6	−13.2	−16.0	−16.7	−16.7	−18.8	−19.6
Macroeconomic effects (percent difference):											
Real GNP	0.1	0.3	0.4	0.3	0.3	0.4	0.3	0.4	1.1	1.3	1.7
Total consumption	0.1	0.2	0.1	0.0	0.1	0.2	0.1	0.1	0.5	0.7	1.0
Nonresidential fixed investment	0.3	3.6	5.2	3.9	4.1	5.5	5.7	5.8	7.3	9.0	9.8
Investment in residential structures	0.7	3.9	1.0	−3.6	−0.5	2.9	1.4	1.9	6.2	10.1	12.5
Net exports	0.6	−0.5	2.2	6.3	8.1	10.9	16.4	21.7	25.5	25.8	26.2
Government purchases	0.0	−1.8	−1.6	−0.7	−2.1	−3.5	−4.2	−4.7	−4.6	−6.0	−6.2
Long-run supply (percent difference):											
Labor force	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Capital stock	0.0	0.4	1.0	1.3	1.6	2.0	2.3	2.6	3.1	3.7	4.3
Output per hour	0.0	0.2	0.2	0.1	0.3	0.6	0.4	0.6	1.0	1.3	1.4
Potential GNP	0.0	0.0	0.1	0.3	0.5	0.6	0.8	0.9	1.1	1.3	1.5
Inflation and unemployment (percent difference):											
Core inflation rate [1]	−0.1	−0.4	−0.4	−0.4	−0.6	−0.7	−0.7	−0.8	−0.9	−1.0	−1.0
Consumer price index	−0.1	−0.1	−0.2	−0.3	−0.6	−0.8	−1.1	−1.5	−2.0	−2.4	−2.9
Average hourly earnings	0.0	0.0	0.0	0.0	−0.1	−0.3	−0.6	−0.9	−1.3	−1.7	−2.1
Real wages	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.9	1.0	1.2
Unemployment rate (difference in level)	0.0	−0.1	−0.1	0.0	0.1	0.1	0.1	0.2	0.1	0.0	0.0
Capacity utilization (difference in level)	−0.005	−0.002	−0.007	−0.020	−0.020	−0.019	−0.031	−0.035	−0.028	−0.029	−0.036
Financial markets (difference in level):											
Rental price of capital (percent difference)	−4.4	−4.6	−4.2	−6.3	−8.1	−8.4	−9.9	−12.0	−13.5	−14.5	−15.7
Prime rate	−0.36	−0.24	0.81	0.73	−0.02	0.21	0.46	−0.12	−0.64	−0.67	−0.82
New high-grade corporate bond rate	−0.02	−0.03	−0.01	−0.02	−0.17	−0.31	−0.37	−0.47	−0.56	−0.58	−0.58

[1] Difference in rate of change.

The lower rental price of capital and improved productivity path reduce the core rate of inflation by an average 0.6 percent over the decade. Again, given the direct initial benefit of the policy on the rental price of capital, much of the reduction is almost immediate. The productivity effect then helps to sustain the lower core rate over the next 10 years.

The Combined Policy

The third simulation imposes the more generous investment tax credit and the more liberal depreciation allowances in order to identify a full supply benefit on the core inflation rate. Table 13 summarizes this simulation. The increase in investment is very sizable, reaching almost a 14 percent increment for the years 1989 and 1990. This $73 billion gain in nominal investment outlays (plant and equipment) is achieved through a full-model reduction in corporate tax collections of equal amount, a very large corporate tax reduction equal to 33 percent of baseline revenues.

Despite the rather large reduction in corporate income taxes, the Federal budget surplus is larger at the end of the decade than it otherwise would have been. This is the result of (*a*) greater economic activity, producing additional revenues and (*b*) an explicit assumption that aggregate demand is held constant by offsetting the tax cuts with spending cuts and tighter monetary policy. Tax cuts alone will not produce an increase in the Federal budget surplus.

TABLE 13.—REDUCING CORE INFLATION THROUGH INVESTMENT TAX CREDITS AND LIBERALIZED DEPRECIATION

[Difference from baseline path]

	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
Policy (difference in level):											
Average tax lifetime (years) producer's durable equipment	−4.0	−4.0	−4.0	−4.0	−4.0	−4.0	−4.0	−4.0	−4.0	−4.0	−4.0
Investment tax credit (rate)	0.027	0.027	0.027	0.027	0.027	0.027	0.027	0.027	0.027	0.027	0.027
Corporate profit tax accruals (percent difference)	−15.7	−15.4	−17.9	−24.1	−24.7	−22.3	−25.4	−26.6	−27.8	−31.0	−32.7
Macroeconomic effects (percent difference):											
Real GNP	0.1	0.3	0.3	0.2	0.7	1.2	1.4	1.8	2.7	3.3	3.7
Total consumption	0.1	0.3	0.2	0.0	0.4	0.7	0.7	0.9	1.4	1.8	2.1
Nonresidential fixed investment	0.4	5.7	8.5	7.0	7.5	9.8	10.2	10.6	12.5	14.6	15.6
Investment in residential structures	1.2	5.6	1.5	−4.5	0.0	4.6	2.2	2.5	7.2	10.1	9.9
Net exports	1.5	1.0	5.2	11.3	11.6	14.1	20.4	27.1	32.6	34.1	35.7
Government purchases	−0.3	−3.7	−4.8	−2.9	−3.3	−4.3	−3.8	−3.4	−3.4	−3.3	−2.9
Long-run supply (percent difference):											
Labor force	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.1
Capital stock	0.0	0.7	1.6	2.2	2.7	3.4	4.1	4.7	5.5	6.4	7.2
Output per hour	0.0	0.2	0.2	0.2	0.8	1.2	1.4	1.9	2.4	2.8	3.3
Potential GNP	0.0	0.0	0.2	0.5	0.8	1.1	1.4	1.6	1.9	2.2	2.6
Inflation and unemployment (percent difference):											
Core inflation rate [1]	−0.2	−0.7	−0.7	−0.8	−1.0	−1.0	−1.0	−1.1	−1.3	−1.3	−1.3
Consumer price index	−0.1	−0.3	−0.4	−0.6	−1.0	−1.4	−1.9	−2.5	−3.0	−3.5	−4.0
Average hourly earnings	0.0	0.0	−0.1	−0.2	−0.4	−0.7	−1.0	−1.4	−1.7	−2.0	−2.2
Real wages	0.1	0.2	0.3	0.4	0.6	0.9	1.1	1.3	1.6	2.0	2.3
Unemployment rate (difference in level)	0.0	−0.1	−0.1	0.1	0.1	0.0	0.0	0.0	−0.2	−0.4	−0.4
Capacity utilization (difference in level)	−0.010	−0.013	−0.017	−0.032	−0.030	−0.027	−0.038	−0.043	−0.039	−0.042	−0.053
Financial markets (difference in level):											
Rental price of capital (percent difference)	−7.1	−7.5	−7.1	−9.8	−12.1	−12.5	−14.4	−17.0	−18.8	−20.0	−21.4
Prime rate	−0.51	−0.30	1.09	0.96	−0.07	0.27	0.62	−0.11	−0.63	−0.56	−0.58
New high-grade corporate bond rate	−0.04	−0.10	−0.08	−0.14	−0.31	−0.43	−0.44	−0.49	−0.56	−0.53	−0.46

[1] Difference in rate of change.

The large increase in investment over the decade boosts the capital stock by 7.2 percent by the end of the period. The extra capital produces an increase in potential GNP of 2.6 percent, and boosts the growth rates of both potential and productivity by 0.2 percentage points a year for the decade.

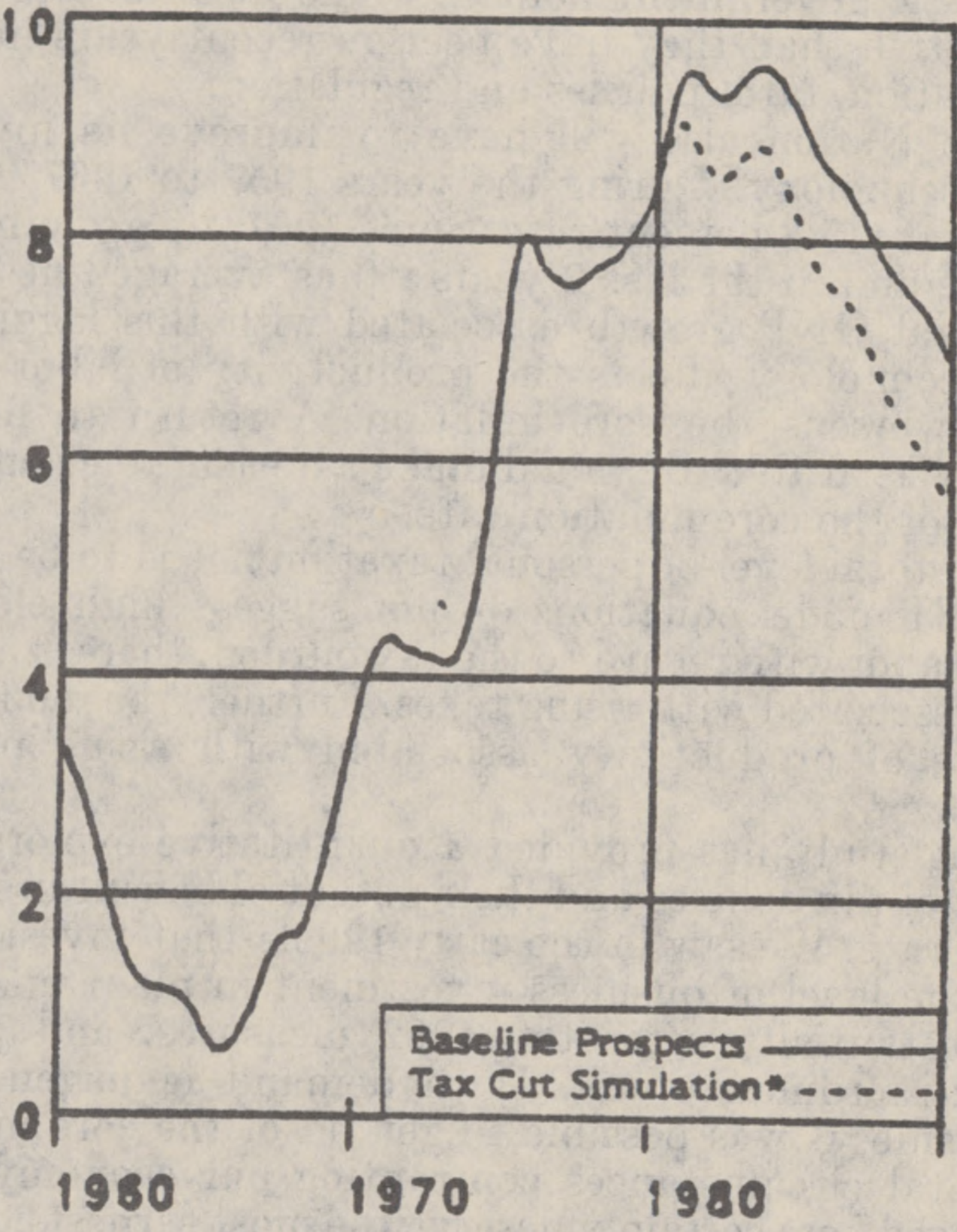
Real wages are higher by 2.3 percent, and better purchasing power produces a modest gain in consumption by the end of the decade. More favorable unit labor costs create a 10.5 percent improvement in real exports. Even State and local governments get a small benefit from the improved real purchasing power and the increase of their real tax base. The high volume of industrial capital formation leads to some crowding out of mortgage financing and a 3.4 percent reduction in average house building activity in 1982–83. Lower nominal interest rates then help the housing industry recoup this loss in 1984–90.

The core inflation rate shows a very significant improvement. For the final 3 years, 1988–90, the core inflation rate is reduced by 1.3 points. While this may seem a still modest gain, it does represent a sizable reduction and would leave the core inflation rate at 5.3 percent and improving.

The improvement in the actual inflation rate is similar. The cumulative reduction in the level of the consumer price index is 4 percent by 1990, or an average improvement of 0.4 points in the annual rate of increase. The better productivity performance affects unit labor costs directly and thereby lowers the costs of many products.

Even the shock inflation rate receives some benefit from the improved overall performance. The model exercise was carried out with the simulation rules of the DRI macro model which can be applied to agricultural and world energy prices. Since the world oil price was defined to increase at 4 percent a year in real terms, there is a feedback from better U.S. domestic inflation performance to world oil prices. Similarly, while agricultural prices may be affected by the weather and other uncontrollables, there is a strong long-term association between the movement of the price level as a whole and the prices collected by farmers. Other elements of shock inflation, including the dollar exchange rate and minimum wages, also show a small benefit. As a result, the total shock factor in inflation is lowered by an average of about 0.1 point a year in this exercise.

CHART 13.—The Impact of Tax Incentives on Core Inflation (Year-over-year percent change, seasonally adjusted)



* Assumes a 2.7 point increase in the investment tax credit and a 4-year reduction in the average tax lifetime of producers' plant and equipment relative to base, 1980–90.

Cautious demand management which holds unemployment at about 6.5 percent for most of the decade plus strong measures to stimulate business capital formation can lower the baseline core inflation rate by a full percentage point, while simultaneously creating a real wage gain of 2.3 percent and higher real output. Clearly other combinations of benefits from the policies could be achieved. Greater progress against core inflation could be accomplished by sacrificing the real output and income gains, using the slack instead to maintain looser product and labor markets. For example, if money and fiscal policies get tightened to hold real wages nearly unchanged, the improvement in core inflation could be boosted another full percentage point, from 1.3 to 2.3 percentage points. But even under that approach, core inflation remains far higher for most of the 1980's than it was just a few years ago. Nor is there any restoration of the conditions of the "golden" age of the first half of the 1960's, when core inflation was almost totally removed from the system.

The remaining core inflation rate shows that demand management and better capital formation are not sufficient to deal with the entire problem. To make further progress, at least three other approaches must be devised. First, the energy factor must be neutralized through conservation, better technology or new discoveries. If the push from

shock inflation could be eliminated, the improvement that becomes possible for the core rate becomes substantially greater. Besides energy, domestic government policies would also have to become far more constructive than they have been in recent years in such fields as payroll taxation, farm policies and regulation.

Second, the Nation also will have to improve its investment in science and technology. During the years 1957 to 1967, the stock of R. & D. grew at a 5.8 percent rate. Since 1967, its growth has slowed to 2.8 percent, and in the last 2 years it has averaged near zero. The loss in potential GNP growth associated with this lagging effort in science and technology affects the productivity of labor and capital and thereby worsens the core inflation. A return to more normal investment levels in R. & D. would make a measurable contribution to the reduction of the core inflation rate.

Finally, the total level of personal taxation needs to be reexamined. While the DRI model equations do not suggest high elasticities for the supply of labor with regard to the tax burden, there is a measurable loss of work associated with rising taxes. Further, the model equations include a loss of productivity associated with rising personal and payroll taxes.

The present study has provided a quantitative exploration of one particular set of tax policies and their potential benefit in reducing the core inflation rate. We saw in the early 1960's that investment incentives work: the level of business investment in plant and equipment increased substantially after the 1962 measures, and productivity performed extraordinarily well. With demand management also on the cautious side, it was possible to get rid of the core inflation rate. Given the total circumstances confronting our economy today, the policies analyzed here certainly deserve the most earnest consideration.

TECHNICAL APPENDIX

Supply Factors in the DRI Model of the U.S. Economy

While the DRI model has long contained major aspects of the supply side of the economy, the 1980 version includes various new elements designed to have the model benefit from the growing body of scientific work on this topic. These innovations include some tax effects in the equations for the supply of labor and potential output and a more elaborate and more quickly adjusting equation for the determination of aggregate potential, as well as the inclusion of the rental price of capital in the equations for the individual wholesale prices of the input-output-based stage of processing sector.

DRI has also revised its simulation methodology for supply-oriented policies in order to more clearly distinguish between the traditional Keynesian multipliers and the newer supply multipliers. In the past, DRI model solutions testing fiscal policies have usually used an unchanged pattern of nonborrowed bank reserves as the definition of a "neutral" monetary policy. As a result, a large part of the initial effect of a supply-based tax change was to create extra activity through the Keynesian multiplier before the supply effects could be felt. While this made policies look very favorable in terms of the creation of employment and activity, it blurred the effects on inflation and supply because the extra stimulus produced a tighter economy. DRI is now using a definition of "neutral" monetary policy based on unchanged real short-term interest rates. The identification of fiscal policy effects is now based on the "differential incidence" viewpoint,[1] with offsetting changes in government expenditures or personal taxes introduced to keep the aggregate unemployment rate unchanged. These policy definitions allow a clearer distinction between aggregate supply and aggregate demand effects. This is not to foreclose the policy choice for aggregate demand: the Government can decide to divide the benefits of supply policies between higher real activity and lessened inflation. But the method leaves a clearer set of analytical conclusions by isolating the supply effects.

The changes in the model create somewhat stronger supply effects than earlier versions, but do not turn the conclusions upside-down. The economy's ability to produce responds more positively to tax incentive changes. The magnitudes are limited, and even with a more quickly responding measure of potential, the effects are slow and require much patience. Unless carefully offset by tighter money or fiscal moves, supply-oriented tax cuts initially boost demand more than supply, and thereby initially make inflation worse. The reductions of actual and core inflation come later, and indeed do not come at all without some reinforcing demand management. The Federal deficit is enlarged by the tax moves unless they are fully offset by reduced spending or increases of other taxes.

While realistic estimates of supply effects leave no room for miracles, they do indicate major opportunities for restoring productivity performance and partial recovery of long-term growth rates toward the historical norm. The decline in productivity performance is due to a considerable extent to the lack of improvement of the capital-labor ratio and to reduced investment in research and development. The capital stock is aging excessively and is using too much energy for current prices. Supply policies can reverse these factors.

The model also focuses on the imbalance between the supply of labor and the supply of industrial capacity. The changed historical relationship between the utilization rates of basic industries and national unemployment produces extra inflation. The deterioration of delivery conditions in industrial markets is measured by the critical vendor performance measure of the model, and affects monetary policies and prices. High utilization rates also directly create inflation in specific industries. Hence, those supply-oriented tax measures which aim to stimulate the growth of industrial capacity improve price performance and make lower unemployment possible. Conversely, measures which do not affect industrial capacity tend to have more limited price benefits.

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[1] Richard A. Musgrave (McGraw-Hill, 1959), *The Theory of Public Finance,* pp. 212–216.

The DRI Model adheres to the philosophy of seeking to build models that represent the behavioral characteristics of the economy as fully as possible. As previous publications have indicated,[2] the macro models of the 1970's gradually incorporated several important new features that advancing understanding and a changing economic situation required. Earlier innovations, some of them based on the scientific work of the 1960's, included the use of a variable-coefficient input-output table as part of the model's simultaneous block to calculate industrial output and capacity utilization, an elaborate financial system representing the flows of funds of households and businesses, stage-of-processing pricing equations to carry particular cost increases more precisely into retail prices, a production-inventory-price loop, and an elaborate energy sector. The introduction of each of these innovations modified the basic behavioral characteristics of the model somewhat, with the aim of making the model reflect the current state of knowledge as found in the work not only of DRI, but of the academic and general research community. The model is meant to be as comprehensive a representation of the economic process as can be devised.

This approach is an alternative to pure "supply models." While models that are fully devoted to classical relationships among the factors of production may be appropriate for very long-term analysis, understanding of inflation and the business cycle requires representation of demand, finance, stock flow adjustment processes, expectation formation, and other short-term elements. For analysis of the 1980's, whether for forecasting or policy purposes, purely supply-oriented models are inadequate. The current financial, energy, and business cycle situations are sufficiently far removed from equilibrium that the next decade will be heavily determined by the initial conditions and other short-run factors.

DRI's approach—to add carefully derived estimates of tax and other supply effects to an already elaborate representation of the economy—should provide as good estimates for the policy options as it is possible to obtain at this time. It should be recognized, however, that the new territory of supply economics, encompassing both the intermediate-term tax issues and the longer range questions of demography, saving, and private-public sector relations, is a very large one and will take years to fully explore. The extensions of the DRI model advanced here are only a few steps along the road to a full econometric representation of supply. "Supply multipliers" in the current model deal with only limited aspects and are not yet calculated over the decades over which they would ultimately be felt. Some of them are not yet as seasoned as the demand multipliers and it will take some years of scientific debate before agreement begins to emerge. At least the point has been reached where supply economics is, and should be, making itself felt in the "mainstream" models.

Major Supply Features in the DRI Model of the U.S. Economy

The supply equations in the DRI model can be classified under the following headings:

(1) The Supply of Labor;
(2) The Supply of Physical Capital;
(3) The Supply of Energy;
(4) The Supply of Materials; and
(5) The Supply of R. & D.

In addition, supply is also determined by the effectiveness with which the factors of production are combined, giving rise to these additional equations:

(6) The Aggregate Production Function;
(7) The Determination of Industrial Capacities; and
(8) The Efficiency of Energy Use in Household and Business Purposes.

This list is far from exhaustive, of course. Numerous other equations are a part of the supply analysis, including the several hundred equations represented by the input-output, stage-of-processing, energy, and financial sectors. However, the list above includes the more significant equations in which the supply economics issues come into focus.

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[2] See "The DRI Model: Historical Perspective and an Overview," Otto Eckstein, *The Great Recession* (North-Holland, 1979), pp. 185–207.

The Supply of Labor

The DRI long-term forecasts employ a set of eight equations for the principal working-age population groups. The participation rates depend on time trends, cyclical conditions as measured by the unemployment rate, real wages, and for a few categories the personal tax burden as represented by the average effective personal tax rate plus the employee share of payroll taxes and the average effective benefit levels of particular transfer programs such as AFDC and social security. These equations are used to forecast the long-term labor supply under normal conditions. These forecasts are preliminary to the macro model solutions.

The macro model contains one equation for labor supply which relies on the working-age population aged 18 to 64, the high participation rate male group aged 25 to 54, the national unemployment rate, real wages, a time trend to reflect the sociological changes in the participation rate, and the average effective personal and payroll tax rate. (See Exhibit 1.) This equation has simulation characteristics that are close to the properties of the eight-equation labor force model. It has an elasticity of supply with regard to real wages of 0.1, i.e., a 1 percent increase in real wages adds 0.1 percent to the number of workers, which at 1980 values would represent 100,000 individuals. The elasticity of the labor force with respect to the personal tax burden is −0.04, indicating that a 1 percent rise in the real tax burden discourages 0.04 percent of our workers from the labor force. Since 1965, the real tax burden has increased by almost 50 percent, driving 1.9 million people from the labor force according to the equation.

The Supply of Physical Capital

The supply of aggregate physical capital is determined by equations for producers' durable equipment and nonresidential construction. (See Exhibit 2.) These equations follow the neoclassical Jorgenson theory which relies on a carefully calculated measure of the rental price of capital and on the level of expected output. The DRI model investment equations have extended the Jorgenson approach by correcting the investment need for pollution abatement expenditures, by calculating the rental price of capital from the actual sources of corporate finance at any particular time as estimated from the flow of funds, by adding a debt service variable which indicates the existing burden of debt on corporate cash flow, and by introducing a surprise element into output which contrasts actual output with what was expected.

EXHIBIT 1.—LABOR FORCE

ORDINARY LEAST SQUARES

QUARTERLY (1956:1 TO 1979:1)—93 OBSERVATIONS
DEPENDENT VARIABLE: LHSLC[1]

	Coefficient	Standard error	T-Stat	Independent variable
	3.09219	0.2811	11.00	CONSTANT
1)	−0.108460	0.01147	−9.463	LOG (EDODML/N18@64).
2)				PDL (QRU\1, 1, 5, FAR).
/1	−0.0377636	0.003423		
/2	−0.0302109	0.002739		
/3	−0.0226582	0.002054		
/4	−0.0151054	0.001369		
/5	−0.00755272	0.0006847		
Sum	−0.113291	0.01027	−11.03	
Average	1.33333	0.0	NC	
3)	3.69545	0.06155	60.04	LOG (NM25@54/N18@64).
4)	0.00526381	6.073E−05	86.67	PARTIPTREND.
5)	0.761680	0.02558	29.78	(QREALWAGE\1+QREALWAGE\2 +QREALWAGE\3+QREALWAGE\4 +QREALWAGE\5+QREALWAGE\6\ +QREALWAGE\7+QREALWAGE\8)/8.0.
6)	−0.290536	0.04017	−7.232	LOG(((TP+TWPER)/TAXBASE)/N18@64).

R-Bar squared: 0.9762.
Durbin-Watson statistic: 0.3301.
Sum of squared residuals: 0.0773.
Standard error of the regression: 0.02997. Normalized: 0.019.

[1] LHSLC=Log (LC@N/(0.87−LC@N)).

EXHIBIT 2.—INVESTMENT (PRODUCERS DURABLE EQUIPMENT)

LEAST SQUARES WITH FIRST-ORDER AUTOCORRELATION CORRECTION

QUARTERLY (1958:1 TO 1979:2)—86 OBSERVATIONS

DEPENDENT VARIABLE: IPDENR72

	Coefficient	Standard error	T–Stat	Independent variable
	−8.58286	2.701	−3.177	CONSTANT.
1)	−0.0323568	0.03990	−0.8109	KNPDENR72\1.
2)	0.128474	0.02804	4.582	KNPDENR72\1*UCAPFRBM.
3)				PDLR(DEBTSERVICE\1,1,7,FAR).
/1	−5.51410	4.432		
/2	−4.72637	3.799		
/3	−3.93864	3.166		
/4	−3.15091	2.532		
/5	−2.36319	1.899		
/6	−1.57546	1.266		
/7	−0.787728	0.6331		
Sum	−22.0564	17.73	−1.244	
Average	2.00000	0.0	NC	
4)	−0.0486685	0.02073	−2.347	QSTAR–LETOUTPUTPABE.
5)				PDL(LETIPDENR72PQC\3,2,6,FAR).
/3	0.000424575	0.001225		
/4	0.00233408	0.0006041		
/5	0.00345148	0.0005461		
/6	0.00377677	0.0006523		
/7	0.00330996	0.0006341		
/8	0.00205103	0.0004223		
Sum	0.0153479	0.002534	6.057	
Average	2.87090	0.4903	5.855	
	0.797527	0.07308	10.91	RHO.

R–Bar squared: 0.9963.
F–statistic(7,78); 3254.
Durbin-Watson statistic: 1.8293.
Sum of squared residuals: 118.4.
Standard error of the regression: 1.232. Normalized: 0.01940.

This equation shows a quite considerable effect of changes in the rental price of capital on the level of investment and therefore on the growth of the capital stock. For example, the mean elasticity of investment in plant and equipment with respect to the rental price of capital was found to be 0.8.

The same theoretical approach is used for the calculation of investment levels of 24 industries, including the two-digit manufacturing industries and such fields as utilities, communication, mining, and the various transportation industries. These equations serve both as a check on the macro estimates as well as inputs for the calculation of capacity for materials, primary, and advanced processing industries.

The Supply of Energy

The supply of energy is largely exogenous to the DRI macro model. Both the quantity and the price of oil from foreign sources must be considered largely exogenous, though there are some loops from activity levels of the industrial world to OPEC pricing. Domestic pricing is also largely exogenous because both oil and gas are still in the period of legislated decontrol price schedules. The supply of domestic energy is estimated endogenously in DRI's energy models, and these answers are entered into the macro analysis. The model does contain various simulation rules that represent the responses of energy prices and supplies to changing macro conditions.

The model's energy sector principally serves two functions, to trace the effects of the exogenous energy prices to the retail stage and from there to the behavior of the system as a whole, and also to provide a supply-demand check to see if available supplies can sustain particular levels of economic activity. The model calculates and cumulates the demand for energy by principal sources, including oil, gas, coal, and electricity. The total energy requirement is compared to the energy supply to test for particular model solutions. If supply falls short of demand

and if prices are still controlled, an energy shortage develops which must be allocated to particular tailormade solutions. Consistency can be achieved by pulling down aggregate activity, by imposing allocations or rationing in specific markets, or by letting delivery conditions deteriorate and thereby creating some indirect inflation.

The Supply of Materials

Because the DRI model takes the market approach, prices are the principal vehicle for supply conditions to affect the economy. A scarce supply of materials, such as steel, chemicals, oil, lumber, etc., is shown through high utilization rates, which increase finished goods prices through the stage-of-processing price equations. Besides the utilization effects, the model also contains a separate channel for vendor performance, the well-known measure of delivery conditions in industrial markets. Poor vendor performance acts in the model to raise industrial prices and to stimulate inventory hoarding.

In considering the determination of the supply of materials, processed materials must be distinguished from raw materials. The supply of processed materials is determined by the capacities of these industries. These capacities, in turn, are determined by the growth in capital stocks and by technology. An industry's capital stock is determined from equations explaining the level of investment. The supply of raw materials is modeled through prices: agricultural commodities and world oil are reflected in exogenous price variables; other raw materials prices are endogenous, moved by the strength of demand, and on the supply side by strike variables. It should be added that DRI's micro models of industrial and agricultural commodities, do model the availability and costs of supply very elaborately, and this work is an input to the materials forecasts in the macro model.

The Supply of R. & D.

The DRI model incorporates the stock of technical knowledge, as measured by the cumulated research and development outlays of governments and private industry, as one of the inputs in the aggregate production function. Thus, the volume of R. & D. investment affects the growth of potential GNP. The stock of R. & D. ,which is treated analogously to the stock of physical capital, is assumed to depreciate over 10 years. In a competitive world, a society which does not advance its technology will lose its relative industrial position, and therefore its growth of potential will diminish. Thus, the stock of knowledge must be treated as a depreciating asset. Technology is also required to offset the decline in exhaustible resources.

The Aggregate Production Function

Potential GNP is estimated in a two-step procedure which facilitates the introduction of the supply of energy and of the stock of research and development into the aggregate production function framework. Step 1 establishes a Cobb-Douglas production function which includes the four inputs, capital, labor, energy, and R. & D. The average age of capital is introduced as an adjustment to the capital stock. The actual use of the capital stock in any period is determined by the utilization rate of manufacturing capacity. This equation is fitted in the form of the output-to-labor ratio in order to overcome the problems of multicollinearity. (See Exhibit 3.)

The coefficients derived from this Cobb-Douglas function are used to calculate an index of composite factor inputs which is then employed in a second equation shown in Exhibit 4. This equation explains the "residual," the measure of change in the productivity of all factor inputs. This equation uses time trends to carry the effects of disembodied technology, with separate trends to reflect the breaks of productivity which occurred in 1967 and 1973. In addition, the equation contains a measure of the personal tax burden to reflect the tax effect on the efficiency of resource utilization as measured by total factor productivity.

The aggregate production function contains an implicit extimate for high-employment labor productivity. To estimate actual productivity, it is necessary to estimate its short-run variation around this potential trend. (See Exhibit 5.) The equation uses the utilization rate of manufacturing capacity and the "surprise" component in expectations about real GNP to explain the cyclical swings. Short-run productivity is also adversely affected by increases in the price of energy.

EXHIBIT 3.—STEP 1—POTENTIAL GNP

ORDINARY LEAST SQUARES

QUARTERLY (1957:1 TO 1979:1)—89 OBSERVATIONS

DEPENDENT VARIABLE: NEWLHSGNP72A[1]

	Coefficient	Standard error	T-Stat	Independent variable
	1.39819	0.01486	94.12	CONSTANT.
1)	0.00151723	6.283E–05	24.15	TIME.
2)	0.0481635	0.01035	4.652	LOG(DTFUELSALLB/EHHHOURSA).
3)	0.290869	0.005939	48.98	LOG(UCAPFRBM*KADJ\1/EHHHOURSA).

R–Bar squared: 0.9874.
Durbin-Watson statistic: 0.4923.
Sum of squared residuals: 0.0087.
Standard error of the regression: 0.01012. Normalized: 0.005.

[1] NEWLHSGNP72A=Log(GNP72/EHHHOURSA)—0.08*Log(TOTALR&DSTOCK72\1/EHHHOURSA).

EXHIBIT 4.—STEP 2—POTENTIAL GNP

ORDINARY LEAST SQUARES

QUARTERLY (1957:1 TO 1979:1)—89 OBSERVATIONS

DEPENDENT VARIABLE: LHSGNP72[1]

	Coefficient	Standard error	T-Stat	Independent variable
	1.28416	0.04866	26.39	CONSTANT.
1)	0.00189295	0.0001432	13.21	TIME.
2)	0.336940	0.1432	2.353	LOG(HPM/HPM\1).
3)	–0.000370151	0.0002303	–1.607	TIMEONE.
4)	0.00918571	0.005368	1.711	TIMETWO.
5)	–0.0518671	0.02302	–2.253	LOG((TP+TWPER)/TAXBASE).

R–Bar squared: 0.9497.
F–statistic (5,83): 333.6.
Durbin-Watson statistic: 0.7874.
Sum of squared residuals: 0.006812.
Standard error of the regression: 0.009059. Normalized: 0.005921.

[1] LHSGNP72=Log(GNP72/EHHHOURS)—0.08*Log(TOTALR&DSTOCK72\1/EHHHOURS)—0.05*Log(DTFUELSALLB/EHHHOURS)—0.29*Log(UCAPFRBH*KADJ\1/EHHHOURS).

EXHIBIT 5.—PRODUCTIVITY

LEAST SQUARES WITH FIRST-ORDER AUTOCORRELATION CORRECTION

QUARTERLY (1962:1 TO 1979:1)—69 OBSERVATIONS

DEPENDENT VARIABLE: LHSJQ%MHNF[1]

	Coefficient	Standard error	T-Stat	Independent variable
	–2.10402	0.04946	–42.54	CONSTANT.
1)	0.00150552	0.0001594	9.442	TIME.
2)	0.00800536	0.003455	2.317	1/(1.1–UCAPFRBM).
3)	–0.0349436	0.02103	–1.662	LOG((TP+TWPER)/TAXBASE).
4)	–0.432759	0.1056	–4.097	LOG(QSTAR/LETOUTPUTPABE).
5)	–0.0614098	0.01932	–3.178	LOG((WPI05\1/PC&I&G\1)/(WPI05\5/PC&I&G\5)).
	0.716376	0.09638	7.432	RHO.

R–Bar squared: 0.9540.
F–statistic (6,62): 236.0.
Durbin-Watson statistic: 2.3156.
Sum of squared residuals: 0.001940.
Standard error of the regression: 0.005594. Normalized: 0.003043.

[1] LHSJQ%MHNF=Log(JQ%MHNF)—Log(GNP72FE/(52.0*0.001*HPMFE*((1.0—.01*RUFE)*LC))).

The Efficiency of Energy Use

Given the pivotal role of energy availability to economic growth at this time, the DRI model must represent the response of energy use to higher prices with particular care. The energy components of consumer spending are modeled in individual equations which incorporate price elasticities. In addition, industrial and other energy use is modeled in a summary equation whose elasticity is reconciled with the more detailed estimates of DRI's core energy model. Exhibit 6 illustrates the response of energy use to higher energy prices in terms of the energy-GNP relationship.

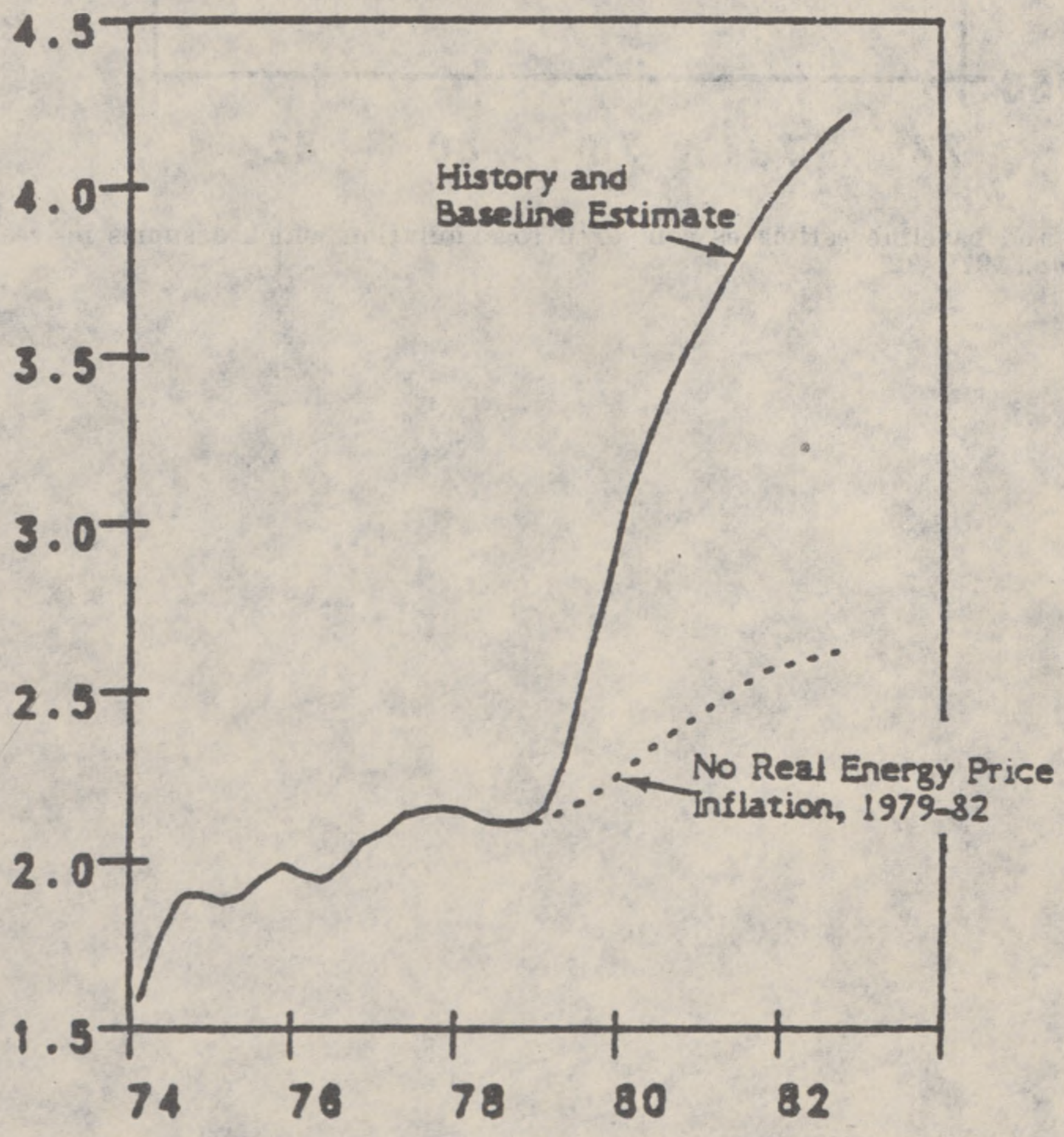
Equations for Core, Demand, and Shock Inflation

The core inflation model is an aggregate construct which summarizes pertinent detail of the macro model. The derivation of the shock and core inflation elements is set forth in the main report. The shock components are derived from simulation exercises of the model. Core inflation is calculated from the weighted sum of the rental price of capital and unit labor costs, both smoothed through Pascal lags. Only the demand equation is derived statistically, and it thereby becomes an empirical verification of the core-shock-demand approach.

Exhibit 7 shows the equation for the demand component. The dependent variable is the residual derived by subtracting core and shock inflation from actual inflation. This residual is mainly a demand variable, as the equation shows. Ninety-one percent of its variation can be explained by distributed lags applied to the industrial utilization rate and the national unemployment rate, plus dummies for price controls.

EXHIBIT 6.—Impact of Energy Prices on Energy Use*

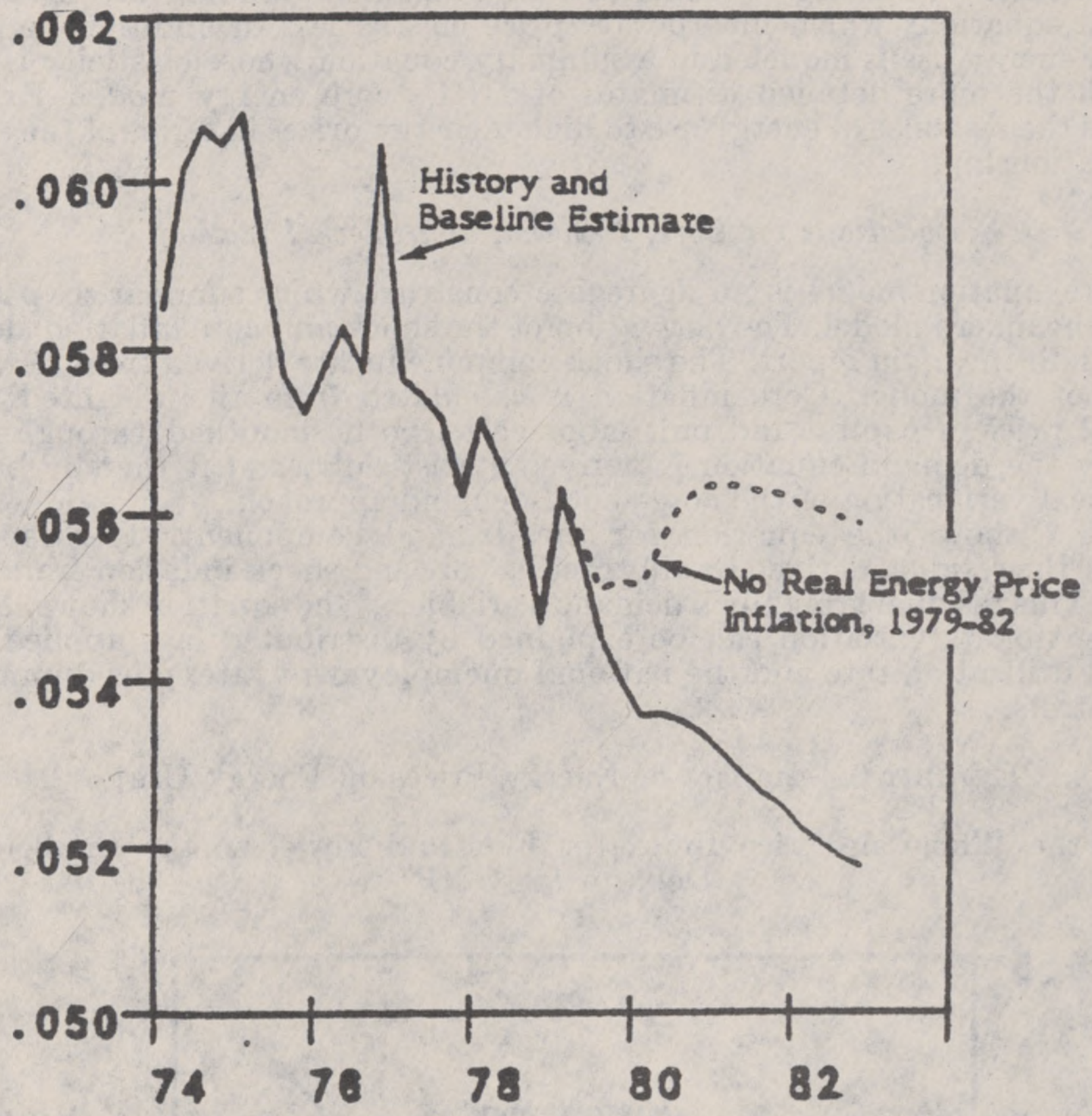
Ratio of the Wholesale Price Index for Fuel and Power to the Implicit Price Deflator for GNP



* History and baseline estimates compared to simulation which assumes no real energy price inflation, 1979–82.

EXHIBIT 6.—Impact of Energy Prices on Energy Use*—Continued

Energy-Use Ratio (Btu per 1972 $ GNP)



* History and baseline estimates compared to simulation which assumes no real energy price inflation. 1979–82.

EXHIBIT 7.—THE DEMAND INFLATION RATE

ORDINARY LEAST SQUARES

QUARTERLY (1966:1 TO 1979:1)—53 OBSERVATIONS

DEPENDENT VARIABLE: DEMAND

	Coefficient	Standard error	T-Stat	Independent variable
	−7.74049	0.4988	−15.52	CONSTANT.
1)	0.199701	0.1227	1.627	DMYPRICE.
2)	−0.0451404	0.05897	−0.7654	DMYPRICECUM.
3)				PDL(ONEOVERRU\1, 2, 7, FAR). [1]
/1	2.15290	1.334		
/2	2.40581	0.6565		
/3	2.47190	0.3163		
/4	2.35116	0.4455		
/5	2.04360	0.5784		
/6	1.54922	0.5597		
/7	0.868023	0.3686		
Sum	13.8426	1.771	7.816	
Average	2.56684	4.315	0.5949	
4)				PDL(ONEOVERUCAPFRBM\1, 2, 7, NEAR).[2]
/1	0.0626168	0.03454		
/2	0.113586	0.05300		
/3	0.152907	0.05591		
/4	0.180580	0.04528		
/5	0.196605	0.03342		
/6	0.200983	0.05906		
/7	0.193712	0.1181		
Sum	1.10099	0.1871	5.883	
Average	3.55566	0.6266	5.675	

R–Bar squared: 0.9059.
Durbin-Watson statistic: 0.7504.
Sum of squared residuals: 11.1733.
Standard error of the regression: 0.49285. Normalized: −8.983.

[1] ONEOVERRU=1/(RU–RUADJ).
[2] ONEOVERUCAPFRBM=1/(1.1–UCAPFRBM).

Exhibits 8 and 9 show two of the macro model equations which determine much of the core inflation rate. Equation 8 is the equation for the long-term bond interest rate. Price expectations are the main variable, along with a liquidity measure in relation to real GNP. Other variables are the returns on competing investment media, including common stocks and tax-exempt securities, the volume of new corporate bond issues, the position of life insurance companies (who are among the principal purchasers of corporate bonds), and dummies to represent the shocks to the bond market that occurred during the Vietnam war. Price expectations are also corrected by the unemployment rate, to indicate that market participants interpret inflation differently if unemployment is abnormally high or low.

Exhibit 9 shows the equation for wages. Long-term price expectations are the principal variable, with a coefficient of 0.63. Short-term inflation experience has a lesser coefficient of 0.21. The deviation of unemployment from its normal level, minimum wage rates and dummies for guideposts, price controls, and an apparent data error are the other variables.

The following list shows the variables used in the equations. The appendix is concluded with a printout of the historical data relating to the core inflation analysis.

EXHIBIT 8.—NEW ISSUE RATE

ORDINARY LEAST SQUARES

QUARTERLY (1954:1 TO 1979:3)—103 OBSERVATIONS

DEPENDENT VARIABLE: RMMBCNEWNS

	Coefficient	Standard error	T-Stat	Independent variable
	−13.3067	1.283	−10.38	CONSTANT.
1)	−5.19846	0.8645	−6.013	LOG((RESFRBNB+CURR+RRADJ)\(PGNP*N)).
2)	0.147057	0.06930	2.122	RMDIFF.
3)	0.268448	0.1393	1.927	DMYVIET.
4)	6.69214	0.5144	13.01	LOG(GNP72/N).
5)	3.86513	3.468	1.115	LOG((NFCBONDS/(PGNP*N))/(NFCBONDS\1/(PGNP\1*N\1))).
6)	0.431036	0.07637	5.644	RMAAAGSLNS\1.
7)	−17.5255	6.305	−2.779	LOG(((LIRES−LIPL)/(PGNP*N))/((LIRES\1−LIPL\1)/(PGNP\1*N\1))).
8)	0.793035	0.1209	6.557	PCEXP79.
9)	−0.0560179	0.01064	−5.265	PCEXP79*(RU+RU\1+RU\2+RU\3)/4.
10)	0.00627718	0.001982	3.167	JS&PEXP34.
11)				PDL(LETRMMBCNEWNS, 1, 12, FAR).
/0	−5.81348	1.353	−4.296	
/1	−5.32902	1.240	−4.296	
/2	−4.84456	1.128	−4.296	
/3	−4.36011	1.015	−4.296	
/4	−3.87565	0.9021	−4.296	
/5	−3.39119	0.7894	−4.296	
/6	−2.90674	0.6766	−4.296	
/7	−2.42228	0.5638	−4.296	
/8	−1.93783	0.4511	−4.296	
/9	−1.45337	0.3383	−4.296	
/10	−0.968913	0.2255	−4.296	
/11	−0.484456	0.1128	−4.296	
Sum	−37.7876	8.796	−4.296	
Average	3.66667	0.0	NC	

R−Bar squared: 0.9877.
F−statistic(11,91): 748.5.
Durbin-Watson statistic: 1.8875.
Sum of squared residuals: 4.714.
Standard error of the regression: 0.2276. Normalized: 0.03760.

EXHIBIT 9.—WAGES

ORDINARY LEAST SQUARES

QUARTERLY (1956:1 TO 1979:1)—93 OBSERVATIONS

DEPENDENT VARIABLE: 400*LOG(JAHEADJEA/JAHEADJEA\1)

	Coefficient	Standard error	T-Stat	Independent variable
1)	0.206108	0.06456	3.192	100*LOG(PC\1\PC/5).
2)	0.629963	0.07306	8.623	PCEXP85.
3)	11.1579	0.6999	15.94	1/(RU−RUADJ).
4)				PDL(%MINWAGE400,1,4,FAR).
/0	0.0102843	0.003743		
/1	0.00771322	0.002808		
/2	0.00514215	0.001872		
/3	0.00257107	0.0009359		
Sum	0.0257107	0.009359	2.747	
Average	1.00000	0.0	NC	
5)	0.605270	0.2026	2.988	DGPOST.
6)	2.13063	0.5253	4.056	ALTP1.
7)	−2.25031	0.7629	−2.950	DMY641.

R−Bar squared: 0.8573 (relative to Y=0, RBSQ: 0.9829).
F−statistic (7,86): 764.5.
Durbin-Watson statistic: 1.4632.
Sum of squared residuals: 47.34.
Standard error of the regression: 0.7419. Normalized: 0.1393.

Mnemonic Table, Variables Used in Technical Appendix

ALTP1	Dummy variable, Phase 1.
AVGRATE	Effective interest cost of nonfinancial corporate liabilities.
CORE	Core inflation rate.
COSTCAPA	After tax cost of capital.
COSTR&DINDEX	Cost index, private research and development.
CURR	Money supply—currency component.
DELTAICNR72	Depreciation rate on producers real nonresidential structures.
DELTAIPDENR72	Depreciation rate on producers real equipment expenditures.
DEMAND	Demand component of core inflation.
DGPOST	Guide post dummy.
DMYBUILDUP	Dummy for Vietnam war buildup.
DMYPRICE	Dummy for price controls.
DMYPRICECUM	Dummy for cumulative impact of price controls.
DMYVIET	Dummy for Vietnam war.
DMY641	Dummy for break in JAHEADJEA series.
DTFUELSALLB	Demand for all fuels, total—all sectors.
EARNSHSA	Earnings per share—composite—500 companies—seasonally adjusted.
EDODML	Defense Department manpower—military.
EHH	Employed (household survey)—total.
EHHHOURSSA	Total worker hours (EHH*HPM*52*.001).
ERETURN	Expected cost of equity financing.
FEDR&D72	Federal stock, research and development.
GEARNSHSAEXP99	Compound annual rate of growth for EARN SHSAEX99.
GNP72	Gross national product—1972 dollars.
GNP72FE	Full employment level of real gross national product.
GNP72FERAW	Nonsmoothed potential GNP.
HPM	Weekly hours of production workers—MFG.
HPMFE	Weekly hours of production workers—MFG—full employment.
ICNRCOST	Rental price of capital—nonresidential structures.
ICNRDPNDIS	Present value—1 $ depreciation of nonresidential structures.
ICNR72	Gross investment in private nonresidential structures—years.
IFIXNRCOSTEXP85	Smoothed yearly percentage change in rental price of capital.
IPDENRCOST	Rental price of capital—producers durable equipment.
IPDENRDPNDIS	Present value—1 $ depreciation of producer's durable equipment.
IPDENR72	Nonresidential investment in producers' durable equipment—1972 dollars.
JAH%PRODEXP79	Smoothed yearly percentage change in average hourly earnings adjusted for productivity.
JAHEADJEA	Index of hourly earnings of production workers—private nonfarm.
JAHEADJEAEXP85	Smoothed yearly percentage change in JAHEADJEA.
JQ%MHNF	Index of output per hour of all persons—nonfarm business sector.
JS&P	Standard & Poor's combined index of common stock prices.
JS&PEXP34	Expectations variable for Standard & Poor's stock price index.

MNEMONIC TABLE, VARIABLES USED IN TECHNICAL APPENDIX—Continued

JS&PYIELD	Yield of the Standard and Poor's daily stock price indexes—composite.
KADJ	Age-adjusted capital stock (KNEPDENR72+KNECNR72)/KNETAGEFWINDEX.
KNCNR72	Real net capital stock—nonresidential structures 72$.
KNECNR72	Effective real net capital stock—nonresidential structures 72$.
KNEPDENR72	Effective real net capital stock—producers durable equipment 72$.
KNETAGEFW	Average age of capital stock.
KNETAGEFWINDEX	Index of average age of capital stock.
KNPDENR72	Real net capital stock—producers durable equipment 72$.
LC	Civilian labor force.
LC@N	Labor force participation rate (LC/N18@64).
LETICNR72PQC	Flexible accelerator term: ICNR72.
LETIPDENR72PQC	Flexible accelerator term: IPDENR72.
LETOUTPUTPABE	Real output factored up by PABE ratio.
LETRMMBCNEWNS	Growth in variant of real per capita monetary base.
LIPL	Life insurance policy loans outstanding.
LIRES	Life insurance reserves outstanding.
MINWAGE	Federal minimum wage—dollars per hour.
%MINWAGE	Logarithmic first difference of MINWAGE.
N	Total population including Armed Forces overseas.
NFC VARIABLES	Various variables appearing in nonfinancial corporate flow of funds sector.
NFCBONDS	Nonfinancial corporate bonds and tax exempt bonds.
NM25@54	Total male population aged 25 through 54 years.
N18@64	Population aged 18 through 64.
PABE	Pollution abatement expenditures by U.S. business on capital account.
PARTIPTREND	Time trend used in LC equation.
PC	Implicit price deflator—personal consumption expenditures.
PC&I&G	Implicit price deflator—excluding foreign trade sector.
PCEXP79	Expected rate of inflation—personal expenditures deflator.
PCEXP85	Expected rate of inflation—personal expenditures deflator.
PGNP	Implicit price deflator—gross national product.
PICNR	Implicit price deflator—investment, private nonresidential structures.
PIPDENR	Implicit price deflator—nonresidential producers' durable equipment.
PQC	Flexible accelerator term, PR&D72 equation.
PR&DSTOCK72	Private stock of research and development.
PR&D72	Private investment in research and development.
QSTAR	Expectations variable for real output.
QRU	Logarithim of RU.
RCPIUYAMACRO	Yearly change in the all-urban CPI.
RDEBTSERVICE	Ratio of interest payments on debt to cash flow (nonfinancial corporations).
REALWAGE	Real wages (JAHEADJEA/PC).
RESFRBNB	Reserves, Federal Reserve member banks—nonborrowed.
RMAAAGSLNS	Yield on Moodys AAA corporate bonds.

MNEMONIC TABLE, VARIABLES USED IN TECHNICAL APPENDIX—Continued

RMCDLM	Maximum interest rate payable on large certificates of deposit.
RMCML4@6NS	Money rate, prime commercial paper, 4 to 6 months.
RMDIFF	RMDIFF=MAX ((RMCML4CGNS–RMCDLM), 0).
RMLEADMTGNNS	Effective conventional mortgage rate, new homes—combined lenders.
RMMBCNEWNS	Average yield on new issues of high-grade corporate bonds.
RM1	Prime rate on short-term business loans.
RRADJ	Reserve adjustment for changes in reserve requirements since 1959.
RTCGF	Rate of Federal Government tax of total corporate profits.
RTCGSL	Rate of State and local government tax of corporate profits.
RU	Unemployment rate—all civilian workers.
RUADJ	Adjustment to full-employment unemployment rate.
RUFE	Unemplyment rate at full employment.
SHOCK	Shock component of inflation rate.
TAXBASE	Personal income taxbase.
TIME	Time trend, 1947:1=1.0.
TIMEONE	Time trend, potential GNP.
TIMETWO	Time trend, potential GNP.
TOTALR&DSTOCK72	Total stock of research and development.
TP	Personal tax and nontax payments.
TWPER	Personal contributions for social insurance.
UCAPFRBM	Capacity utilization—manfacturing—total.
UCAPFRBMEXP	Expectations variable for capacity—manfacturing (UCAPFRBM).
UCAPFRBMFE	FRB capacity utilization—manufacturing—full employment.
WPI05	Wholesale price index—fuels and related products and power.
ZA	Corporate profits after tax excluding inventory valuation adjustment.

The following variables were added to the DRI macro model of the United States.

CORE
SHOCK
DEMAND
RCPIUYAMACRO
JAHEADJEAFE
JQ%MHNFE79
IFIXNRCOSTEXP85
GNP72FERAW
GNP72FE
TOTALR&DSTOCK72
PR&DSTOCK72
FEDR&D72
PR&D72
COSTR&DINDEX
PQC

The following table contains historical series for the period 1960:1–1979:1 for the new variables described above.

HISTORICAL DATA

NEWVARIABLES	60:1	60:2	60:3	60:4	61:1	61:2	61:3	61:4	62:1	62:2	62:3	62:4	63:1	63:2	63:3	63:4
CORE	3.3	3.1	3.0	2.8	2.5	2.3	2.0	1.8	1.5	1.4	1.3	1.2	1.2	1.2	1.1	1.1
SHOCK	−0.2	−0.0	0.2	0.4	0.4	0.1	−0.1	−0.2	−0.1	0.2	0.2	0.1	0.1	0.0	−0.1	−0.3
DEMAND	−1.7	−1.3	−1.8	−1.7	−1.4	−1.5	−0.7	−0.8	−0.6	−0.3	−0.3	0.0	−0.0	−0.2	0.4	0.5
RCPIUYAMACRO	1.4	1.8	1.4	1.4	1.5	0.9	1.2	0.7	0.9	1.3	1.2	1.3	1.2	1.0	1.4	1.4
JAHEADJEAFE	0.74	0.75	0.76	0.76	0.77	0.78	0.79	0.80	0.81	0.81	0.82	0.83	0.84	0.85	0.86	0.86
JQ%MHNFFE79	0.78	0.78	0.78	0.78	0.79	0.79	0.79	0.80	0.80	0.80	0.81	0.81	0.82	0.82	0.83	0.83
IFIXNRCOSTEXP85	1.9	1.8	1.8	1.6	1.2	0.7	0.2	0.0	−0.1	−0.1	−0.1	−0.1	−0.1	−0.0	0.0	0.1
GNP72FERAW	761.9	772.8	778.3	784.9	790.7	796.4	799.6	804.0	809.2	814.2	821.6	827.5	835.1	842.3	850.0	857.9
GNP72FE	759.9	766.2	772.6	779.2	785.8	792.4	798.7	804.8	810.6	816.3	822.3	828.4	834.6	840.9	847.4	854.2
TOTALR&DSTOCK72	82.3	83.6	84.9	86.3	87.8	89.2	90.7	92.2	93.7	95.2	96.7	98.1	99.6	101.0	102.5	104.0
PR&DSTOCK72	39.3	39.7	40.1	40.5	41.0	41.4	41.9	42.4	42.9	43.4	43.9	44.4	44.9	45.5	46.0	46.6
PR&D72	6.6	6.5	6.4	6.2	6.4	6.6	6.8	7.1	7.0	7.1	7.2	7.2	7.3	7.5	7.5	7.7
R&DITC	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FEDR&D72	9.2	9.2	9.3	9.4	9.2	9.3	9.2	9.5	9.4	9.5	9.4	9.2	10.5	10.5	10.3	10.2
COSTR&DINDEX	0.6	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7
PQC	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.2	0.3	0.3	0.3	0.3

	64:1	64:2	64:3	64:4	65:1	65:2	65:3	65:4	66:1	66:2	66:3	66:4	67:1	67:2	67:3	67:4
CORE	1.1	1.0	0.9	0.8	0.7	0.6	0.6	0.6	0.7	0.9	1.0	1.2	1.4	1.5	1.6	1.6
SHOCK	−0.1	−0.2	−0.2	−0.2	−0.1	0.2	0.4	0.5	0.9	0.7	0.7	0.4	0.1	0.1	−0.1	−0.1
DEMAND	0.5	0.7	0.4	0.6	0.6	0.8	0.8	0.7	0.8	1.1	1.5	2.0	1.5	0.9	1.2	1.3
RCPTIUAMACRO	1.5	1.5	1.1	1.2	1.2	1.6	1.8	1.8	2.4	2.7	3.2	3.6	2.9	2.6	2.7	2.9
IAHEADJEAFE	0.87	0.88	0.89	0.90	0.91	0.92	0.93	0.93	0.94	0.95	0.96	0.97	0.98	0.99	1.01	1.02
JQ%MHNFFE79	0.84	0.84	0.85	0.86	0.86	0.87	0.87	0.88	0.89	0.89	0.90	0.91	0.92	0.92	0.93	0.94
IFIXNRCOSTEXP85	0.1	0.1	0.1	0.0	−0.0	−0.0	0.0	0.1	0.4	0.8	1.1	1.5	1.9	2.1	2.2	2.1
GNP72FERAW	866.9	880.8	886.5	894.3	902.0	915.1	927.5	938.6	945.3	956.9	969.3	981.3	989.0	1,000.7	1,011.8	1,024.5
GNP72FE	861.3	869.2	877.4	885.6	893.9	902.7	912.0	921.9	931.7	941.7	952.1	962.8	973.4	984.1	995.0	1,006.1
TOTALR&DSTOCK72	105.4	106.9	108.4	109.9	111.6	113.2	114.8.	116.5	118.2	119.8	121.3	122.9	124.5	126.1	127.7	129.3
PR&DSTOCK72	47.2	47.7	48.3	48.9	49.5	50.1	50.8	51.4	52.0	52.7	53.4	54.2	54.9	55.7	56.5	57.4
PR&D72	7.7	7.9	8.0	8.2	8.4	8.6	8.8	8.9	9.2	9.4	9.5	9.6	10.1	10.0	10.1	10.4
R&DITC	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.152	0.150	0.148	0.147	0.142	0.137	0.132	0.128
FEDR&D72	11.2	11.0	10.7	10.4	10.2	10.3	10.4	11.1	10.0	10.4	11.0	11.3	10.4	10.4	10.6	10.60
COSTR&DINDEX	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8
PQC	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.4	0.3	0.3	0.4

	68:1	68:2	68:3	68:4	69:1	69:2	69:3	69:4	70:1	70:2	70:3	70:4	71:1	71:2	71:3	71:4
CORE	1.6	1.8	2.0	2.2	2.5	2.8	3.1	3.5	3.8	4.1	4.3	4.3	4.4	4.3	4.3	4.2
SHOCK	0.0	0.1	0.2	0.4	0.4	0.5	0.5	0.5	0.6	0.3	0.4	0.3	0.6	0.8	0.7	0.6
DEMAND	2.0	2.2	2.2	2.1	1.9	2.2	1.9	1.7	1.9	1.6	1.1	1.0	−0.2	−0.7	−0.7	−1.3
RCPIUYAMACRO	3.6	4.1	4.4	4.7	4.8	5.5	5.6	5.7	6.2	6.0	5.7	5.6	4.8	4.4	4.3	3.5
JAHEADJEAFE	1.03	1.04	1.05	1.07	1.08	1.09	1.11	1.12	1.14	1.15	1.17	1.19	1.20	1.22	1.24	1.26
JQ%MHNFFE79	0.94	0.95	0.96	0.96	0.97	0.97	0.98	0.98	0.99	1.00	1.00	1.01	1.01	1.02	1.02	1.03
IFIXNRCOSTEXP85	2.0	2.1	2.2	2.6	2.9	3.3	3.9	4.5	5.0	5.5	5.8	5.9	5.9	5.7	5.3	5.0

GNP72FERAW	1,030.1	1,041.4	1,046.7	1,055.6	1,065.7	1,075.7	1,091.2	1,102.2	1,114.0	1,121.5	1,133.5	1,140.8	1,147.8	1,154.0	1,162.2	1,169.9
GNP72FE	1,016.8	1,027.5	1,037.7	1,047.5	1,057.2	1,066.9	1,077.2	1,087.9	1,098.9	1,109.7	1,120.6	1,131.3	1,141.5	1,151.2	1,160.5	1,169.4
TOTALR&DSTOCK72	131.0	132.7	134.4	136.0	137.7	139.3	140.9	142.5	144.1	145.6	147.1	148.6	150.1	151.4	152.7	153.9
PR&DSTOCK72	58.2	59.1	60.0	61.0	61.9	62.9	63.8	64.8	65.8	66.9	67.9	68.9	70.0	71.0	72.0	73.0
PR&D72	10.5	10.7	10.8	10.9	11.3	11.3	11.5	11.4	11.4	11.3	11.3	11.0	10.9	11.0	11.1	11.3
R&DITC	0.119	0.116	0.113	0.111	0.109	0.108	0.106	0.104	0.106	0.105	0.102	0.098	0.0	0.0	0.0	0.0
FEDR&D72	10.5	10.5	10.3	10.2	9.9	9.8	9.9	9.7	9.4	8.9	8.7	8.7	8.7	8.3	8.0	8.1
COSTR&DINDEX	0.8	0.8	0.8	0.8	0.8	0.9	0.9	0.9	0.8	0.9	0.9	0.9	0.9	0.9	0.9	0.9
PQC	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
	72:1	72:2	72:3	72:4	73:1	73:2	73:3	73:4	74:1	74:2	74:3	74:4	75:1	75:2	75:3	75:4
CORE	4.2	4.2	4.2	4.1	4.1	4.2	4.4	4.7	5.1	5.6	6.3	7.0	7.6	8.0	8.0	8.0
SHOCK	0.6	0.7	1.0	1.1	2.0	2.8	3.3	3.6	4.0	4.0	3.6	3.6	1.7	1.2	0.9	0.8
DEMAND	−1.3	−1.6	−2.0	−1.8	−2.1	−1.4	−1.0	0.1	0.8	0.9	1.6	1.6	1.7	0.5	−0.2	−1.4
RCPIUYAMACRO	3.5	3.2	3.1	3.4	4.1	5.6	6.8	8.3	9.9	10.5	11.5	12.2	11.1	9.7	8.7	7.3
JAHEADJEAFE	1.28	1.29	1.31	1.33	1.35	1.37	1.39	1.41	1.43	1.46	1.49	1.52	1.55	1.58	1.61	1.65
JQ%MIINFFE79	1.03	1.03	1.04	1.04	1.05	1.05	1.05	1.06	1.06	1.06	1.06	1.07	1.07	1.07	1.07	1.08
IFIXNRCOSTEXP85	4.6	4.3	4.1	4.0	4.0	4.2	4.5	5.0	5.5	6.1	6.9	7.7	8.4	8.9	9.1	9.3
GNP72FERAW	1,176.4	1,186.7	1,196.0	1,205.9	1,214.4	1,228.2	1,235.9	1,247.7	1,257.9	1,267.4	1,273.9	1,288.8	1,292.9	1,312.0	1,309.9	1,313.0
GNP72FE	1,178.1	1,186.7	1,195.4	1,204.3	1,213.3	1,222.8	1,232.4	1,242.3	1,252.4	1,262.6	1,273.1	1,283.6	1,293.5	1,304.0	1,313.7	1,322.5
TOTALR&DSTOCK72	154.9	155.9	156.8	157.5	158.3	159.0	159.7	160.4	161.1	161.9	162.6	163.4	164.1	164.8	165.6	166.2
PR&DSTOCK72	73.9	74.8	75.6	76.4	77.2	77.9	78.7	79.5	80.3	81.2	82.1	83.0	83.9	84.9	85.8	86.8
PR&D72	11.1	11.4	11.6	12.0	12.2	12.3	12.5	12.5	12.7	12.8	12.9	12.2	11.8	11.9	12.5	12.8
R&DITC	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FEDR&D72	8.3	8.2	7.8	7.8	7.9	7.6	7.4	7.5	7.3	7.2	7.2	7.1	7.2	7.2	7.1	7.2
COSTR&DINDEX	1.0	1.0	1.0	1.0	1.0	1.1	1.1	1.1	1.1	1.1	1.2	1.2	1.2	1.2	1.2	1.2
PQC	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
	76:1	76:2	76:3	76:4	77:1	77:2	77:3	77:4	78:1	78:2	78:3	78:4	79:1	79:2	79:3	79:4
CORE	7.8	7.7	7.6	7.6	7.6	7.6	7.7	7.7	7.8	7.8	7.8	7.9	8.0	8.1	8.2	8.4
SHOCK	1.3	0.9	0.2	0.1	0.8	1.0	0.8	0.5	0.5	0.7	1.4	1.6	1.8	1.9	2.5	2.9
DEMAND	−2.7	−2.5	−2.4	−2.7	−2.5	−1.9	−1.8	−1.6	−1.7	−1.4	−1.2	−0.5	0.0	0.6	1.0	1.4
RCPIUYAMACRO	6.4	6.0	5.4	5.0	5.9	6.8	6.6	6.7	6.6	7.1	8.0	9.0	9.8	10.6	11.7	12.6
JAHEADJEAFE	1.68	1.71	1.74	1.77	1.81	1.84	1.88	1.91	1.95	1.98	2.02	2.06	2.10	2.14	2.19	2.23
JQ%MHNFFE79	1.08	1.09	1.09	1.09	1.10	1.10	1.10	1.11	1.11	1.11	1.11	1.12	1.12	1.12	1.13	1.13
IFIXNRCOSTEXP85	9.5	9.6	9.7	9.8	9.9	9.9	10.0	10.1	10.2	10.3	10.4	10.4	10.4	10.4	10.4	10.4
GNP72FERAW	1,323.4	1,331.8	1,339.5	1,349.6	1,358.2	1,370.7	1,380.5	1,392.3	1,404.7	1,417.6	1,428.5	1,441.0	1,458.2	1,463.0	1,476.8	1,487.6
GNP72FE	1,331.5	1,339.6	1,347.7	1,356.0	1,364.4	1,373.3	1,382.5	1,392.2	1,402.3	1,413.0	1,424.0	1,435.3	1,447.4	1,459.2	1,471.1	1,482.9
TOTALR&DSTOCK72	166.9	167.4	167.9	168.3	168.8	169.3	169.9	170.5	171.2	171.9	172.9	174.1	175.5	176.7	177.7	178.5
PR&DSTOCK72	87.7	88.5	89.2	89.9	90.7	91.4	92.2	93.1	93.9	94.9	96.1	97.5	99.0	100.3	101.4	102.4
PR&D72	12.8	13.0	13.1	13.2	16.0	16.2	16.4	16.4	13.3	13.6	13.7	14.0	14.0	14.3	14.6	14.1
R&DITC	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FEDR&D72	7.3	7.2	7.1	7.1	7.2	7.4	7.5	7.6	7.3	7.3	7.2	7.2	7.2	7.2	7.3	7.3
COSTR&DINDEX	1.3	1.3	1.3	1.3	1.4	1.4	1.4	1.5	1.5	1.5	1.5	1.6	1.6	1.6	1.6	1.6
PQC	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3