

# The Macroeconomic Impact of Changes in Income Taxes in the Short and Medium Runs

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The effects of an unexpected change in income taxes are studied in a model with full rational expectations. In the short run, aggregate supply is quite price elastic because commitments to pay predetermined wages are made 1 or more years in advance. The model also recognizes the limited response of investment to unexpected developments in the short run. The paper finds that much of the effect of unexpected tax policy operates through inflationary expectations—an economy with rational expectations is more responsive to tax changes than is one with naive expectations.

This paper takes a new look at an old question of fiscal stabilization policy: How much stimulus does a tax reduction impart over the time period of concern in stabilization, say, up to 5 years hence? The question is studied within a small empirical model that embodies a number of important modern principles of macroeconomics, particularly the view that expectations are formed rationally. A major purpose of this paper is to formulate an empirical macroeconomic model in a way that overcomes Robert Lucas's (1976) fundamental objection that existing models are incapable of analyzing economic policy.

The immediate effect of a tax reduction is increased consumption, according to the standard view. Though the standard view is not universally accepted, it is a maintained hypothesis of this paper. If tax cuts have no effect on consumption, they have no effect at all, and there is

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nothing further to say about fiscal stabilization. An increase in consumption drives aggregate output up its supply schedule. To the extent that supply is less than perfectly price elastic, part of the expansionary effect is dissipated in increased prices. Further, the increased nominal GNP brought about by the combination of output and price increases drives up the interest rate, which in turn depresses investment. Real output rises by less than the increase in consumption on account of this "crowding out." Finally, in the medium run, the adverse effects of fiscal expansion on aggregate supply become important, as the capital stock falls increasingly short of its level in the absence of the tax cut.

This brief summary of the macroeconomic response to a tax reduction calls attention to the major empirical issues that arise in trying to give specific numerical values for the effects on the important variables. First, how much does a tax cut stimulate consumption, if at all? This paper cites evidence that whatever effect personal tax rates have on consumption acts through permanent income, but it does not attempt to link specific tax changes to changes in permanent income. Second, how price inelastic is aggregate supply, in the short and medium runs? This decomposes into two issues, the response of prices to output with the wage held constant and the response of the wage to the demand for labor. Most of the original material in this paper deals with these central issues. Previous analysis of fiscal stabilization has made the extreme Keynesian assumption of perfectly elastic supply (fixed prices) or the extreme classical assumption of perfectly inelastic supply (full employment). This paper embodies a theoretically defensible compromise in which the price elasticity of supply is fairly high but not infinite in the short run and approaches zero in the medium run.

The third issue is the strength of crowding out. How do interest rates respond to an increase in nominal GNP? How does investment respond to interest rates? Here the paper relies primarily on earlier research on the demands for money and investment, except that the lags in investment are specified in a way that is consistent with the shifts over time in the price elasticity of aggregate supply. Finally, the fourth issue is the adverse shift of the aggregate supply schedule in the medium run as fiscal policy depresses the capital stock. This issue has largely escaped attention in formal analysis, because it does not arise in Keynesian macroeconomic models—a leftward shift of aggregate supply has no effect under the assumption of fixed prices.

The model used here takes advantage of several basic principles of macroeconomics whose importance has become recognized in recent years, though it could hardly be said that the principles are universally accepted. The celebrated permanent income-life cycle hypothesis appears in the model in a strong form; "multiplier effects" are essentially ruled out. The model contains no arbitrary distributed lags or other mechan-

isms to explain expectations but, instead, rests on the principle of rational expectations where economic agents form expectations by thinking about the future. But the model also recognizes that economic agents rationally enter into contracts that commit themselves unconditionally to future transactions over a span of time that covers the short and medium runs. These commitments explain the high price elasticity of supply in the short run. As they expire, aggregate supply becomes less price elastic. Finally, the model follows modern investment theory in linking investment to the underlying factor demand for capital services.

Experimentation with the complete model reaches the unsurprising conclusion that the impact of an unexpected tax reduction depends crucially on the interest elasticity of the demand for money. If money demand is highly interest elastic, real output rises by more than the increase in consumption because of an induced increase in investment, the conventional Keynesian analysis of fiscal expansion. If money demand is totally unresponsive to the nominal interest rate, the conventional monetarist analysis applies: at first, increased consumption is exactly offset by decreased investment, and real output remains unchanged, but in later years real output is decreased by the tax reduction because of the shortfall in the capital stock. But empirical evidence on the demand for money rejects both of these cases in favor of an intermediate case where a tax reduction has a substantial expansionary effect in the first few years through a novel channel. Fiscal expansion immediately brings about expectations of inflation, which causes the holders of money to economize on its use without any increase in the real interest rate. The resulting expansion is similar to the one that would follow an unexpected increase in the nominal money supply of corresponding magnitude. Two major features of the model contribute to this conclusion: the aggregate supply system, which predicts future price levels and therefore today's expected inflation, and the use of rational expectations in the link between the real interest rate and the nominal interest rate.

### **Aggregate Supply**

The price elasticity of aggregate supply is a central issue in the analysis of fiscal stabilization. In the model, the price elasticity of the supply brought forth by an unexpected tax cut is high in the short run but approaches zero in the medium run. The high elasticity in the short run is attributable to the existence of contracts for labor input which provide highly wage-elastic labor supply in response to changes in demand that occur after the terms of the contract are set. As time passes after the tax cut, more and more contracts are renegotiated, and the demand shift is gradually offset by shifts of the labor supply schedule. When the process reaches its conclusion, the expansion has no lasting real effect within the

labor market—it is translated entirely into increases in the nominal wage.<sup>1</sup>

On the other hand, aggregate supply is less price elastic in the short run than in the long run because of lags in adjusting capital inputs. When demand rises unexpectedly, the supply response at first will be based on the short-run marginal cost schedule established by the existing fixed-capital stock. Later, as capital becomes freely adjustable, the aggregate supply schedule becomes more price elastic on this account.

A model of these processes must treat the workers hired under different contracts as different factors of production, or else firms would simply concentrate all employment in the group with the lowest contractual wage. Similarly, capital goods with different delivery times must be imperfect substitutes in use, or else firms would meet all their needs with the goods with the shortest delivery times. For simplicity, I will assume that there are  $M$  kinds of workers, each covered by a wage contract lasting  $M$  years, and that one group negotiates each year. For capital, there are  $N$  types, and type  $j$  requires that its quantity be determined  $j$  years in advance.

All groups of labor and all types of capital enter the production function symmetrically, so in the absence of planning errors all groups of labor will be employed at equal levels and all types of capital will be used in equal amounts. By hypothesis, the only surprise is the unexpected tax cut in year 1. Thus all wage and capital commitments made before year 1 should be equal, and all those made during and after year 1 should be equal, across groups of labor and types of capital in the same year. In year  $t$ , the amount of labor input from group  $i$ ,  $L_{it}$ , and capital of type  $j$ ,  $K_{jt}$ , are

$$\begin{aligned} L_{it} &= \hat{L}_t & i \leq t, \\ &= L_t & i > t; \\ K_{jt} &= \hat{K}_t & j \leq t; \\ &= \bar{K}_t & j > t. \end{aligned}$$

Here  $\hat{L}_t$  and  $\hat{K}_t$  are the common levels of labor when its wage is adjustable and capital when its quantity is adjustable;  $L_t$  and  $\bar{K}_t$  are the common

<sup>1</sup>It is hard to do justice to the voluminous recent literature treating this hypothesis. Fischer (1977) presents a fully worked-out theoretical model in a simple case. The contracts referred to are not just collective bargaining agreements—see Baily (1974), Azariadis (1975), Grossman (1975), and Okun (1975). Gordon (1976) gives many references in this area. For reasons given in Hall (1975), the slow diffusion of information in the labor market emphasized in earlier work on wage adjustment does not seem to be an important explanation of the temporary fixity of wages. A discussion of the reasons for setting the wage and not the quantity of labor in the labor contract appears in Hall and Lilien (1977).

levels of labor when the wage is held at the level contracted before year 1 to apply in year  $t$  and capital input contracted before year 1 to be available in year  $t$ .

The production function is assumed to be Cobb-Douglas in  $M + N$  factors:

$$X_t = \alpha_0 L_1^{\alpha/M} \dots L_{Mt}^{\alpha/M} K_1^{(1-\alpha)/N} \dots K_{Nt}^{(1-\alpha)/N}.$$

I define  $f_t$  as the fraction of the labor force whose contracts have been negotiated since the policy surprise:  $f_t = (t - 1)/M$  or 1, whichever is smaller, and  $g_t$  as the fraction of capital whose quantity has been set since the surprise:  $g_t = (t - 1)/N$  or 1, whichever is smaller. Then the production function is

$$X_t = \alpha_0 \hat{L}_t^{\alpha} \bar{L}_t^{(1-f_t)\alpha} \hat{K}_t^{g_t(1-\alpha)} \bar{K}_t^{(1-g_t)(1-\alpha)}.$$

Total labor input is seen to be a geometrically weighted average of its level under the wage determined before the surprise and the level resulting from negotiation afterward, and similarly for capital.

For labor groups with predetermined wages  $\bar{w}_t$ , (all groups have the same  $\bar{w}_t$ , for the reason mentioned earlier), the cost-minimizing level of employment for producing output  $X_t$  is  $\hat{L}_t = \alpha(p_t X_t / \bar{w}_t)$ . Similarly, the cost-minimizing level of capital input after capital becomes adjustable is  $\hat{K}_t = (1 - \alpha)(X_t / v_t)$ . Here  $v_t$  is the real rental price of capital, which is the same in all adjustable categories because the various types of capital goods are assumed perfect substitutes in production. The determination of labor input after the wage bargain can respond to the policy surprise involves some subtle issues. Rather than pursue them very far, I will simply assume that there is a natural level of employment,  $\hat{L}_t$ , and that the wage bargain attempts to set actual employment to its natural rate. If the labor market is purely competitive, labor supply is wage inelastic, and there is no frictional unemployment, then  $\hat{L}_t$  will just be the labor force. If there is a natural rate of turnover, then  $\hat{L}_t$  will be the labor force less the resulting frictional unemployment. In unionized markets, it is a reasonable hypothesis that unions set wages to achieve full employment for union members, in which case  $\hat{L}_t$  is union membership (for elaboration, see Hall and Lilien 1977). The hypothesis that the wage will fluctuate to set employment to its natural rate is the first and by far the most important role of rational expectations in the model. It has the strong implication that employment will always converge in  $M$  years to its natural level from any shock caused by unexpected fiscal policy.

### Investment

Modern investment theory is dominated by the principle that investment is derived from the factor demand for capital services, though theoretical

macroeconomic models still often make investment an arbitrary function of output and interest rates, not derived from the production function. The major unsettled issue is the way to incorporate the lag of investment behind changes in the demand for capital goods that arises from the time required to plan, design, build, and deliver capital goods. The theory of aggregate supply developed in the previous section contains within it a specification of investment behavior as constrained by the lag. Within the  $N$  years following an unexpected development, observed investment consists of a combination of investment at a level  $I_t$  for types of goods contracted before the surprise [ $I_t = \bar{K}_{t+1} - (1 - \delta)\bar{K}_t$ ] and level  $\hat{I}_t$  for those contracted for afterward. Total investment is the weighted average of the two:  $I_t = g_{t+1}I_t + (1 - g_{t+1})\hat{I}_t$ . Investment in year  $t$  is intended to meet the need for capital services in year  $t + 1$ . The demand for capital services in each flexible category is  $(1 - \alpha)X_{t+1}/v_{t+1}$ . In the preceding year, investment  $\hat{I}_t$  is set at the level needed to achieve the demand. The average amount of capital in each category in the absence of any further investment would be  $(1 - \delta)[h_t\hat{K}_t + (1 - h_t)\bar{K}_t]$  ( $\delta$  is the rate of depreciation of capital;  $h_t$  is  $[t - 1]/t$  or 1;  $t - 1$  of the types were flexible in the previous year and have capital  $[1 - \delta]\hat{K}_t$ , and one just became flexible and has  $[1 - \delta]\bar{K}_t$ ). The  $\hat{I}_t$  that closes the gap is  $\hat{I}_t = (1 - \alpha)(X_{t+1}/v_{t+1}) - (1 - \delta)[h_t\hat{K}_t + (1 - h_t)\bar{K}_t]$ . The response over time of investment to an unexpected change in the demand for output is not unlike the response of the ad hoc distributed lag models of Jorgenson (1965) and others. In addition to integrating the theory of the short-run supply function and the theory of investment, the formulation of the investment function proposed here accomplishes the distinction between expected and unexpected changes in demand that is essential for the purposes of the paper.

### Consumption

The sensitivity of current consumption to current income is an important element of modern macroeconomic thought, though few economists today would make consumption exclusively a function of current income. Under the influence of the permanent income–life cycle theory, recent empirical work generally considers consumption a function of permanent income or its equivalent concept in stocks, total human and nonhuman wealth. Permanent income, or the human component of wealth, is in turn a weighted average of current and lagged income. However, the weight assigned to current income is fairly high, so the multiplier process operates to magnify stabilization policies even in the period in which they take effect. The magnification becomes stronger in the year or so following.

The sensitivity of consumption to current income is somewhat out of tune with the permanent income–life cycle theory, which emphasizes

the long-run determinants of consumption but is apparently easily rationalized by appeal to imperfect credit markets, contractual savings, and other practical considerations that make consumption, not savings, the residual that absorbs a temporary fluctuation of income. Elsewhere I have argued (Hall 1977) that the factual support for this modern consensus is much weaker than is generally thought. In fact, the data seem to point in rather a different direction. The high contemporaneous correlation of consumption and income can be explained by important movements in permanent income from year to year, which of course induce similar movements in consumption, in line with the pure theory. It is true that permanent income is formed by consideration of the long run, but every year new information becomes available that changes the long-run prospects of consumers. Permanent income does not evolve smoothly in the way suggested by the moving average model. Quite to the contrary, the logic of permanent income suggests that every movement around its trend should be unexpected, for the same reason that every departure of stock prices from trend should be unexpected: everything expected about future movements is already incorporated in this year's level. Permanent income should be a random walk. Empirically, the view that all movements of consumption about its trend are unexpected stands up very well.<sup>2</sup>

The random-walk theory of consumption has a clear implication for forecasting: wherever consumption is today relative to its trend, the best forecast for any future year is that it will be just as far from its trend. For example, at the trough of a recession, there is no good reason to forecast a return of consumption to its prerecession level relative to trend.<sup>3</sup> In the benchmark forecast presented later in this paper, therefore, consumption is simply extrapolated by its trend rate of growth from its current level. There is no consumption function.

The analysis of the response of consumption to an economic surprise is more complex. When taxes are cut unexpectedly, consumers reevaluate their permanent incomes, which requires thought about the possible future behavior of tax rates. Under certain conditions, most important that the future path of government expenditures be unaffected by whatever brought about the tax cut, a tax cut has no effect on permanent income.<sup>4</sup> In other circumstances, a fiscal program may well affect permanent income. If a tax cut is widely interpreted as a sign of reduced

<sup>2</sup>See Hall (1977), where the stochastic behavior of consumption is decomposed into a random walk and a stable transitory term, and no strong evidence is found that the transitory term is important. McCulloch (1975) argues that, empirically, income itself is essentially a random walk, but he does not provide a rationale for the finding.

<sup>3</sup>Of course one must distinguish between consumption and expenditure on consumption goods; see Darby (1974). The evidence in Hall (1977) sidesteps this problem by dealing with consumption of nondurables and services.

<sup>4</sup>See Barro (1974).

future government expenditures, for example, then its stimulative effect could be substantial. There are two good reasons for stopping short of building a formal model of the relation between taxes and permanent income. In the first place, the effect of the announcement of the program on permanent income in the year of the announcement is all that the rest of the model needs to know about the program, since consumption in later years will be expected to follow its usual trend, displaced upward by the same proportion in each year. In the second place, the issues involved in relating fiscal programs to permanent income are the subject of extreme controversy and are as much political as economic. The purpose of this paper is to study the effect of any one of the many programs that has a given effect on consumption (specifically, \$10 billion in 1972 dollars), and not to enter the debate about exactly what these programs do.

### The Money Market

Money is an important determinant of real economic activity precisely to the extent that prices are fixed over time in money terms. In this model, the contractual fixity of money wages extends up to 5 years in the future with steadily diminishing effect. Within this period, fixing the money stock also tends to fix real output.

No purpose would be served here by an elaborate model of financial markets. Rather, the money supply is taken as exogenous, and money demand is characterized by a relation between velocity and the cost of holding money,  $r_t$ :  $\log(p_t X_t / M_t) = \psi_0 + \psi_1 r_t + \mu_2 t$ . Financial intermediaries, including corporations, are netted out, and the only other form of property that can be held is real capital. The net return to adjustable capital is  $v_t - \delta - \theta + (p_{t+1} - p_t)/p_t$ . Inserting this in place of  $r_t$  in the money demand function gives a compact statement of financial equilibrium. Here again, rational expectations play an important role through the future price,  $p_{t+1}$ , in the cost of holding money.

### Summary of the Model

The model consists of the following equations:

Production function:

$$X_t = \alpha_0 e^{\mu_1 t} \bar{L}_t^{\alpha f} \bar{L}_t^{\alpha(1-f)} \bar{K}_t^{(1-\alpha)g} \bar{K}_t^{(1-\alpha)(1-g)} \quad (1)$$

GNP identity:

$$X_t = C_t + I_t + G_t \quad (2)$$

Demand for labor for groups with predetermined wage:

$$L_t = \alpha \frac{p_t X_t}{\bar{w}_t} \quad (3)$$



Investment in flexible capital:

$$\hat{I}_t = (1 - \alpha) \frac{X_{t+1}}{v_{t+1}} - (1 - \delta)[h_{t+1}\hat{K}_t + (1 - h_{t+1})\bar{K}_t]. \quad (4)$$

Accumulation identity for flexible capital:

$$\hat{K}_t = \hat{I}_{t-1} + (1 - \delta)[h_t\hat{K}_{t-1} + (1 - h_t)\bar{K}_{t-1}]. \quad (5)$$

Total investment:

$$I_t = g_{t+1}\hat{I}_t + (1 - g_{t+1})\bar{I}_t. \quad (6)$$

Demand for money:

$$\log \frac{p_t X_t}{M_t} = \psi_0 + \psi_1 r_t + \mu_2 l. \quad (7)$$

Equality of the nominal return to capital and the nominal interest rate:

$$v_t - \delta - \theta + \frac{p_{t+1} - p_t}{p_t} = r_t. \quad (8)$$

The endogenous variables are

1.  $X_t$ : real GNP
2.  $p_t$ : price level
3.  $\bar{L}_t$ : employment in groups with predetermined wages
4.  $\hat{I}_t$ : investment in flexible categories of capital
5.  $\hat{K}_t$ : stock of flexible capital
6.  $I_t$ : total investment
7.  $r_t$ : nominal interest rate
8.  $v_t$ : real gross rental price of capital

The exogenous or predetermined variables are

1.  $\bar{L}_t$ : natural rate of employment
2.  $\bar{K}_t$ : stock of inflexible capital
3.  $\bar{I}_t$ : predetermined investment in inflexible capital
4.  $C_t$ : consumption
5.  $G_t$ : government expenditures
6.  $\bar{w}_t$ : predetermined contract wage
7.  $M_t$ : nominal stock of money

### Determination of the Initial Price Level

Though the model contains the same number of equations and endogenous variables, the presence of future variables in certain equations implies that it is underdetermined by order one—fixing any single variable in any single year is enough to determine all variables in all years fully. It is most convenient to think of  $p_1$ , the price level in the year of the policy

surprise, as the quantity to be determined by further considerations. Each value of  $p_1$  corresponds to a different trajectory of prices and real quantities over the period of concern; higher  $p_1$  not only implies higher subsequent prices but higher rates of inflation in every subsequent year. The indeterminacy of the initial price level is a universal characteristic of monetary theories involving perfect foresight or rational expectations.<sup>5</sup> It is possible to show that there is only a single value of  $p_1$  for which the present model predicts an infinite trajectory for the price level. If  $p_1$  is below that value,  $p_t$  eventually becomes negative, and if it is above,  $p_t$  reaches infinity in finite time. In fact, the simple requirement that the price level in 14 years be positive and less than 100 times its initial value suffices to identify  $p_1$  to at least one part in 1,000. In the results reported later in this paper, the requirement was imposed that the terminal rate of inflation after 14 years lies between 4 and 6 percent, which determines  $p_1$  to better than one part in 10,000. Within the framework of rational expectations, there seems no additional difficulty in resolving the ambiguity of the initial price level—the hypothesis that the participants in the economy expect the monetary economy to continue functioning in the next 14 years is all that is required.

### Assignment of Parameter Values

The elasticity of output with respect to total labor input,  $\alpha$ , is measured by the share of total labor compensation in GNP, which is historically stable and was taken at its 1974 value of 0.656. The length of the typical labor contract,  $M$ , was taken as 5 years. This is longer than any collective bargaining agreement, but lower values are inconsistent with the known persistence of unemployment. In terms of the theory of implicit labor contracts, this implies that the typical worker who remains with the same employer remains isolated from the market for 5 years. For capital, the planning horizon,  $N$ , was taken as 2 years—half of the capital stock can be adjusted in 1 year and the remaining half in 2 years. This is roughly consistent with estimates of distributed lags from ad hoc adjustment models and also with surveys on lead times as perceived by businessmen.

The single most important parameter in the model is the coefficient,  $\psi_1$ , of the interest rate in the equation for the log of monetary velocity. An increase of 100 basis points in  $r$  increases  $pX/M$  by  $\psi_1$  percentage points. Under the crude quantity theory ( $\psi_1 = 0$ ), expansionary fiscal policy has no immediate effect on real output and a depressing effect in the medium run, because crowding out reduces the capital stock. But the evidence against the pure quantity theory is fairly convincing—see

<sup>5</sup>See Brock (1975), who observes that the consumer's budget constraint provides the appropriate identifying condition.

especially Goldfeld (1973). The most likely value for  $\psi_1$  seems to be 2.0 or perhaps somewhat less.

The various trends and constants in the model are  $\alpha_1 = 5.41$  (constant in production function);  $\mu_1 = 1.9\%$ /year (rate of productivity growth);  $\delta = 10\%$ /year (rate of depreciation of capital);  $\theta = 18\%$  (rate of tax on capital as a fraction of the value of capital);  $\psi_0 = 1.561$  (constant in equation for log of velocity); and  $\psi_2 = 2.7\%$ /year (trend rate of growth of velocity).

### Estimates of the Impact of a Tax Reduction

The various effects of tax policy depend on the state of the economy at the time of the policy. For the sake of concreteness, I will begin with a description of the possible evolution of the U.S. economy over the period 1976–80 under the assumption that no surprising events are to take place in those 5 years. Further assumptions underlying this forecast appear in table 1B.<sup>6</sup> Monetary growth is projected at around 7 percent throughout. Future wage increases already agreed upon in 1976 are assumed to be around 7.5 percent. Investment commitments are assumed to be roughly as given in independent forecasts and surveys of investment intentions (recall that this variable is defined to be approximately half the actual level of investment). The rate of growth of the natural level of employment is assumed to be 1.4 percent per year, in line with recent growth in the labor force adjusted for employment conditions. Finally, total predetermined expenditures (consumption, net exports, and government expenditures) are assumed to grow at 3.8 percent per year from their 1976 level of \$1,100 billion.

The forecast obtained by the method described earlier does not differ markedly from others made at the time of this writing (June 1976). Real output is expected to grow at 4.7 percent from 1976 to 1977, 4.2 percent from 1977 to 1978, and 3.9 percent thereafter. The initial bulge of growth is associated with the return of employment to its natural level, an intrinsic feature of the model. The rate of inflation falls somewhat during the period, as does the nominal interest rate. The real return to capital rises slightly and then falls.

Table 2 shows the perturbation in the forecast caused by the unexpected announcement of a tax cut in 1976 that brings about an increase of \$10 billion in predetermined expenditures in 1972 dollars.<sup>7</sup> In table 2

<sup>6</sup>Table 1 does not present the assumptions for the years 1981–90 that are needed to determine  $p_1$ , but in all cases further extrapolation at the stated rates of growth was used.

<sup>7</sup>Again, it is necessary to specify the path of expenditures through 1990 to compute  $p_1$ . I assumed that government expenditures fell by \$12.5 billion in 1981–90, so that total predetermined expenditure was \$2.5 billion less than assumed in the original forecast. This “pays back” half of the \$50 billion in extra expenditure during 1976–80.

TABLE 1  
A. FORECAST FOR 1976-80

Year	Real Output, $X$ (Billions 1972 \$)	Price Level, $p$ (1972 = 1.000)	Rate of Inflation, $(p_{t+1} - p_t)/p_t$ (%)	Nominal Interest Rate, $r$ , (%)	Net Real Return to Capital, $v - \delta - \theta$ (%)
1976....	1,299	1.350	5.2	7.9	2.7
1977....	1,360	1.421	5.2	7.8	2.6
1978....	1,417	1.495	4.9	7.8	2.9
1979....	1,473	1.567	4.8	7.6	2.7
1980....	1,531	1.643	4.6	7.1	2.5

B. ASSUMPTIONS

Year	Money Stock, $M$ (Billions)	Contract Wage, $\bar{w}$ (\$ Thousands/ Year)	Investment Com- mitments, $\bar{I}$ (Billions 1972 \$)	Natural Level of Employment $L$ (Millions)	Pre- determined Expen- diture, $C + N + G$ (Billions 1972 \$)
1976....	306	12.7	89	89.8	1,100
1977....	329	13.6	100	91.1	1,143
1978....	351	14.6	...	92.3	1,187
1979....	374	15.7	...	93.6	1,233
1980....	400	16.9	...	94.9	1,281

the parameter controlling the response of velocity to the nominal interest rate is taken at the high end of its likely range, 2.0. Under this assumption the tax cut brings about a substantial increase in total real output not only in the year of the announcement but also in the 2 succeeding years, as shown in the first column. These increases are movements up the aggregate supply schedule and carry with them increases in the price level, as shown in the second column. These grow over time, so the expansionary policy raises the rate of inflation, as shown in the third column. Because the increase in total real output is smaller than the increase in predetermined expenditure, investment is smaller, and the real return to capital is higher. The increase in real output and employment also raises the real return to capital. The first influence strengthens over time, and the second weakens; and the net effect of the expansionary program is roughly the same 20-basis-point increase in the real return to capital. This appears in the fourth column. The effect of the tax cut on the nominal interest rate, shown in the last column, is just the sum of the effects on the rate of inflation and on the real return to capital and is roughly stable over time at just over 50 basis points.

The conventional analysis of the effect of fiscal policy explains part of the story of table 2. An increase in the demand for goods drives up the

TABLE 2  
EFFECTS OF TAX CUT, INTEREST-ELASTIC MONEY DEMAND

Year	Real Output (Billions 1972 \$)	Price Level (Ratio Expressed as %)	Rate of Inflation (Percent- age Points)	Nominal Interest (Percent- age Points)	Real to Capital (Percent- age Points)
1976....	7	.37	.28	.46	.18
1977....	6	.56	.29	.52	.23
1978....	4	.80	.35	.53	.18
1979....	-1	1.21	.36	.56	.20
1980....	-7	1.52	.29	.55	.26

interest rate by increasing the demand for money. The increase in the interest rate depresses investment. On the other hand, an increase in total output stimulates investment. The net effect on investment is negative in this case, but it could be positive if the interest effect on investment were smaller. In the vocabulary of Hicks's IS-LM analysis, table 2 corresponds to a fairly horizontal IS curve and a fairly vertical LM curve.

Table 2 also points out an unconventional channel of fiscal policy, which actually accounts for well over half of the total effect of a tax reduction. Most of the increase in the nominal interest rate is attributable to the increased expected rate of inflation (28 basis points in 1977) rather than to the increased real rate of interest (18 basis points). It is this increase in the nominal rate that makes the increased nominal GNP consistent with the money demand function. But expectations of inflation have no effect on investment, so the stimulus on this account is unambiguously positive. In other words, fiscal policy obtains most of its effect in the first years by raising expected rates of inflation, which brings about a higher level of nominal GNP.<sup>8</sup> In the early years, the higher nominal GNP means a higher real GNP, but fairly soon the price level catches up, and the real GNP falls behind its level in the absence of the expansionary policy. Increased GNP and employment in the first few years is a benefit of the notorious inflation tax associated with inflationary policies. The tax brings about a conservation in the use of money which is desirable in an economy where temporarily fixed wages are responsible for suboptimal levels of employment.

Needless to say, this conclusion rests critically on the response of money demand to the nominal interest rate. If money demand is highly interest elastic, real output will expand by considerably more than the increase in real predetermined expenditures. The increment will go to increase the capital stock in the future. Although the price level will rise sharply in the year of the announcement of the policy, expectations

<sup>8</sup>The expansionary effect of an exogenous increase in the expected rate of inflation was pointed out by Mundell (1963) some years ago.

TABLE 3  
EFFECTS OF TAX CUT, LESS INTEREST-ELASTIC MONEY DEMAND

Year	Real Output (Billions 1972 \$)	Rate of Inflation (Percentage Points)	Real Return to Capital (Percentage Points)	Nominal Interest Rate (Percentage Points)
1976.....	3	.34	.08	.42
1977.....	2	.31	.31	.62
1978.....	-1	.43	.25	.68
1979.....	-5	.36	.34	.80
1980.....	-12	.40	.45	.85

of its future favorable effect on supply will cause the policy to have a *negative* effect on expected inflation. This case will not be pursued here, because empirical evidence does not support a more interest-elastic money demand function than the one in table 2.

The case for fiscal policy is much less favorable at the other end of the range of likely values for the interest response of money demand. Table 3 repeats table 2 for  $\psi_1 = 1.0$ . Here the analysis based on the simple quantity theory is close to the truth. The adverse effect of the increase in predetermined expenditures on aggregate supply is more severe, and the policy stimulates larger increases in expected inflation. But these do less to increase velocity and thus to permit a larger nominal GNP. The initial favorable effect on real GNP is smaller and more quickly reversed by the adverse effect of reduced aggregate supply.

## Conclusions

The hypothesis of rational expectations does not rule out an important influence of fiscal policy over a 5-year period, provided that two conditions are met. First, employment decisions must be influenced by contracts that make the nominal wages of part of the labor force unresponsive to the effects of the policy during this period. Though much additional thought needs to be given to the subject, it seems clear that this condition or something like it actually prevails in the U.S. economy, or else unemployment could not persist over 5-year periods. Second, the interest elasticity of money demand must not be so low that the simple quantity theory applies. At the other extreme, if money demand is highly interest elastic, then fiscal policy has a large effect along elementary Keynesian lines—not only does GNP rise because of the increase in consumption, but there is a further increase in investment as well. Crowding out is absent, and fiscal policy appears a desirable instrument for achieving full employment.

In the intermediate case, rational expectations about the rate of inflation suggest a stronger expansionary effect than would be found in an

otherwise identical model where holders of money are naive or adaptive in forming expectations about inflation. Rational consumers know that fiscal expansion causes inflation through adverse effects of crowding out on supply. Consequently, they hold less money for each dollar of nominal GNP, and nominal GNP can rise. The introduction of rational expectations to a macroeconomic model does not always make it more classical or monetarist in its behavior.

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