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The Outlook for Investment in Plant and Equipment

PRIVATE EXPENDITURES FOR EQUIPMENT and nonresidential construction, as measured in the national income accounts, have shown a fair amount of strength in the first three quarters of 1971, and it now appears that, for the year as a whole, this investment total may even show a small real rise over 1970. Projections based on econometric equations suggest that considerably larger advances may be in store for 1972 and 1973, though the magnitude of the expected increases varies considerably depending on the equation used. A considerable portion of the projected increases can be attributed directly to the incentives provided by the likely restoration of the investment tax credit for equipment spending and by shortened depreciation lifetimes allowed under the new regulations first announced by the Treasury in January 1971 and formally adopted in June.

In this report, which is a sequel to my earlier comparison of alternative econometric explanations of investment expenditures,[1] I review the performance of several of the models over the first three quarters of 1971 and project these equations through 1972 and 1973. In addition, I examine the

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1. Charles W. Bischoff, "Business Investment in the 1970s: A Comparison of Models," *Brookings Papers on Economic Activity* (1:1971), pp. 13–58.

improvements in the investment outlook stemming from the more optimistic predictions for the real growth of the economy as a whole that have become prevalent since the announcement of the New Economic Policy in August, and from the prospect of reinstatement of the tax credit. The projected effects of the tax credit are compared with effects to be expected from the new depreciation rules. Finally, I present alternative projections based on somewhat more pessimistic and optimistic growth paths for the total economy, and on alternative assumptions about bond and equity yields.

Ex Post Predictions for 1971

According to the latest figures available, plant and equipment spending as measured in the national income accounts was 8.8 percent higher in the third quarter of 1971 than it was in the strike-depressed fourth quarter of 1970.[2] In real terms the increase was 4.9 percent. The price-deflated aggregates for equipment and nonresidential construction expenditures have, however, been moving in opposite directions. Over this period, the annual rate of equipment spending rose $4.8 billion, though about $2 billion of this rise represented recovery from the General Motors strike. During the same period, the annual rate of nonresidential construction spending reportedly fell $1.1 billion, continuing a decline that began in the fourth quarter of 1969.

In Table 1, I present projections of investment spending, based on the most recently revised data, using the three models from my earlier paper that were the most successful in explaining the 1969–70 performance. All of these projections were made using the same methods described in that paper: The equations are adjusted to fit perfectly in the fourth quarter of 1970; the strike is assumed to have depressed equipment spending in 1970:4 by $2 billion, which is recovered over the next two quarters causing a $3 billion swing; and the new depreciation rules are assumed to have been taken into account as soon as they were announced in January 1971.[3]

2. *Survey of Current Business*, Vol. 51 (October 1971), p. 9. On November 2, the Bureau of the Census announced a revision of construction statistics, which lowered the totals for nonresidential construction expenditures in recent years. The precise extent to which these revised totals will lead to revisions in the national income accounts totals is not yet clear.

3. The only difference in the projection method is that the adjustment of investment price deflators described in note 4, p. 14, of my "Business Investment in the 1970s" has not been used. This makes a negligible difference in the totals.

Table 1. Actual Investment and Simulation of Three Investment Models, 1971[a]

Billions of 1958 dollars, seasonally adjusted at annual rates

Year and quarter	*Actual*	*Generalized accelerator*	*Standard neoclassical*	*Federal Reserve-MIT-Penn*
		Equipment expenditures		
1971:1	53.7	54.3	53.8	54.5
2	55.6	53.4	53.9	53.5
3	56.8	52.0	53.3	54.9
Mean error[b]	...	2.1	1.7	1.1
Root-mean-square error[c]	...	3.1	2.2	1.7
		Construction expenditures		
1971:1	23.8	23.4	22.7	22.3
2	23.1	23.2	21.9	21.4
3	22.4	23.1	21.0	20.9
Mean error[b]	...	−0.1	1.2	1.6
Root-mean-square error[c]	...	0.5	1.2	1.6

Sources: Actual values are from *Survey of Current Business*, Vol. 51 (October 1971), p. 9. Simulated values are from equations described in Charles W. Bischoff, "Business Investment in the 1970s: A Comparison of Models," *Brookings Papers on Economic Activity* (1:1971), pp. 13–58.

a. Simulations are made using predicted changes from 1970:4 levels.

b. Average of actual minus predicted values.

c. Square root of average of squared errors.

The generalized accelerator equations, which are based solely on output and past capital stock, explain construction expenditures relatively well, but predict equipment spending very poorly. After a \$2.3 billion rise in 1971:1, which is more than accounted for by the estimated post-strike recovery of \$3 billion, the simulated values decline rapidly. The standard neoclassical equations, which are based on output multiplied by a relative price term (the ratio of output price to the rental price of capital services) and on capital stock, also predict declines in both aggregates, although the decline in predicted equipment spending is moderated in 1971:2 and 1971:3 by the positive effect of the new depreciation rules. The equations patterned after those in the Federal Reserve-MIT-Penn (FMP) econometric model provide the best explanation of equipment spending, but the worst explanation of construction. These equations also include a relative price term, but the cost of capital entering into this expression is a function of market yields, and a separate lag distribution for the relative price term is allowed in the equipment equation.

A possible explanation of the weakness of the neoclassical and FMP equations in tracking construction expenditures is that they overstate the price elasticity of nonresidential building. As measured by the deflators in the national income accounts, the price for this category of construction has risen more than 12 percent in the last year, and the price rise has averaged more than 10 percent over the last three years. The success of the generalized accelerator equation would indicate that this price rise has had little, if any, depressing effect on real construction, and that the decline that has occurred can be attributed almost entirely to the lagged effects of past output declines.[4]

Projections into 1972 and 1973

These same three pairs of equations are projected through the end of 1973 in Table 2. In deriving these projections I have assumed that gross national product will total $1,050 billion in 1971 and rise to $1,148 billion in 1972 and $1,251.5 billion in 1973. For the latter two years this amounts to growth rates of 9.3 and 9.0 percent, respectively. For GNP in 1958 dollars, I have assumed values of $742.2 billion, $788.1 billion, and $824.4 billion in the three years. Thus, the real growth rate is set at 6.2 percent in 1972 and 4.6 percent in 1973. The rate of inflation as measured by the GNP deflator is 3.0 percent in 1972 and 4.0 percent in 1973.[5] Alternative projections based on other GNP paths are included later in this report.

For the FMP equations projected values of bond and equity yields are also required. I have assumed that Moody's industrial bond yield will remain at about its September 1971 level (about 7.64 percent) and that Moody's industrial dividend-price ratio will also be approximately unchanged (at about 2.94 percent).[6] With dividends growing rapidly, this

4. Note that a statement that the degree of inflation has been overestimated due to poor statistical methods would not help to explain the underpredictions. The constant dollar numbers are presumably derived indirectly by deflation of current dollar magnitudes, and thus overestimation of prices would mean simply that the real magnitudes are larger than those that have been reported.

5. These assumptions correspond to the forecasts released in *Chase Econometrics*, October 27, 1971, Tables 1.1, 1.2, and, for 1972, are a reasonably good approximation to the "consensus" forecast of business economists. The latest survey of members of the National Association of Business Economists showed an average forecast of an 8.8 percent rise in GNP and a 3.3 percent rise in prices for 1972. See H. Erich Heinemann, "8.8% Rise in G.N.P. is Seen for 1972," *New York Times*, September 28, 1971.

6. In the event that dividend controls depress dividends below the level they would otherwise attain, given earnings, the role of the dividend-price ratio as a measure of the cost of capital will be distorted. In the FMP equations, the dividend-price ratio is a proxy

Table 2. Projections of Investment Expenditures Using Three Models, 1971–73[a]

Dollar amounts in billions of 1958 dollars, seasonally adjusted at annual rates

	Generalized accelerator		*Standard neoclassical*		*Federal Reserve-MIT-Penn*	
Year and half	*Amount*	*Change from previous period*	*Amount*	*Change from previous period*	*Amount*	*Change from previous period*
			Equipment expenditures			
1971 Second	$56.3	+3%	$57.0	+4%	$57.6	+5%
1972 First	56.3	0	58.6	+3	61.4	+7
Second	58.6	+4	58.8	0	64.7	+5
1973 First	61.5	+5	59.3	+1	67.6	+4
Second	63.4	+3	60.6	+2	69.2	+2
			Construction expenditures			
1971 Second	22.5	−4	21.9	−7	22.1	−6
1972 First	23.2	+3	20.0	−9	21.6	−2
Second	24.5	+6	19.0	−5	22.1	+2
1973 First	26.1	+7	18.8	−1	23.0	+4
Second	27.4	+5	19.1	+2	23.9	+4
			Total			
1971 Second	78.8	+1	78.9	+1	79.8	+2
1972 First	79.5	+1	78.6	0	83.0	+4
Second	83.2	+5	77.9	−1	86.8	+5
1973 First	87.6	+5	78.0	0	90.5	+4
Second	90.8	+4	79.6	+2	93.1	+3

Sources: Values through 1971:3, *Survey of Current Business* (October 1971), p. 9; projected values are author's estimates based on assumptions described in text. Figures are rounded and may not add to totals.

a. Projections for 1971 second half include actual values for third quarter of 1971. All projections for construction are made using first differences; equipment projections are made with error for 1971:3 added to raw projection with gradually decreasing weight.

would require the stock market, as measured by Standard and Poor's 500-stock index, to rise to an average level of about 128 (1941–43 = 10) for the last quarter of 1973. I have also included projections based on alternative assumptions about this yield.

Assumptions for price deflators for equipment and nonresidential construction are taken from solutions of the Chase Econometrics model. They

for the expected earnings-price ratio. To use these equations in a period of effective dividend control, it would seem appropriate to adjust the dividend-price ratio upward by the estimated proportion of dividends that are not paid due to controls.

point to a marked deceleration in inflation in this sector in 1972 and a sharp reacceleration in 1973. I have also made certain simple assumptions to move from total private output and its deflator, which are predicted in the model, to business gross product and its deflator, which are not predicted but which are required for the simulations.

Without correction for past errors, all of the construction equations except the accelerator construction equation are rather far off the track for the most recent quarters. For the construction equations I have corrected for this by making all projections in first-difference form, with 1971:3 as the base. For the equipment equations this seemed to be an excessively large correction. With no account taken of past errors, the accelerator, neoclassical, and FMP equations underpredict 1971:3 by $6.6 billion, $5.4 billion, and $3.8 billion, respectively. Building in a permanent correction of this magnitude would push the equipment-output ratio by the end of 1973 far above the levels suggested by past experience. Instead, I have added the 1971:3 error to the raw projections with steadily decreasing weights; the weights are 0.8 raised to a power equal to the number of quarters since 1971:3. In this way, the forces that caused past investment to deviate from the predicted path are assumed to exert an influence that is strong at first but dies out gradually; by 1973–4, the weight is only about 0.13.

The projections depend very heavily on how past errors are used, and I am rather uncomfortable about this. For the three equations, the difference in 1973:4 between using first-difference projections and the weighting scheme I have actually used is $6.1 billion for the accelerator equation and $3.4 billion for each of the other two.[7]

Given these qualifications, the projections in Table 2 may be examined. The accelerator equation shows equipment spending declining in 1971:4 and remaining flat through the first half of 1972, with relatively rapid rises in the next six quarters. The standard neoclassical equipment equation results in a much different pattern, with increases in the first half of 1972 followed by relative stagnation. The FMP equipment equation is by far the most optimistic, indicating rises at annual rates of greater than 10 percent through the first quarter of 1973, and a deceleration to about half that rate in the rest of 1973.

7. The differences are not equal to 0.87 times the 1971:3 errors because of the varying ways each of the equations takes account of past capital stock, which is cumulated from past investment.

For construction, the accelerator equation produces a small rise in 1971:4 and very rapid increases from then on. The standard neoclassical equation projects a continuous decline until a trough is reached in the first quarter of 1973, with a small recovery. The FMP equation indicates a much smaller decline with a trough in 1972:1, and substantial increases in 1973. As pointed out earlier, the neoclassical construction equations predict substantial declines in construction as a result of price increases in that area, and rises in output only gradually offset this effect.

On the basis of the experience with these equations over the last three years, the FMP equipment equation and the accelerator construction equation should be considered the most reliable. They are also the most optimistic—perhaps a bit too optimistic. Current excess capacity should moderate the effect of the tax incentives on equipment, and I persist in believing that there is *some* price elasticity of construction demand, however small. My own best guesses for each of the aggregates are about $1 billion lower in both 1972 and 1973, putting total constant dollar investment spending at about $85 billion in 1972 and $93 billion in 1973. As Table 3 shows, spending of this magnitude would mean a 7 percent rise in real investment

Table 3. Projections of Investment Expenditures, 1971–73, Using Federal Reserve-MIT-Penn Equipment Equation and Accelerator Construction Equation, with $1 Billion Downward Adjustment in Each Total for 1972 and 1973

Dollar amounts in billions

	Equipment expenditures		*Construction expenditures*		*Total nonresidential fixed private investment*	
Year	*Amount*	*Percent increase*	*Amount*	*Percent increase*	*Amount*	*Percent increase*
			1958 dollars			
1971	$56.2	+3.3%	$23.0	−5.0%	$79.1	+0.6%
1972	62.0	+10.3	22.8	−0.9	84.9	+7.3
1973	67.4	+8.7	25.8	+13.2	93.2	+9.8
			Current dollars			
1971	69.7	+6.6	38.7	+5.2	108.4	+6.2
1972	78.3	+12.3	41.4	+7.0	119.7	+10.4
1973	88.6	+13.2	49.7	+20.0	138.3	+15.5

Source: Author's estimates. Details may not add to totals because of rounding.

in 1972, with current dollar investment rising by 10 percent.[8] The figures for 1973 must be regarded as extremely speculative, but they do indicate that, if the expansion continues, very strong rises in spending should be occurring by that time.

My projections for 1972 are higher than any others I have seen. The annual fall survey made by the Economics Department of McGraw-Hill suggests that capital investment will rise by 7 percent in current dollars and by 2 percent in real terms above the OBE-SEC estimate for 1971.[9] It should be noted that the national income aggregates have been rising faster than the OBE-SEC totals over the last three quarters, and the discrepancy seems too large to explain on the basis of the differences in coverage of the two series.[10] Which numbers are "right" remains an open question. A survey by Lionel D. Edie and Company indicates a 9 percent rise for the OBE-SEC total.[11] The Chase Econometrics model, aimed at predicting the national income series, shows current dollar spending rising at rates of 10.2 percent and 15.0 percent, respectively, in 1972 and 1973, with constant dollar expenditures rising at 6.6 and 9.2 percent for the two years.[12]

As a share of projected GNP, investment of $119.7 billion in 1972 would be about 10.4 percent, while $138.3 billion in 1973 would amount to 11.1 percent. In the postwar period, 1966 was the record year for the share of nonresidential fixed investment in GNP, at 10.9 percent, with 1969 the runner-up at 10.6 percent. The fixed investment share was close to 10.5 percent in 1956–57, in 1965, and in the 1967–70 period; 1947 and 1948 are the

8. The price deflators for investment goods, taken from the Chase Econometrics projections, show equipment prices rising by 1.6 percent in 1972 and 4.1 percent in 1973, while the price of nonresidential construction rises 7.5 percent in 1972 and 6.9 percent in 1973. At the panel meeting, skepticism was expressed about the low price increase for equipment in 1972; an alternative projection of the FMP equation with equipment prices rising 2.7 percent in 1972 and 2.8 percent in 1973 shows real equipment spending in 1972 lower by $100 million (but higher by $800 million in current prices) while 1973 constant dollar spending is lower by $500 million (in current prices it is lower by $700 million).

9. "A Bit More Confidence in Spending Plans," *Business Week*, November 6, 1971, pp. 30–31. The Office of Business Economics-Securities and Exchange Commission survey results are given in their joint report, "U.S. Plant and Equipment Expenditures by Business" (September 3, 1971; processed).

10. Compared with the 8.8 percent rise shown by the national income accounts investment series between 1970:4 and 1971:3, investment spending measured by the OBE-SEC survey will have risen 4.8 percent over the same period, if the anticipated totals reported in the latest survey are realized; *Survey of Current Business*, Vol. 51 (September 1971), p. 17.

11. *Merrill Lynch Review*, October–November 1971, p. 2.

12. *Chase Econometrics*, October 27, 1971, Tables 2.1, 2.2.

only other years in which it exceeded 10 percent. Thus, judged historically, the investment levels suggested here are very high.

The Improvement in the Outlook since July

Shortly after the New Economic Policy was announced in August, many economic forecasters sharply raised their forecasts for real growth in 1972, assuming that the wage-price freeze would be at least partially effective, that some fiscal stimulus would be applied, and that the trade balance would improve. The forecasts released by Chase Econometrics, on which I have precise details, seem fairly typical. In July this group was forecasting real GNP at $737 billion in 1971 and $766.8 billion in 1972, for growth rates of 2.4 percent and 4.0 percent in the two years. Inflation rates were estimated at 5.2 percent and 4.5 percent for the same periods.[13] In August the estimates of real growth for the two years, especially 1972, were revised upward, while the inflation rates were pushed down. Very little change appeared between the August predictions and the October forecasts cited earlier in this report, which indicate real growth of 3.0 percent in 1971 and 6.1 percent in 1972.

With the investment equations used to simulate spending, given the pre-August forecast, measures of how much the outlook has improved can be derived. The major elements of the change are the improved prospect for output, slower inflation, the adoption of a 7 percent investment tax credit, and the annulment of the modified first-year convention, which was part of the depreciation package implemented in June. Table 4 shows the estimated direct impacts of each of these changes, plus the residual effects due to varying price patterns, interest rate projections, and initial conditions due to starting the simulations in 1971:3 rather than 1971:2.

As Table 4 reveals, the improvement is largest for the standard neoclassical equipment equation, which projects a very large and rapid impact of reinstatement of the tax credit. This equation adjusts more slowly than the others to output change, and thus shows a smaller projected gain from this source. The accelerator and FMP equipment equations both suggest large increases, especially in 1973, as a result of increased output growth. In addition, the FMP equipment equation indicates a substantial impact from the tax credit, though it is not nearly as large as that predicted by

13. *Chase Econometrics*, July 23, 1971.

Table 4. Effects of Improvements in Outlook between July and October 1971 on Investment Projected for 1971–73 Using Three Models

Billions of 1958 dollars

Source and year of effect	Equipment investment: Accelerator	Equipment investment: Standard neoclassical	Equipment investment: Federal Reserve-MIT-Penn	Construction investment: Accelerator	Construction investment: Standard neoclassical	Construction investment: Federal Reserve-MIT-Penn
Output change						
1971	*	*	*	*	*	*
1972	1.8	1.0	3.5	0.8	0.4	0.5
1973	4.1	1.8	4.2	1.6	1.3	1.4
7 percent tax credit						
1971	0.0	0.3	0.0	0.0	0.0	0.0
1972	0.0	4.4	1.4	0.0	0.0	0.0
1973	0.0	6.1	2.9	0.0	0.0	0.0
Repeal of modified first-year convention[a]						
1971	0.0	0.0	0.0	0.0	0.0	0.0
1972	0.0	−0.4	−0.1	0.0	0.0	0.0
1973	0.0	−0.7	−0.4	0.0	0.0	0.0
Starting point conditions						
1971	1.4	1.1	−0.1	−0.4	0.1	*
1972	1.6	0.8	−0.1	−0.7	0.2	*
1973	0.8	0.1	0.1	−0.6	0.1	*
Price changes and interest rate changes						
1971	0.0	*	0.4	0.0	*	*
1972	0.0	−0.3	−2.3	0.0	−0.8	−0.4
1973	0.0	0.8	−4.1	0.0	−1.2	−0.3
Total improvement in outlook						
1971	1.5	1.5	0.3	−0.3	*	*
1972	3.5	5.5	2.4	0.2	−0.2	0.1
1973	4.9	8.1	2.7	1.1	0.2	1.1

Source: Author's estimates. Details may not add to totals because of rounding.
* Less than $50 million.
a. The entire set of new depreciation rules, including permanent adoption of the modified first-year convention (as originally announced), is estimated to have "direct impacts" on real equipment spending in the three years 1971, 1972, and 1973 of $1.2 billion, $2.6 billion, and $3.4 billion, according to the standard neoclassical equation, and $0.3 billion, $1.6 billion, and $2.2 billion, according to the FMP equation.

the standard neoclassical equation. This divergence occurs only in the short run, for these equations show very similar ultimate impacts. However, in the case of the FMP equipment equation, the deceleration of inflation leads to a sharp fall in the expected rate of inflation, and this increases the real interest rate, which plays an important role in this equation. The use of the real interest rate in this equation is experimental and tentative, especially in view of the difficulties in measuring the expected rate of inflation. However, if the equation is correctly specified, the dampening effect from this source appears to be large enough, at least in 1972 and 1973, to offset the stimulus from the tax credit.

The changes in the outlook for construction are smaller, both because the output impacts are smaller and because, for the neoclassical and FMP equations, the slowing of inflation raises the price of construction relative to that of output, and thus depresses investment. In large measure this is a result of the very high reported rate of increase in construction costs in 1971:3 while the total output deflator rose very little.

Alternative Output Paths

The buoyant growth path predicted by the consensus forecast may not be realized; on the other hand, still more growth in 1972 is a possibility. The sensitivity of the projected investment patterns to the output growth rate is recorded in Table 5. There, I have indicated the decreases in projected investment that would be predicted if output were to grow more slowly in the last quarter of 1971 and throughout 1972. The incremental investment, which is the same for decreases and increases, is calculated on

Table 5. Increments in Investment Expenditures Assuming Slower Rate of Growth of Output, 1971:4–1972:4, Using Three Models, 1972 and 1973
Billions of 1958 dollars

Year	*Generalized accelerator*	*Standard neoclassical*	*Federal Reserve-MIT-Penn*
		Equipment expenditures	
1972	−0.7	−0.4	−1.1
1973	−13.0	−7.1	−15.7
		Construction expenditures	
1972	−0.3	−0.1	−0.1
1973	−5.4	−3.1	−3.4

Source: Author's estimates. Increments are computed assuming that real GNP is lower in the five quarters 1971:4–1972:4 by, respectively, $1.67 billion, $5.0 billion, $8.67 billion, $11.33 billion, and $15.0 billion, seasonally adjusted at annual rates, and lower by $15 billion throughout 1973. Increments of investment associated with increases in GNP of the same magnitude and time pattern are equal in amount and opposite in sign to those given in the table.

the assumption that output is below the assumed levels by $1.67 billion in 1971:4 and by $5.0 billion, $8.67 billion, $11.33 billion, and $15.0 billion, respectively, in the four quarters of 1972. Throughout 1973, output is assumed to be $15 billion below the previously assumed levels. Thus, output is reduced by $0.4 billion in 1971, $10 billion in 1972, and $15 billion in 1973. The lower path corresponds to real growth of only 4.9 percent in 1972 and 4.0 percent in 1973; on the other hand, when these increments are added to output the real growth rate is 7.5 percent in 1972 and 5.2 percent in 1973. If output were assumed to grow more rapidly in the last quarter of 1971 and throughout 1972, the results would be of the same magnitude reported here, but of opposite sign.

The results of this experiment indicate that slower growth would have relatively little effect on investment in 1972, in view of the lags involved. The projection of the most sensitive equations (FMP equipment, accelerator construction) change by only $1.4 billion. By the same token, faster growth would lead to little immediate stimulus.

In 1973, however, the equations predict that a failure to grow at a rapid rate in 1972 would lead to extremely unfavorable results. The estimated increments are large enough so that both aggregates would decline in real terms in 1973 as compared with 1972. With the projected values of the investment deflators, both equipment and construction would decline year to year in current dollars as well.

Fiscal and Monetary Impacts on Investment

The past year has seen two important fiscal policy changes intended to stimulate equipment spending. The changes in depreciation policy, which were formally implemented in June despite legal protests, were discussed in my earlier paper. Congress has acted to make one of the changes, the modified first-year convention, inapplicable to any equipment purchased after January 1, 1972. However, the asset depreciation range system, which is expected to shorten the depreciation lifetimes used to write off equipment by an average of 20 percent, has received legislative ratification. In addition, the reserve ratio test has been repealed; it required that after they had used any new depreciation system for a certain period, firms would have to demonstrate that their actual retirement patterns corresponded at least approximately to those they claimed on their tax returns. Repeal of the test allows shorter tax lifetimes in the absence of changes in actual retirement practice.

The same legislation reinstates the allowance of a credit against tax of 7 percent of the purchase price of new equipment with a service lifetime of seven or more years, instead of the eight years required under the earlier law. For equipment written off with lives of between five and seven years, the credit may be applied against two-thirds of the purchase price; one-third of the price may be used for the credit if the lifetime is three to five years. The credit is only 4 percent for public utilities (instead of the previous 3 percent) and there are certain restrictions on the maximum size of the credit and on its application to used equipment and to equipment purchases from abroad, along with various carry-back and carry-forward provisions. In my analysis I assume that all of these provisions will bring the present value of the total credit applicable to equipment purchases in a given year to an average of 4.5 percent, which is the best estimate I have been able to make for the "effective rate" of the credit that prevailed between 1962 and 1969.

In this section, more detail is presented on the derivation of the estimates of the effect of repeal of the modified first-year convention and of reinstitution of the tax credit, and the effects are compared with the estimated effects of shortening depreciation lifetimes. Also, the critical assumptions underlying the analysis are made clear. It should be emphasized that the derived impacts in Table 4 are based on the assumed paths of total output, and thus ignore the secondary, induced effects that would work through changes in incomes, interest rates, and so on, resulting from the initial additional investment. Thus, I have labeled the estimated effects "direct" impacts. I have, however, attempted to make ad hoc adjustments for the fact that, with wages unchanged, marginal cost pricing would dictate reductions in the price of output as a result of the tax credit, because the cost of one of the factors of production, capital services, is reduced.

The formula for the rental price of equipment services that I use is

$$c = q(d + r)(1 - k - wz)/(1 - w),$$

where

c = rental price
q = price deflator for equipment
d = exponential rate of depreciation of equipment

r = discount rate used to value return from future capital services

k = rate of tax credit (provided that it need not be deducted from the basis used for tax depreciation)

w = rate at which corporate income is taxed

z = discounted value of allowable depreciation deductions on a dollar's worth of new investment.

In the FMP equation, r is a function of the bond yield, the dividend-price ratio, the expected rate of increase of output prices, and the corporate tax rate. At August 1971 levels of these variables, this discount rate was 8.85 percent. In the standard neoclassical equation, r is a function only of a constant and the corporate tax rate; at the current tax rate, r is taken to be 10.4 percent. The parameter d is estimated to be about 0.1457. In calculating z, the discount rate, the lifetime of the equipment for tax purposes and the method of tax write-off used are all relevant. With a discount rate of 8.85 percent, a continuous approximation to z for a piece of equipment with a lifetime of 13.1 years (which I take as the average tax lifetime before institution of the asset depreciation range system) is 0.592 if straight-line depreciation is used and 0.704 if the sum-of-the-years-digits method is used. For the purposes of the calculations I assume that 47.6 percent of equipment is depreciated using straight-line methods and 52.4 percent using accelerated methods (the sum-of-the-years-digits formula is also used as an approximation for double-declining-balance depreciation). Salvage value is ignored, and all equipment is treated as if the mean lifetime applied to it, an approximation that may lead to distortions but that is very convenient.

With all of these assumptions, the rental price of equipment services with a discount rate of 0.0885, a tax lifetime of 13.1 years, and no tax credit, is 0.4290 for q equal to 1.385, the value of the equipment deflator in 1971:3. Institution of a tax credit with an effective rate equal to 0.045 reduces the rent to 0.4009. Shortening of tax lifetimes by 16 percent (rather than 20, to allow for incomplete adoption of the asset depreciation range system) lowers the rent to 0.4164 in the absence of the tax credit and to 0.3883 if the credit is included.

The effect of the short-lived modified first-year convention is to increase z. With the earlier half-year convention, one-half of the ordinary first-year deduction could be taken in the tax year in which equipment was purchased. In the second year the deduction was the average of the first- and second-year deductions, and so forth. Under the modified first-year convention, any equipment purchased before the midpoint of the accounting year is eligible for a full first-year's deduction, while any equipment purchased later in the year may be depreciated under the half-year convention. Thus the effect of the new convention, on the average, is to move the whole stream of depreciation deductions three months closer to the present.

In light of this analysis, the appropriate change in the formula for c, under the modified first-year convention, is to multiply z by $1 + r/4$, to allow for the increase in the present value of the deduction stream. With the assumptions mentioned in the last paragraph, the convention reduces c to 0.4247 with no credit and the old lifetimes, to 0.3966 in the presence of the credit, to 0.4118 with the new lifetimes, and to 0.3868 with both.

The percentage reductions in c for all of these fiscal changes are highly sensitive to the discount rate used. Clearly, shorter lifetimes and the modified first-year convention are less valuable the lower the discount rate used. The tax credit, on the other hand, reduces c by a larger percentage the lower the rate used, because with a lower rate z is higher, $1 - wz$ is smaller, and a given change in k changes $1 - k - wz$ by a larger percentage. In Table 6 I indicate percentage reductions in c stemming from the three fiscal changes, calculated using three different discount rates and in the presence of varying combinations of the other incentives. Each of the incentives is relatively more valuable the more additional incentives are already in effect.

With a discount rate of 13 percent, the tax credit is slightly less than twice as valuable as a 16 percent reduction in tax lifetimes, and about five times as valuable as the modified first-year convention. At a discount rate of around 4 percent, the tax credit is more than three times as valuable as the shortening of lifetimes, and about ten times as valuable as the convention.

According to the standard neoclassical and FMP equations, the relative effectiveness of the three measures in inducing investment spending is strictly proportional to their effects on c, regardless of what the induced effect on output price is and regardless of feedbacks. Furthermore, the time sequence of the effects is precisely the same. The time profiles of revenue loss are, however, radically different.[14] Thus, the relative magnitude of the estimated effects depends almost entirely upon one's idea of the relevant discount rate. Presumably, however, the discount rate used should

14. On this point, see the Treasury study, "Tax Depreciation Policy Options: Measures of Effectiveness and Estimated Revenue Losses," *Congressional Record*, daily ed., July 23, 1970, pp. E6964–75.

Table 6. Percentage Reductions in Rental Price of Equipment Services Resulting from Various Fiscal Incentives, Assuming Selected Interest Rates

Source of reduction in rental price and related assumptions	Interest rate (percent)		
	8.85	13.28	4.43
Tax credit with effective rate equal to 4.5 percent			
Tax lifetime: 13.1 years			
Without MFYC[a]	6.6	6.1	7.3
With MFYC	6.6	6.2	7.4
Tax lifetime: 11.004 years			
Without MFYC	6.7	6.3	7.4
With MFYC	6.8	6.4	7.5
Reduction in tax lifetime from 13.1 to 11.004 years			
No tax credit or MFYC	2.9	3.1	2.2
Tax credit but no MFYC	3.1	3.3	2.3
MFYC but no tax credit	3.0	3.2	2.2
Both tax credit and MFYC	3.2	3.5	2.4
Adoption of MFYC			
Tax lifetime: 13.1 years			
Without tax credit	1.0	1.2	0.7
With tax credit	1.1	1.2	0.8
Tax lifetime: 11.004 years			
Without tax credit	1.1	1.3	0.7
With tax credit	1.2	1.4	0.8

Source: Author's estimates.
a. Modified first-year convention.

be of the order of magnitude of the after-tax rate of profits on total capital. Risk discounting, cyclical variability, and other factors, however, may make the observed ex post profit rate a poor guide to the approximate discount rate.

Assessment of the absolute magnitude of induced effects, even "direct" effects, does depend on both the induced changes in output price and the elasticity of investment spending with respect to c. In both the standard neoclassical and FMP equations, in the longest run the partial elasticity or predicted investment with respect to c is unity if output is growing steadily. The presence of an intercept in both equations makes the elasticity less than unity for any finite period of time, and the short-run impacts differ greatly for the two equations. For the standard neoclassical equation, the impact in the third year after a change in c is nearly double the long-run impact, while in the FMP equation, the long-run impact is never exceeded.

In the long run, however, and probably in the intermediate run as well, the price of output cannot reasonably be held constant. Of course, if the prices of goods in general and investment goods (which are also produced with capital) change by equal amounts, the long-run impact on the ratio p/c will be the same as the partial impact just computed with q held constant. If, on the other hand, investment goods are thought of as produced only with labor, or by more labor-intensive methods, the ratio p/q will shift. The extreme case would be when q did not change. Then, if the share of equipment costs in properly computed total costs is of the order of magnitude of 10 to 15 percent, the 6.6 percent reduction in c due to a tax credit will lead to a reduction of one-tenth to one-sixth that size in output price, and the overall reduction in p/c would be 5.5 to 5.9 percent. This, then, would be the amount of the proportional stimulus to investment spending, and capital stock, that would be attributable to the tax credit in the very longest run.

As one final note, I record in Table 7 the projected effects of some fairly extreme alternate assumptions about bond and securities yields. The four cases are: (a) a 100-basis-point rise in Moody's industrial bond yield, effective November 15, 1971, and continuing throughout the sample period; (b) a fall in the bond yield of similar magnitude; (c) a sustained rise of 20 percent in the dividend-price ratio, presumably because of a hypothesized stock market crash; and (d) a fall in the dividend-price ratio of similar magnitude. These alternative assumptions affect only the FMP equations, but the effects are large, pointing up the important role these yields play in these equations.

Table 7. Effects of Permanent Changes in Bond Yield or Dividend-Price Ratio, Federal Reserve-MIT-Penn Equations, 1972–73

Billions of 1958 dollars

	100-basis-point change in bond yield		*20 percent change in dividend-price ratio*	
Year	*Rise*	*Fall*	*Rise*	*Fall*
		Change in equipment expenditures		
1972	−1.2	+1.4	−0.4	+0.4
1973	−3.8	+4.8	−1.2	+1.2
		Change in construction expenditures		
1972	0.0	0.0	−1.0	+1.1
1973	0.0	0.0	−2.8	+3.3

Source: Author's estimates. Changes are assumed to be effective November 15, 1971.

Discussion

R. J. GORDON WAS STRUCK by the contrast between the rather pessimistic investment outlook implied by the standard neoclassical and accelerator models, on the one hand, and the optimistic view implied by the FMP model, on the other. He suggested that the possibility of actually achieving growth of real GNP of 6 percent or more in 1972 was likely to depend on whether the investment outlook in the FMP model is more accurate than those in the two pessimistic models. Bischoff agreed, noting that, in the Evans forecast that he had used as a benchmark for overall economic performance, the investment projections were quite similar to those of the FMP model. Lawrence Klein reported that the Wharton model also generated investment projections in line with those of the FMP version.

Klein suggested that the tendency of the models to underpredict business capital outlays in 1971 might reflect the very strong investment requirements of the public utility sector. Particularly because the horizon of public utility investment is so long term, the sector is not very sensitive to short-term fluctuations in overall activity.

George Perry noted that many economists argue that the marginal effects of investment tax credits and other specific incentives to investment might depend critically on the level of output and on utilization rates. According to their view, these incentives would not be effective while excess capacity prevailed in the economy. Perry inferred, however, that the marginal effects of investment incentives, as estimated by Bischoff's econometric models, were not greatly influenced by output and utilization, and Perry's own intuition basically agreed with the models.

R. A. Gordon was concerned that, by assuming that a constant fraction of the capital stock is replaced, some models may understate the sensitivity of investment both to swings in output and to changes in tax incentives for investment. In point of fact, replacement decisions are not likely to be automatic; they probably respond to changes in the determinants of investment. R. J. Gordon cautioned that, if fiscal measures create incentives for added investment outlays but monetary policy does not accommodate that enlarged demand, a major consequence might be increases in real interest rates and hence a shift away from residential construction and other interest-sensitives ectors. In that event, the directly stimulative impact of the fiscal measures would be offset to some extent.

Paul Samuelson suggested that tax incentives to investment might be an effective stimulus to investment in the short run and yet not be a desirable form of stimulus from a longer-run social point of view. If, as some economists believe, the elasticity of substitution between labor and capital is low and thus the marginal productivity of capital drops off sharply as capital is deepened, measures that boost investment strongly in the short run will subsequently create lower profit rates and reduced incentive to invest. They would mean more investment now at the expense of less investment later. Such a line of argument would support the conclusion that more stimulus to investment is not what society needs at this time. Bischoff pointed out that, in the FMP model, the elasticity of substitution is unity and capital deepening has only a modest negative impact on profit rates. A continuation of expansionary monetary policy is needed to make capital deepening sustainable, but there is no necessary boomerang effect in subsequent periods.