Do We Know Enough to Adopt a Variable Investment Tax Credit?

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The United States adopted a flat-rate 7 percent investment tax credit in the Revenue Act of 1962 to induce higher rates of new capital investment. The underlying purposes were to stimulate the economy and increase its rate of growth in real terms, to reduce unemployment and to make American industry more competitive with foreign firms. Although enacted as a "permanent" credit, certain changes were made in 1964 and the credit was suspended in 1966 only to be reinstated early in 1967. More recently, the credit was again suspended in 1969, but was reenacted as a "Job Development Credit" in 1971 and continues in effect as a flat-rate credit. This on-again, off-again history of the "permanent" flat-rate credit has increasingly led to suggestions that the existing instrument, originally designed for economic stimulation, be redesigned as an explicitly *variable* investment tax credit for purposes of economic *stabilization.* Instead of either being allowed at fixed rate or completely suspended, as with the present credit, the level of the new variable investment tax credit allowed could be varied from time to time within a wider band of rates in response to varying conditions and prospects of the economy. In several major addresses over the past year, for instance, Arthur Burns has proposed that Congress enact new legislation delegating authority to initiate changes in the investment tax credit, between a lower limit of zero and a maximum rate of perhaps 15 percent, subject to modification or disapproval within 60 days by either house of Congress. Such legislation is now pending in Congress.

There are several important reasons why a variable investment tax credit (VITC) scheme merits serious consideration for inclusion as one of the instruments in a well designed policy for economic stabilization. Experience over a quarter of a century has well documented

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the practical difficulties involved in implementing a flexible fiscal policy which will effectively stabilize the economy through variations in *general* tax rates and aggregate government expenditures. It has been painfully established that a flexible monetary policy is very uneven in its impacts, with the major burdens of monetary restrictions falling on the housing sector and state and local governments. Moreover, effective efforts to insulate these sectors would substantially compromise the effectiveness of monetary policy as a stabilization device. Business fixed investment is another large and highly volatile component of expenditures. Econometric and other research has established that more generous depreciation allowances and "permanent" investment credits lead to significant increases in these outlays over a period of time. The limitations and undesirable side-effects of other more general stabilization instruments, and the apparent effectiveness of maintained investment credits, lend a certain *a priori* attractiveness to a variable investment tax scheme as an additional component of our overall stabilization policies.[1]

Indeed, one would have thought that these well known considerations would have led long before now to a substantial amount of research specifically examining just how effective a VITC might reasonably be expected to be as an added stabilization instrument. Nevertheless, we find that there has been remarkably little serious research work done on the effects of an explicitly *variable,* as distinct from a "permanent", investment tax credit. The very paucity of probative research on the design, implementation and probable effects (or effectiveness) of the VITC adds significantly to the potential importance of this session on variable investment tax credits, and to the commendation otherwise due to those planning the program of this conference.

I suspect that there are essentially four reasons why there has not been more earlier work on variable investment tax credits. Although as already noted, both theoretical arguments and various econometric studies agree that a permanent investment tax credit has a sizable and significantly positive impact on investment outlays over a considerable period of time, it is also apparent from a review of the literature that there is a wide range of difference in the estimates of the *extent* of this effect even in the long run. There are even greater differences in the estimates of the *time path* of the effects which

[1]The material in this paragraph has been ably developed and summarized in the papers by Gramley and others in the Federal Reserve Staff Study, *Ways to Moderate Fluctuations in Housing Construction.* See also the first section of the Picou-Waud paper at this conference.

become critically important in assessing the desirability of a variable tax credit and designing good strategies for its use. In addition, the introduction of a tax credit scheme which was billed in advance as being variable would require allowance for the *expectations* of company managers with respect to the *future* timing and size of the credit itself which raise a host of delicate and difficult problems that are not easily amenable to standard econometric techniques. And finally, one of the important reasons more work has not been done by economists on *variable* investment tax credit schemes is doubtless the fact that the effects and effectiveness of such variable credits will depend very heavily on administrative considerations and legal "details" of regulations which are not normally of concern to professional economists.

The first body of information required to appraise the probable effectiveness (and optimal implementation) of a VITC is a good structural econometric model of the determinants of investment outlays, including reliable statistical estimates of the slope of elasticity coefficients on the relevant variables and with special emphasis on the reliability of the *time-path* of the response to variations in the term (or terms) involving the investment credit. Unless we have relatively sure knowledge of these basic matters, variations in the level of investment tax credits will produce uncertain and potentially destabilizing effects. A recent Conference at the Brookings Institution under the title *Tax Incentives and Capital Spending* included papers by Hall and Jorgenson (HJ), Bischoff, Coen, and Klein and Taubman which, together with the Picou and Waud (PW) paper at this session, provide a good set of references for judging the adequacy of our present knowledge regarding the impact of investment credits on investment outlays. The first section of this paper will review the structure of the models used by these authors and their different findings and implications with respect to the effects of investment tax credits. Reasons for the different findings are explored, and suggestions are made for needed further research on the structural determinants of investment outlays. The internal evidence of the available papers is used to form a composite assessment of the steady-state effects of investment tax credits and the time path of these effects which can serve as a provisional basis for exploring some of the important additional issues that must be resolved before we will have a firm basis for policy decisions regarding the introduction and implementation of a VITC program. These further issues are examined in the second section of the paper. A brief summary of our entire analysis will be found in the concluding section.

Structural Determinants of Investment Outlays and Effects of Permanent Tax Credits

Broadly speaking, Picou-Waud's work and the four Brookings papers fall in the mainstream of recent econometric work on investment functions. In each case, a theoretical model of the optimal capital stock *desired* (on the basis of currently available readings of other variables) is specified, and the amount of current investment outlay is made a function of the discrepancy between the capital stock on hand and that desired, with the speed and time pattern of closure depending upon both theoretical and institutional considerations. But in spite of this common general structure, differences in assumptions regarding (a) optimal capital stocks and (b) the relevant determinants of the response to disequilibria have led to very substantial differences in the estimated response of investment outlays to changes in the cost of capital services in general, and more particularly to changes in tax rates, depreciation allowances and tax credits.

As would be expected in the published work of eminent professional authors, each model provides excellent "fits" to the past data used, with high multiple correlation coefficients, uniformly high t-ratios on the included variables and very satisfactory Durbin-Watson coefficients. The disturbingly wide range of estimates regarding the effectiveness of even a "permanent" investment tax credit, which PW and the Brookings authors nevertheless present, dramatically highlights the fact that we do not yet have professional agreement regarding some of the basic elements required for serious analysis of a variable tax credit.

Among the Brookings authors, Hall and Jorgenson develop estimates which are most favorable to the introduction of a variable tax credit. They found that the investment tax credit had stimulated approximately four times as much additional gross investment as the 1962 depreciation guidelines, and that the 1964 reduction in corporation tax rates had considerably less effect than the change in depreciation provisions. Specifically, they estimated that the 7 percent investment tax credit introduced in 1962 increased *gross* investment in manufacturing and nonmanufacturing equipment in 1965 by $3.95 billion (about 10 percent of its actual level of $40.6 billion), and the $2.82 billion increase induced in *net* investment in equipment was over 22 percent of the actual level in that year.[2] Through 1966, the *total* increase in gross outlays on equipment was estimated

[2]Computed from Tables 2-5 and 2-7, Hall and Jorgenson, *op. cit.*, pp. 43-60.

to have been slightly over $14 billion. They also found substantial effects from the repeal of the Long Amendment in 1964 and the suspension of the credit in 1966. The Hall-Jorgenson estimates are particularly favorable to a VITC, not only because they estimate larger long-run "total" effects than most other authors but even more because of the *time shape* of the response. They find that the induced investment increases rapidly over a roughly two year period to a level very substantially *above* the "steady state" magnitude, with geometric declines in the induced effects thereafter.

Bischoff also finds very substantial, though smaller, effects from the 1962 investment tax credit in the four years through 1966. Specifically, he estimates that the 1962 credit induced a total increase in equipment outlays through 1966 of $9.1 billion, which is only about two-thirds of the HJ estimates.[3] Although Bischoff's equations imply that the *long-run* steady state effect of a *maintained* tax credit would be as large as suggested by HJ,[4] his estimates of these effects over any short run period are nevertheless considerably smaller. Most significantly for present purposes, Bischoff estimates that the effects of the credit build up rather slowly over at least a four year period as they *asymptotically* approach their steady-state impact. Robert Coen was still more pessimistic on the effectiveness of the credit, estimating that the *combined* effects of depreciation guidelines, the tax cut in 1964 *and* the investment tax credit which "produced and estimated $8.6 billion in tax savings through the third quarter of 1966 increased (investment) expenditures by only $2.8 billion."[5] While "significant," Coen finds the benefit/cost ratio very low. Finally, Klein-Taubman provided estimates regarding the effects of tax credits a little higher than Coen's but considerably short of Bischoff's and very much below the Hall-Jorgenson estimates.

Unfortunately, Picou-Waud have not provided estimates of the effect of an investment tax credit which can be directly compared to these others. In part, this is because they focus on micro-effects on individual industries rather than in economy-wide aggregates. Also,

[3]Bischoff, *op. cit.*, esp. p. 117 and *passim.*

[4]Both authors infer this long run effect from the elasticity of desired capital stocks with respect to the rental price of capital (which HJ assumes to be unity and Bischoff's unrestricted equations estimate to have essentially this value). For both authors, the elasticity of the rental price of capital with respect to an investment credit is also unity (see footnote page 119 below).

[5]Coen, *op. cit.*, p. 179.

we observe that (the distributed lag sum of) the regression coefficients on the implicit rental rate on capital stock was significant and of the right sign in only 7 of the 12 two-digit industries studied – and they did not carry through the additional calculations required to evaluate the effect of (even a permanent) investment tax credit on this rental price of capital. Nevertheless, some general qualitative observations may be made. First, the Picou-Waud work provides a salutary caution that the percentage changes induced in capital stocks by a permanent investment tax credit, even in a long-run steady state, will probably vary widely among different industries in the economy. We can also observe that in five of the seven industries for which "significant" estimates are provided, the elasticity of the desired capital stock with respect to the rental value of capital is *substantially below* the unitary value in the Hall-Jorgenson estimates – implying that the *long-run steady-state* effects of a change in investment tax credits in these industries would range from 19 percent to 86 percent of the HJ values. Moreover, in all seven industries emphasized in the PW analysis, the impact on desired capital stocks *builds gradually* over a very *substantial period* of time (ranging from 8 to 16 quarters). We also note that the two industries with significant elasticities greater than one also show the longest reaction periods (14 and 16 quarters). The time-paths of the response of desired *capital stocks* to changes in investment tax credits estimated by PW are thus on balance roughly the same as the sluggish buildup to asymptotic levels Bischoff estimates for the response of *investment outlays*. But since all modern investigators explain investment outlays by some distributed lag on changes in desired capital stocks, we may conclude that the PW work implies *slower adjustments* and longer mean lags in the response of *investment outlays* than Bischoff's estimates suggest. PW's work consequently implies that permanent investment outlay tax credits will have a *cumulative* effect on investment outlays over any period of two, three or four years which probably falls in the range between the Bischoff and Coen estimates.

As noted above, the substantial differences in the estimates of the magnitude and time pattern of the response of equipment outlays to investment tax credits provided in these five studies largely reflect differences in the assumptions made regarding the determinants of optimal capital stocks and the patterns of reaction to disequilibria. A brief review of these assumptions will help to explain the differences in their findings, and will also set the stage for some further comments bearing directly on the variable investment tax credit.

Since all these studies have been heavily influenced by the neo-classical theory originally developed by Jorgenson, the structure and assumptions of this model provide a common base reference for all the others as well.

Specifically Jorgenson assumes that (1) the firm seeks to maximize its market value at all points in time (which equivalently requires the maximization of profits at all points in time)[6] with (2) no allowance for uncertainty, and (3) that this maximization is subject to a Cobb-Douglas production function; that technological change is (4) neutral and (5) "embodied" (in effect) in all equipment, old as well as new; that the required before-tax rate of return is (6) independent of the scale of investment and (7) constant over time; that (8) tax rates and (9) the prices of capital goods and all other inputs are expected at each point in time to be constant in the future, but that (10) the price of capital goods at all times must be equal to the present after-tax value of their future net rental values; finally, that (11) *economic* depreciation occurs at a constant (exponential) rate. Maximizing the firm value or profits under assumptions (1)-(9) yields marginal conditions which make the optimal capital stock desired at any point of time strictly *proportional to output* in the ratio $a(p/c)$ where a is the elasticity of output with respect to capital input, and (p/c) is the ratio of the price of the firm's output to the net rental value of capital services. Jorgenson makes direct estimates of the desired capital stock K_t^* at every date from data on the level of output, the price of output and the rental price of capital services at that time.[7] HJ then uses rational distributed lag functions to esti-

[6] See Hall and Jorgenson, *op. cit.*, esp. p. 12 and references there cited.

[7] The latter, on the basis of assumptions (9), (10) and (11), turns out to be

(1) $c = q[(1-u)r + \delta]\ (1-k-uz)/(1-u)$

where

c = net rental value of a unit of capital services
q = price of a unit of capital goods
u = corporation tax rate
δ = (exponential) rate of depreciation
r = cost of capital (before tax)
k = the (decimal) investment credit
z = the after tax present value of depreciation deductions totaling one dollar over the life of the investment.

Equation (1) applies to years beginning in 1964 and allows for an investment credit to 100k% which is not deducted from the depreciation base of the asset. During the years 1962 and 1963 the Long Amendment requiring that the credit be deducted from allowable depreciation was in effect, and the coresponding formula for these years is:

(1') $c = q[(1-u)r + \delta]\ (1-k)(1-uz)/(1-u)$.

Bischoff and Coen also use these same formulas for computing the rental value of capital services, although they insert different values for the cost of capital.

mate the time path of the investment outlays induced by discrepancies between actual and desired capital stocks. The form of the lag functions draws primarily on statistical rather than economic theory, and the resulting speeds of adjustment to disequilibria are essentially empirical, in contrast to their estimates of desired capital stocks which implement an explicit, rigorous theory.

This Jorgenson model of desired capital stocks is also the starting point for Coen's work, as well as the Picou-Waud paper at this conference.[8] But both Coen and PW (following Gould) object that output and desired capital stocks are simultaneous decision variables. To avoid the resulting biases in estimates of K_t^* both introduce exogenous estimates based respectively on distributed lags on orders and sales (Coen), or on labor costs, costs of capital services and real GNP (Picou-Waud) [see their equations (13) and (20)]. While the PW procedure for estimating K_t^* seems to be preferable to the others used in these papers, we should also note that their use of planning horizons computed from NICB Surveys of Capital Appropriations is much more questionable. Apart from his exogenous estimates of the capital stocks desired, the major innovation in Coen's work is the idea that the time path of the distributed lags relating investment outlays to the difference between actual and desired capital stocks will be a function of the internal cash flows of funds available to finance the new investment [see his equation (4.38)]. With sufficient imperfections in the capital markets, cash flows (as a fraction of the gap between actual and desired capital stocks) can clearly affect the pace of investment outlays, but Coen's implementation leaves open serious matters of identification and collinearity. In particular, his model essentially reduces to estimating K_t^* by a distributed lag on past sales, while simultaneously varying the time path of response of investment outlays to the differences between desired K_t^* and actual capital stocks by a cash flow term which is known to be very highly correlated with sales.[9] Even if perhaps satisfactory for strictly forecasting purposes in the absence of policy changes, the structural parameters required for estimating the marginal impact of investment credits are not identified in Coen's work.

[8]Picou-Waud, however, revert to Jorgenson's original work in which [instead of using assumptions (10) and (11) above] he simply specified net profits each year as profits before tax less tax payments, which led to the formula for the net rental value of capital services reproduced as equation (9) in the PW paper here. This may be compared to the formulas given in the preceding footnote used by HJ, Coen and Bischoff.

[9]In this connection, see Franklin Fisher's criticisms at the Brookings Conference, *op. cit.*, p. 250.

Bischoff also uses most of the same assumptions underlying the Jorgenson model as listed above, but he develops a more complex formula for the desired capital stock (K_t^*) because his maximization is subject to (3′) a more flexible CES production function; also he specifies that (5′) technological change is embodied in new investment but not existing capital stocks (the "putty-clay" hypothesis with irreversible investment), and (7′) the cost of capital varies each year with a weighted average of bond yields and dividend yields and the tax rate. He also relaxes the assumptions of static expectations (9) found in Jorgenson and other work. His hypothesis of the more plausible "putty-clay" formulation of technological change is well supported by the data as against the "putty-putty" assumption; and relative prices (including tax credits) are convincingly shown to affect equipment outlays with a much longer lag than do changes in output. Also, while the Almon lag distributions fitted could easily have revealed a "humped" effect as had been reported by Jorgenson, Bischoff finds clear evidence that the effects of investment credits (and other elements affecting the rental value of capital) build gradually over time and approach their long-run steady-state effects asymptotically.

Klein and Taubman also accept the Jorgenson specification of optimal capital stocks with respect to an idealized world of perfect competition and certainty, but they make rather extensive adjustments for various market imperfections and uncertainty which are ignored in Jorgenson's work (and largely ignored in the other papers). Like Bischoff, they also adjust their data to allow for the fact that accelerated depreciation was adopted quite gradually by business firms; failure to allow for the fraction of assets actually depreciated by the new methods clearly introduces biases in the HJ, Coen and PW results for the effects of investment credits as well as for the change in depreciation itself. The Klein-Taubman analysis also evaluated the effects of investment tax credits and accelerated depreciation within the full Wharton model of the economy, thereby allowing for feedback effects ignored in all the other papers. (I come back later to their distinctive and valuable analysis of the *temporary* suspension of the credit in 1966).

In summary, the four important papers at the Brookings Conference and the Picou-Waud paper here clearly reflect the great advances which the profession had made over the last 15 or 20 years in understanding the determinants of investment expenditures and in developing probative statistical models of the investment process. But with full recognition of the highly constructive developments

which have occurred over the years, it is distressingly clear that the profession has not yet found "the" structural explanation of investment outlays. Each of the five papers reviewed has used sophisticated theoretical and econometric techniques; each study was addressed to the same question of the effectiveness of investment credits; but even with respect to the magnitude and time pattern of the effects of a *permanent* investment tax credit, the estimates provided differ very widely. It seems fair to conclude that no one of these papers provides an adequate basis for making firm estimates of the effects of investment tax credits for policy purposes, quite apart from the additional issues involved in the implementation of a *variable* tax credit.

Further work on the basic determinants of investment outlays is clearly needed. Jorgenson's development of the neoclassical model a decade ago lifted work on investment functions to new levels of rigor and sophistication, but reliance on this model involves acceptance of all the 11 basic assumptions listed above – at least (in the spirit of Milton Friedman's positivist metaphysic) as an adequate basis for the prediction of investment behavior. We also know, however, that inappropriate specifications, omission of relevant variables and measurement errors all bias parameter estimates and falsify predictions. Other work reviewed has relaxed the original restrictive assumptions of static expectations, constant required returns, and Cobb-Douglas production functions. But even as modified, the basic framework remains a Fisherian model of optimization of desired capital stocks *under certainty,* and no intertemporal tradeoffs affect the stocks desired at any given time. Relevant variables are allowed to vary from time to time, but no allowance is made in the models for the knowledge that they *will* vary and in an unknown (uncertain) way.[10] I suggest that the next great watershed in the econometrics of investment functions will be the explicit and rigorous incorporation of uncertainty and adjustment costs *within* dynamic optimizing models used to specify and capital stocks desired under a given set of conditions. In virtually all models to date, uncertainty is ignored and adjustment costs only enter into the distributed lags through which investment outlays gradually bring existing capital stocks up to desired levels.

In the same vein and as part of the same effort, more attention must be given to market imperfections, disequilibria and the proper measure of the cost of capital under uncertainty. Jorgenson's assumption (10) that the price of capital goods at all times equals the

[10]The Klein-Taubman paper is a partial exception in this respect, but their allowances for uncertainty are *ad hoc* and judgmental rather than vigorously derived in an explicit model.

present value of their future after-tax net rentals, for instance, implicitly but unrealistically assumes *continuous perfect equilibrium* in purely competitive markets for real capital goods. Moreover, none of the papers measures required returns in a way consistent with modern neo-Fisherian portfolio and capital market theory. Nor do any of the papers properly allow for the increasing costs and restrictions on desired capital stocks involved in an uncertain world with increased leverage and/or declines in equity values.[11] Misspecification in each of these respects will introduce errors in measurement in the rental value of capital goods – and thereby into the estimates of the effects of investment credits on investment outlays obtained in each of the papers reviewed.[12]

In addition to such improved formulations and measurements of desired capital stocks K_t^* and relevant rental value of capital c, much more work is needed on the dynamic adjustments of actual capital stocks through investment outlays to their desired levels. Current models introduce distributed lags, essentially on an *ad hoc* basis, to reflect the influence of past data on expectations and delays in the conversion of appropriation into installed capital goods.[13] Much more careful work on the formulation of expectations is required. Costs of varying speeds of adjustment need to be measured and more rigorously incorporated into the optimal time patterns of response to perceived discrepancies in capital stocks from their desired levels; and this analysis must explicitly incorporate the effects of the unavoidable uncertainties regarding the underlying determinants of optimal capital stocks upon the desired time pattern of response. Finally, we observe that investment functions to date have very generally regarded the order-to-installation lag as being constant over time. In fact, we know that in 1956-7, in 1966, and again quite recently, supply bottlenecks have significantly delayed deliveries. Failure to allow for such exogenous effects will clearly bias the parameters of the distributed lags of investment outlays on desired capital stocks.

[11]See Lintner, esp. pp. 224-30 and 242-52 for the theory and empirical evidence for the stable and highly significant *negative* effect of leverage on investment outlays, where leverage is measured by long debt (less current retained funds) as a fraction of equity at current market values.

[12]The same conclusion follows directly from any mismeasurement of the effect of the credit on the required return in the Klein-Taubman paper.

[13]Distributed lags on past actual values of capital stocks are of course used to incorporate replacement demands into total investment demand; but these are not on the essentially *ad hoc* basis being criticized.

Pending the outcome of all this further work needed on investment functions themselves, we must simply review the assumptions used and the evidence provided in the available papers to arrive at a "best judgment" assessment of the probable magnitude and time path of the effects of an investment tax credit presumed to be permanent. However uncertain and subject to error, such judgments form an essential base for considering the design and probable effects of a variable credit. Using the Hall-Jorgenson estimates as a provisional benchmark, we observe that Bischoff's strong confirmation of the superiority of the "putty-clay" hypothesis and of the different lag distributions on changes in output and relative prices argue strongly in favor of his more conservative estimates of the time-path of the effects of investment credits.[14] The appropriate allowance in Picou-Waud and Coen for non-static expectations, and for output and desired capital stocks being simultaneously determined decision variables, seem to point in the same direction – as do the more judgmental adjustments for uncertainty and market imperfections introduced in Klein and Taubman's work. It consequently appears from the composite evidence of the five papers taken together that (a) the total long-run steady-state effects of permanent investment tax credit is no greater than the Jorgenson-Bischoff estimates and may be a little lower, and (b) the time path of these incremental effects on the rate of investment outlays builds up rather slowly over a period of at least three and perhaps as much as five years, with relatively little effect within the first year and a somewhat more rapid increase in the effect during the second year, so that (c) the *cumulative* response of induced incremental investment outlays within the first one or two years will be a rather small fraction (probably a third or less) of the *total* incremental response over a four or five year period. We now turn to the implications of these apparent properties of a permanent investment tax credit for the probable effectiveness of a variable investment tax credit as part of an overall stabilization policy.

[14]Further support for the conclusion comes from the fact that the Hall-Jorgenson assumption of a *constant* 20 percent required return before tax almost certainly involves an "error in variable" bias in their estimates. Bischoff's use of a separate weighted-average estimate each year is clearly preferable; even though his formula for the cost of capital leaves much to be desired, its year-to-year movements will moderate the bias induced by the HJ fixed number.

FURTHER PROBLEMS AND ISSUES RAISED BY VARIABLE TAX CREDITS AS AN INSTRUMENT FOR STABILIZATION POLICY

This synthesis of the evidence of previous investment studies, if it is at least a reasonably good representation of the true underlying reality, raises several serious questions with respect to the design, implementation and probable effectiveness of a *variable* investment tax credit. The fact that the steady-state effects of a maintained investment tax credit are large of course provides strong justification for the use of such credits as an important component of long-run policies designed to affect the composition and growth of real GNP. But the fact that these long-run effects are large has *two different and offsetting* implications for the potential use of investment tax credits as a variable instrument for *stabilization* purposes.

Any instrument under consideration which was found to have no substantial impact on events even in the long run *if* it were continued would not be regarded as a promising candidate for purposes of stabilization. But while the large long run effects of an investment tax credit make it a *potentially* attractive stabilization instrument, they also compound the requirements for accurate forecasting on the part of policy-makers when viewed in the context of substantial lags and a slow build-up in the effects of any given change in the level of the credit. If, as our composite assessment of the available evidence suggests, more than half of the increase in the rate of investment outlays induced by the credit in any quarter occurs *after* six or eight quarters have elapsed, there is a clear danger that the delayed effects of earlier changes in the credit will continuously swamp the shorter run effects of more recent changes in the credit. *Unless* (a) some effective way can be found to "bunch up" the response of investment outlays to changes in a VITC *or* (b) policy makers responsible for changes in the levels of variable investment credits can forecast the needs for such changes with some precision as much as six or eight quarters in advance, the VITC will prove to be destabilizing rather than stabilizing in its effects whenever the forecast on which it is based is sufficiently erroneous. Moreover, unless one or the other of these conditions is satisfied, the destabilizing effects will be more serious the larger the long-run or steady-state effects of investment tax credits *per se*. This further important conclusion reflects the fact

that in all modern models the pace of investment outlays depends with a lag on changes in *desired* capital stocks which depend multiplicatively (rather than linearly) on output and a term involving investment credits (inversely) through the rental value of capital services.[15]

Zarnowitz' analysis of the "track record" of the forecasts of business conditions which have been made by official agencies (Council of Economic Advisors) and by serious private forecasters, including those using the larger econometric models, show substantial forecast errors as little as three or four quarters ahead, especially when the forecast interval turned out to have included an upper or lower turning point. This record surely raises serious doubts that the profession can yet provide forecasts of conditions *six and more quarters ahead* which have the degree of accuracy and reliability required to eliminate the danger that a VITC might turn out in practice to be a destabilizing rather than a stabilizing policy instrument. Indeed, unless substantial "bunching" of *outlays* can be induced, it appears that errors in forecasts of general economic conditions over such necessarily long forecasting horizons are still so large in the relevant respects that the risks of counterproductive outcomes remain at an unacceptably high level.

Experience with the first American effort to modify our investment tax credit for countercyclical purposes clearly supports this negative conclusion. In 1966-67, the economy was seriously overheated and experiencing its first credit crunch. In an effort to restrain booming investment outlays, the investment tax credit for equipment was suspended as of October 10, 1966 with an announcement that the suspension would remain in effect for the 15 months through December 1967. In fact, with weakening business activity, the suspension was lifted on March 9, 1967 after an effective period of less than five months.

Investment expenditures in 1966:4 and 1967:1, just after the suspension of the credit, were clearly dominated by the decisions and orders placed in earlier quarters under the stimulus of the investment credits then in effect. The lack of the credit in these two quarters reduced outlays later in 1967 and in 1968 and 1969. To have significantly relieved the overheating of the economy in 1966, the investment tax credit would have had to be suspended in 1964 or early in 1965, but there were no public or private forecasts which anticipated

[15]Thanks are due my colleague Benjamin M. Friedman for fruitful discussions of these issues, as well as others in this paper.

the pressures of mid-1966 so far in advance. The suspension of the credit in October 1966 clearly presumed continued overheating through 1967, even though within five months new data had so changed the prospect that the credit was restored. But once again, the restoration of the credit early in 1967 did little to shore up economic activity during the mini-recession of 1967. The lags between the decisions to place more orders for equipment under the stimulus of the restored credit primarily raised spending in 1968 and 1969 when the economy was again needing restraint rather than stimulus.

Similarly, the credits was repealed in the first quarter of 1969, just two quarters before the cyclical peak, and the effects of this action primarily accentuated the subsequent recession in economic activity. To complete the historical record, the reinstatement of the credit while business was weak in 1971 added little to investment outlays until late 1972 and 1973 when the economy was again overheated. While other fiscal and monetary policy actions were probably more important factors in creating the excesses of 1973, our concern here is that once again the timing of changes in the investment credit was perverse.

On the basis of the investment functions fitted to date, the burden of accurate forecasting upon policy makers undertaking to implement a VITC seems onerous indeed. But as repeatedly emphasized, all of the empirical studies of the effects of investment credits upon investment outlays have simply introduced the level of the credit available in *each* quarter into the estimate of *desired* capital stocks and then run these numbers through a distributed lag to get estimates of the impact on investment outlays in *future* quarters. No allowance has been made for anticipations or forecasting by business firms of what the level of the investment credit will be in the future. In one of the few studies concerned with the design of a variable investment tax credit, Craine, Stephenson and Tinsley (CST) have provided some *indirect* evidence that business firms also act on anticipation of changes in the level of investment credits. Specifically, they noted that there were widespread rumors in 1966 which correctly forecast the suspension of the investment tax credit. When they computed the residuals in the level of new equipment orders in the MIT-FRB-Penn model, they found that new *orders* for equipment were between 1.0 and 1.5 standard deviations above their expected values in the first three quarters of 1966, and were correspondingly lower in 1966:4 and 1967:1 right after the suspension.

After we allow for the lags between orders and investment outlays, these findings are of course quite consistent with the negative appraisal of the effects of the 1966 suspension of the credit given above. They nevertheless suggest that businessmen do respond to some extent to their *anticipations* of the level of the investment credit which will be available in the future. Indeed, since the 1966 suspension involved a change in legislation and went against the prevailing mores regarding the proper use of an investment tax credit, the anticipation response in 1966 was no doubt substantially weaker than could have been expected had an explicitly variable investment tax credit scheme already been in effect.

Picou-Waud, like Craine-Stephenson-Tinsley, argue that in *principle* such anticipatory "bunching" of investment plans during periods of deficient aggregate demands and high tax credits in anticipation of reduction (or removal) of investment tax credits *should* be stabilizing – as would the corresponding hold-back of investment plans in periods of excess aggregate demands in anticipation of future restoration (or increases) in the VITC. The CST proposal to restrict high investment tax credits to periods of deficient aggregate demands (with small credits or none when demand is excessive) clearly eliminates the perverse timing of our 1966-7 experience when in fact the 7 percent investment tax credit was continued through the period of excess aggregate demand, taken off during the (short) interval of declining business activity, and restored in time to exaggerate the overheating of 1968 and early 1969. But the proposal does not go far enough, as our experience in 1969 to date well illustrates. The bunching of investment plans during periods of high investment tax credits in anticipation of their elimination (or reduction) when aggregate demands become excessive involves *orders,* not investment outlays. The bunched orders while demands are still deficient but just before the credit is eliminated will add to the investment outlays three to six quarters later when aggregate demands may be excessive. To be truly stabilizing, the granting (or suspension) of investment tax credits must not be geared to the *current* excess or deficiency of aggregate demands, but rather to the *future* need for stimulus or restraint.

In short, as compared to the situation before 1966, legislation giving some government agency discretionary authority to impose, suspend or vary an investment tax credit will clearly lead to more anticipatory "bunching" or withholding of *orders,* but it will still leave this agency with a substantial *forecasting problem* because it will not eliminate or even reduce the long lead times involved in the distributed lag between orders and investment outlays.

Moreover, this forecasting problem involves more than just having reliable estimates of the state of excess (or deficient) aggregate demands several quarters in advance. The agency must *also* have reliable forecasts of the incremental effects of its own current actions (or inaction) – and these further forecasts must explicitly allow for the responses of the business community to their assessments (and uncertainties) regarding the pattern of the agency's subsequent actions as well as other aspects of the upcoming economic environment.

To illustrate with a concrete simple case, suppose that new legislation had given some government agency the right to impose or suspend an investment tax credit of 7 percent – its discretion is limited to *timing* and to a choice of 0 percent or 7 percent. At least once each quarter, the agency will then have to decide whether to maintain an existing credit a little longer or suspend it, and this will involve judgments or *forecasts of how much incremental order-bunching will occur during the upcoming quarter* if the credit is not suspended immediately. In the contrary case, where the credit has been suspended, the decision when it should be reallowed will of course involve corresponding judgments regarding incremental rates of order deferral. In the context of its estimates of the distributed lag between investment orders and outlays, and its forecasts of business conditions several quarters in advance, *ceteris paribus,* the responsible government agency's decision will depend substantially on its assessment of the anticipatory bunching (or deferral) or orders which would be induced by a *one quarter change in the timing* of its action. At any given time, however, this assessment will depend (along with all standard variables usually included in investment functions) on the probability distributions businessmen were *then* assessing regarding the *timing and magnitude* of the *agency's own future actions.* Whether "raw judgment" or judgment informed by spot surveys or other sources of intelligence were used, the decisions would be difficult and fraught with doubt – and the consequences of error could easily turn good stabilizing intentions into destabilized histories after the fact. As George Terborgh has perceptively noted,[16] although the authority to suspend or restore 7 percent investment tax credits may reduce the policy response lag, it probably increases uncertainty in the business community and involves considerable risks of perverse responses.

[16] *Capital Goods Review,* No. 92, May 1973.

These added forecasting burdens under proposed legislation giving some agency the right to *vary* investment tax credits between limits of 0 percent and 15 percent would obviously be even greater, even though the risks of perverse responses might be somewhat reduced. Supposing that the current credit were 7 percent, the agency would then have to decide at least once each quarter not only whether to sit tight for a while longer or move to say 9 percent, 11 percent, 13 percent, or 15 percent, *or* to 5 percent, 3 percent or 0 percent – and such decisions would involve assessments of the *incremental* effects of *changes in timing and magnitude simultaneously.*

At the present time, we simply have no adequate theory of how much anticipatory ordering (or deferral) would be optimal for the business firms themselves, let alone any good econometric estimates of how much would in fact occur under any given set of circumstances. Klein and Taubman at least introduced a simple model of the present value of a one-period deferral of investment in their consideration of the temporary suspension in 1966, and Craine-Stephenson and Tinsley build on some earlier work to develop optimal adjustment paths to *assumed sequences* of "anticipated" (as well as anterior) events, but the optimal *stochastic* control solutions based on explicit probability distributions over future levels of the investment credit (as well as other variables) have not yet been developed. Moreover, even *if* such more relevant theory were available and good structural econometric estimates of its parameters had been developed, there would still be a very substantial range of uncertainty regarding the magnitudes and time path of the effects of any given change in the credit at any particular time, and probably substantial risks of destabilizing consequences from any given change in the credit.

In addition to these theoretical, empirical and assessment problems involved in the successful implementation of a variable investment tax credit plan, there are also administrative problems which to date have seriously compromised the short-run cost-effectiveness of the introduction (or suspension) of investment credits. Although the law has included a complex binding contract rule and (nominally at least) applied the credit to only the uncompleted fraction of work on earlier contracts, the practice has been to allow credit on most of the equipment installed after the effective date of the credit. As Brannon has written,

> At the end of the effective period of the VIC (the go-out), the binding contract rule seems to limit the tax law change to prospective decisions, but it does so only in a loose way. In normal business affairs, contracts which appear to be binding are modified when it is in the interests of both parties to do so. Also, entering into a binding contract is a fairly trivial event taken by itself. Given any anticipation of the termination of VIC, it is relatively costless to enter now some contracts that would have ordinarily been entered over the next year.

As a result, credits are given (and tax revenues lost) on substantially all investment outlays based on equipment order-backlogs at the time of the "go-in" (even though these have not been induced by the credit) – and also on a substantial volume of *later* investment outlays based on orders placed prior to the suspension. The resulting inefficiencies may not be of major moment if investment tax credits are introduced (or suspended) only at very infrequent intervals and regarded as "permanent" in either case, but raise fundamental questions regarding the cost-effectiveness of a *variable* investment tax scheme.

In an unpublished memorandum, Brannon has suggested that this problem might be met by legally restricting the credit of the *value-added* by the producer of each investment good during the credit period.[17] This proposal is attractive in principle and surely merits much more study and development. If feasible, reliable and not too costly, it could also significantly ease the forecasting burdens emphasized earlier. There are clearly serious problems of reporting and

[17] Brannon sketches the operation of his proposal as follows:

> Consider first a large non-fungible item like a dynamo. The producer of dynamo would certify his goods-in-process inventory as of the starting date, and he would be permitted to normalize this goods-in-process inventory for the normal relationship between inventory values and sales prices. The producer would be limited to certifying for investment credit purposes only and value added after the starting date. The basic control on this system is that a producer must indicate an amount of partial certification in which the disallowed amounts equaled his normalized goods-in-process inventory as of the starting date. He would normally be permitted to report a schedule of these partial certifications which would involve their being spread over a year or two after the starting date. There would seem to be no particular reason for government to be greatly concerned about the possibility that a particular seller could juggle certifications between buyers. This could be left to bargaining. With respect to fungible goods, the producer of the good should simply be allowed to submit a program of partial certifications which would in aggregate equal the initial normalized goods-in-process inventory. It could be left to him to decide how to allocate this to particular sales. With regard to the go-out, the same technique of partial certification would apply. The producer of a fungible good would simply certify the normalized goods-in-process inventory value as of the termination date, and this would be available as a partial certification whether or not there was a binding contract.

compliance involved, even if a variable investment tax credit scheme has the simple form of administrative discretion merely to allow or suspend an investment credit at a *fixed* rate of, say, 7 percent. These problems of costly reporting and compliance would obviously be greatly compounded if a more flexible VITC were adopted, such as proposed plans which involve administrative discretion to vary at quarterly or semi-annual intervals the level of the credit anywhere in the range from 0 or 3 percent up to as much as 15 percent. The more variable the credit, the more serious are the questions of the costs, the reliability, and the basic feasibility of the scheme.

CONCLUSIONS

Neither the theoretical nor econometric work on investment functions to date justifies much optimism that a VITC would prove to be stabilizing rather than destabilizing in practice. While substantial developments have been made in the theoretical models over the last decade or so, much more work on the formation of expectations, incorporating uncertainty and explicit probability distributions, is required before we have an adequate theoretical basis for designing a VITC plan. The available econometric work has treated the level of the credit prevailing at each point in time as if it were permanent, and even so, widely differing assessments of the magnitude and time paths of the effects of tax credits have been presented by respected scholars. Variables essential to the operation of a VITC have not been introduced into the fitted equations, so the values of the parameters are unknown.

Relying on the best composite assessments, based on the internal evidence of the available investment studies, it seems clear that successful implementation of a VITC based on investment outlays will depend upon substantial accuracy in forecasts of excess (or deficient) aggregate demands *at least* three to six quarters ahead (because of the basic lag between orders and outlays), and very probably over a much longer forecast interval. Under a flexible VITC, businessmen's anticipations of the timing and magnitude of prospective changes in the credit will seriously compound the administering agency's decision as to what if any changes should be made at any given time. Brannon's proposal that the credit be allowed only on values-added in each time interval would in principle reduce the time interval over which the agency would need accurate forecasts of future business conditions. It would also substantially improve the cost-effectiveness of an "on-again, off-again" tax credit. However,

the monitoring and compliance costs and the complexity of the scheme would be very considerable even if a given level of credit (say 7 percent) were reintroduced or suspended only after several quarters had elapsed, and these legal and administrative problems and costs would be greatly increased if credit levels were changed more frequently or in more flexible steps.

This review of the state of our knowledge regarding the probable effectiveness and desirability of a variable investment tax has raised more doubts and unanswered questions than reassuring conclusions. Within the context of past American practice in which tax credits have been granted *de facto* essentially on the basis of investment *expenditures,* frequent changes in the level of an investment tax credit get low marks on the basis of their cost-effectiveness. Moreover, the long lead times between the business decisions affected by the credit and the resulting *outlays* raise substantial risks that variations in the level of the credit will prove to be destabilizing rather than stabilizing. We can anticipate that further research on investment functions themselves, and further improvements in the reliability of the forecasts of aggregate demands and supplies from large scale econometric models several quarters ahead, will ease these problems in the future, but for the nearterm they appear to be very substantial indeed.

Several alternatives to simply varying the level of our existing tax credit which in practice is based essentially on investment outlays should also be examined further. If difficult legal and administrative problems can be worked out, the proposal to tie the investment tax credit to values-added may provide a means of simultaneously improving the cost effectiveness of a VITC and reducing the risks of destabilizing effects of changes in the level of the credit. Even if practically feasible with relatively infrequent changes in the level of the credit, this plan would probably break down into a morass if the level of the credit were varied every two or three quarters. Lindbeck's optimistic reports of Sweden's experience with variable investment *reserve funds* at this conference should also encourage further study of this alternative to U.S.-type investment credits.[18] Finally, Pierce and Tinsley have proposed a modified Business Investment Fund scheme which in principle promises more flexibility as well as stronger and more assured stabilizing effects, but to date we only

[18]See, however, Brannon's critical discussion of the Swedish plan at this conference, and other analyses of this experience as cited by Pierce and Tinsley.

have the results of a preliminary theoretical exploration of the plan. Further work on the *design,* and the practical problems of *implementing,* a variable investment stimulus plan as an added stabilization instrument is clearly justified, even though our experience to date has not been favorable. The gaps in our present knowledge must be closed before we proceed.

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