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THE ASSET PRICE APPROACH TO THE ANALYSIS OF CAPITAL INCOME TAXATION

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ABSTRACT

This paper summarizes my recent research directed at the development of an asset price approach to the analysis of capital income taxation. While asset prices play a crucial role in many macroeconomic models, they have been subordinate in most previous efforts to study the effects of capital income taxation on economic behavior. A number of reasons for focusing on the role of asset prices in analyzing public finance questions are discussed. These include the role of asset prices in determining investment decisions, and the fact that changes in asset prices are indicators of the horizontal and vertical equity effects of tax reforms. Recent empirical research in which asset price information is studied in order to measure the effects on economic behavior of tax reforms and to distinguish between alternative models of the effects of capital income taxation is reviewed. Directions for future research in public finance, focusing on asset markets, are also discussed.

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This paper summarizes and attempts to place in a broader context my recent research directed at developing an asset price approach to the analysis of the effects of capital income taxation. The link between asset markets and real investment decisions has been an important theme of much recent research in macroeconomics dating at least from Tobin's seminal q theory of investment. However, asset markets have been subordinate in most previous theoretical and empirical efforts to model the effects of capital income taxation on economic behavior. Although changes in asset prices are the proximate determinants of who gains and loses following tax reforms, asset markets are suppressed in standard models used to study tax incidence.

A recurring theme in much of the empirical work described here is the effect of inflation on the tax system. Empirical work on the macroeconomic effects of tax reforms has always been difficult because of the paucity of statutory changes. In this limited respect, inflation has been salutary, because its frequent increases during the 1970's and recent sharp decreases have significantly altered the effective taxation of real income because of nominal accounting practices. Indeed, it is fair to say that most of the variation in tax rates on corporate capital over the last two decades can be traced to the effects of inflation.

Beyond its scientific interest, an analysis of capital income taxation and particularly its interactions with inflation is highly pertinent in light of recent economic events. The inflationary decade of the 1970's witnessed important changes in traditional patterns of capital accumulation and valuation in the American economy. The real price of corporate capital relative to consumption goods declined by almost 50 percent. Almost as dramatic was the real appreciation in the relative price of owner-occupied housing and land. As a consequence of these changes, the relative value of the two principal forms of wealth in the economy changed by a factor of more than two. During late 1982, the rate of expected inflation fell very sharply, and the stock market rose very dramatically, while real housing prices remained relatively stable. These large changes in relative prices were reflected in movements in rates of investment. The growth rate of non-residential business capital employed per man hour declined from 3.4 percent during the 1949-74 period to .2 percent during the 1976-80 interval, while the share of net investment devoted to residential capital rose significantly.

The first section of this paper describes in more detail what is meant by the asset price approach to capital income taxation and discusses its advantages for studying certain public finance questions.

The second section illustrates how the effects of tax reforms on both asset prices and investment can be estimated in

a simple partial equilibrium setting. The third and final section of the paper summarizes research on the relationship between taxes and the pricing of capital assets and suggests directions for future research.

I. The Asset Price Approach

The asset price approach to capital income taxation provides a united framework in which three traditional issues in the analysis of capital income taxation can be addressed. These issues include the short-run effects of tax reforms on investment, their long-run effects on capital accumulation and growth and their effects on horizontal and vertical equity. The relationship between the asset price and traditional approaches to each of these issues is discussed below.

Taxation and Investment

Before discussing the advantages of focusing on asset prices in analyzing the effects of capital income taxes on investment, it is useful to review briefly more standard approaches to the problem. There exists a large literature attempting econometric evaluation of the effects of investment incentives. This literature which is extensively summarized in Eisner and Chirinko (1980) is all based on extensions of the flexible accelerator approach to investment developed in the

seminal work of Hall and Jorgenson (1967). These studies all model investment as an adjustment process to a desired capital stock. The desired capital stock is postulated to be a function of the past levels of real output and the cost of capital. Often, as in Jorgenson's work, theory is used to tightly constrain this function. As Eisner and Chirinko illustrate, there is room for substantial disagreement about these constraints and the specification of the cost of capital. Here I leave these issues aside, and consider two more fundamental problems with the use of flexible accelerator-type econometric investment equations to model the effects of investment incentives.

The major conceptual difficulty with flexible accelerator approaches is that they treat output as predetermined from the point of view of the firm's investment decision. The desired capital stock is chosen conditional on output rather than being simultaneously determined. This is an important problem. Presumably, government's reason for offering investment tax incentives is the belief that reductions in the cost of capital will raise the level of output firms desire to supply. This in turn leads to increased investment. It is difficult to imagine how investment incentives could be beneficial, if they have no impact on the level of output firms expect to produce. Yet this constraint is imposed <u>a priori</u> in studies using flexible accelerator approaches to model investment.

This objection is sometimes met by embedding equations of this type in large scale Keynesian models, and simulating the path of the economy, under alternative asumptions about tax policy. This approach brings with it all the well-known problems with such models. More importantly, it does not really meet the objection that meaningful evaluation of the effects of the effects of investment incentives requires analysis of their effects on the desired supply of output. In standard Keynesian models, output is demand determined with essentially no role left for the effects of policies on aggregate supply.

A second problem with flexible accelerator models is the treatment of expectations. Presumably the desired capital stock should be a "forward looking variable" depending on expectations about the future marginal product and cost of capital. Standard approaches assume that these variables can be adequately proxied by lagged values of output and the cost of capital. This seems implausible. Announced but not yet implemented tax policies will clearly have effects on the level of investment, but this possibility is precluded in standard investment equations. A second example is provided by changes in the production function through time. Flexible accelerator approaches typically assume that the marginal product of capital is a stable function of the capital output ratio. The substantial variation in observed rates of profit suggests that this assumption is unwarranted. These examples are merely

illustrations of Robert Lucas's (1976) famous critique of standard large scale econometric models. In general, the estimated parameter will be complex combinations of underlying structural parameters, and the stochastic processes followed by policy and other exogenous variables. It is unlikely that the estimates will be stable from period to period, especially when policy rules are altered.

The asset price approach to analyzing the effects of capital taxation relied on here takes as its point of departure a different strand of the literature on investment. A number of authors including Eisner and Strotz (1963), Lucas (1967), Treadway (1968), and Abel (1980) have recognized the ad-hoc character of the delivery lags introduced in many models of investment, and developed models of investment in which costs of adjustment enter explicitly. In these models, the level of investment depends on the shadow price associated with the capital accumulation constraint. When the value of capital rises, firms are willing to incur more adjustment costs in order to rapidly increase their capital stock. As Hayashi's (1982) important paper demonstrates, these models of competitive firms facing adjustment costs, are under constant returns to scale assumptions, closely related to q investment models of the type pioneered by Tobin (1969). In models the rate of investment is a function of q, the ratio of the market value of the capital stock to its replacement cost. In fact, the observed q ratio can be used to infer the shadow price of

capital goods in the model of a firm facing costs of adjustment.

These linkages are important because they imply that an asset price approach can avoid the difficulties with standard econometric evaluations of investment incentives which were considered above. When adjustment costs are introduced, it is possible to develop a meaningful theory of supply even for firms with constant returns to scale. In any given period, the firm will choose its desired level of output depending on its previous capital stock. The growth rate of the capital stock will depend on the return on capital investment. Thus the asset price approach is supply based and so can be used to evaluate the effects of investment incentives.

The link between the observable q ratio and the shadow price of capital in the firm's dynamic optimization problem also solves the problem of modelling expectations. The q ratio will summarize the expectations of future profitability and costs of capital on which investment depends. Thus it obviates the need to adopt complex procedure for estimating expectations about these future variables. The relationship between investment and q, is structural in the sense that it should be invariant with respect to changes in policy rules, depend only on technology. Therefore the asset price approach can be used to estimate the effects of policy announcements, and temporary measures, which are not susceptible to analysis using alternative econometric approaches.

Taxation and Capital Accumulation

The asset price approach also bears on the literature in public finance examining the long-run effects of capital income taxation on both the accumulation and allocation of capital, and the long-run efficiency and incidence implications of capital income taxation. This literature originating in Harberger's (1962) seminal paper on the corporate income tax has largely ignored the process of investment. The models employed are not well suited to analyzing the short and intermediate-run response of the economy to changes in tax policy since they assume that there are no costs of adjustment impeding the accumulation or reallocation of capital. As a consequence, sectoral marginal products of capital are always equated. This means that there is essentially no scope for variation in the asset price of existing capital goods.

The evident volatility of observed asset prices demonstrates the unrealism of the maintained assumption of instantaneous adjustment. In order for large relative price changes to occur, it is necessary that adjustment be slow so that divergences of the marginal product of capital and its cost endure. The asset price approach developed here provides a basis for explicitly estimating the extent of these adjustment costs and modeling more realistically the transition of the economy following tax changes.

Tax Incidence

The presence of large adjustment costs also has important implication for the analysis of the incidence of capital income taxation. The implausibility of standard models without adjustment costs may be seen by noting that they imply that corporate shareowners would not gain relative to homeowners from an equalization of the tax rates on residential and corporate capital. This is because the standard approach to tax incidence ignores an important aspect of the actual economy's response to such a tax change. In the short run, the price of existing corporate capital would rise, and of existing homes would fall, as investors adjusted their portfolios. The price changes would capitalize the expected present value of the effects of the tax reform on future returns, conferring windfall gains on the owners of corporate capital, and losses on homeowners. These price changes would act as signals to the suppliers of new capital, calling forth more plant and equipment and fewer homes, until their relative prices were again equated to their relative long-run marginal costs of production.

Because an essential step in the asset price approach is the estimation of the effects of tax reforms on the market valuation of existing assets, it is ideally suited for evaluating the short-run incidence of tax policy changes. Such an analysis is important to evaluating the effects of tax reforms on both vertical and horizontal equity. Given information on the effects of tax reforms on asset prices, and the

distribution of wealth holding, it is possible to evaluate the vertical equity effects of tax reforms. As Feldstein (1976) pointed out, horizontal equity is best achieved by avoiding reforms that give rise to windfall gains and losses.

The asset price approach also highlights the very different incidence of reforms that reduce taxes on all capital income and those which benefit only new investments. While appropriately chosen reforms of these two types may have an equal impact on investment, they are likely to have very different effects on existing wealthholders. Measures that reduce the tax burden on all capital are likely to substantially raise the market value of existing assets, conferring a windfall gain on the holders of existing assets. On the other hand, measures that subsidize only new capital may well actually reduce the wealth of owners of the existing capital which must compete with newly subsidized capital. These distinctions are not recognized within standard analyses which focus on the effects of tax policy changes on after tax rates of return but not on the value of existing assets.

II. The Dynamics of Investment and Market Valuation

The asset price approach to public finance and its implications for investment and market valuation can be illustrated in the context of simple stylized model. A more complex version of this framework is used in much of the research described in the next section.

The dynamics of investment and market valuation are considered in a model in which there is no inflation, capital does not depreciate, investment is financed through retained earnings, and the only tax is a proportional levy on corporate income. In this setting it is reasonable to assume that investment depends on the ratio of the market value of existing capital to its replacement cost. Unless an investment of one dollar increases the market value of the firm by more than one dollar, there is no reason to invest. Given the costs of adjustments and lags in recognition and implementation, there is no reason to expect that all investments that increase market value by more than their cost will be made immediately. As Tobin argued, these considerations lead to an investment equation of the form:

$$I = I\left(\frac{V}{K}\right)K \qquad (1)$$

$$I(1) = 0 \qquad I' > 0$$

where I represents gross investment and V/K is the q ratio of market value to replacement cost. Since inflation is assumed to be zero, the price of capital can be taken to be 1. The assumption that the ratio of I/K depends on q ensures that the growth rate of the capital stock is independent of the scale of the economy. It is important to recognize that the investment schedule given by equation (1) is a technological relation that depends on the adjustment cost function.

It is assumed that equity owners require a fixed real rate of return to induce them to hold the existing stock of equity. This return comes in the form of dividends -- equal to after-tax profits minus retained earnings for new investment -- and capital gains. Hence the condition,

$$\rho = \frac{Div}{V} + \frac{\dot{V}}{V} \qquad (2)$$

which implies:

$$\dot{V} = \rho V - (1-\tau)\, F'(K)K + I\left(\frac{V}{K}\right)K, \qquad (3)$$

where τ is the corporate tax rate, and the production function, with labor input fixed, is given by F(K). Because it is assumed that the economy's fixed labor force is fully employed, the rate of profit, F'(K), declines as the capital stock increases. It will be convenient to examine the dynamics in terms of K and q. Equations 2 and 3 imply that the system's equations of motion are:

$$\dot{K} = I(q)\, K \qquad (4)$$

$$\dot{q} = [\rho - I(q)]\, q + I(q) - (1-\tau)F'(K) \qquad (5)$$

The steady state properties of the model are easily found by imposing the conditions $\dot{K} = 0$ and $\dot{q} = 0$. These imply:

$$q = I^{-1}(0) = 1 \qquad (6)$$

$$\rho = (1-\tau)F'(K) \qquad (7)$$

Equation 6 indicates that in the steady state, the value of q must equal 1 so that the market value of capital goods

equals their replacement cost. Equation 7 indicates that, in equilibrium, firms equate their net marginal product of capital to the cost of capital. Inspection of 6 and 7 makes clear that a change in the corporate tax rate affects the steady-state capital stock but has no effect on steady-state q because the change does not influence the cost to the firm of acquiring new capital goods.

The dynamics of adjustment following a tax change are illustrated in Figure 1, a phase diagram representing equations 4 and 5. In the figure, the arrows depict the equations of motion of the system when it is not in equilibrium. The dark line represents the saddle-point path along which the system will converge to a steady state. A reduction in the corporate tax rate does not immediately affect the capital stock. The value of q jumps from E_1 to B, as shown in Figure 2. As capital is accumulated, the marginal product of capital falls and the system converges to E_2, where q is again equal to its equilibrium value. This path assumes that investors have perfect foresight and take account of the capital losses that occur as capital is accumulated. An alternative assumption is that the investors have myopic expectations and fail to foresee the effects of capital accumulation. In this case, the system jumps from E_1 to A and then converges to E_2 along the $q = 0$ schedule; along this transition path investors consistently earn less than their required rate of return.

An alternative type of tax reform benefits only new investment. Consider the introduction of a subsidy at rate s, a new investment. This reduces the effective purchase price of capital goods to firms. It also reduces corporate tax payments for any firm that invests. The effects of such a subsidy are displayed in Figure 3. Unambiguously, the steady state level of capital intensity increases. However, the short-run effect of the tax change on the market valuation of existing capital is unclear as illustrated in Figure 3. There are two off-setting effects. The investment subsidy reduces tax payments tending to increase market valuation, but it also increases the competition for old capital tending to reduce the value of existing capital. The crucial distinction between tax reforms which benefit all capital, and those which benefit only new capital, discussed in the previous section can be readily observed by comparing Figures 2 and 3.

This discussion illustrates the asset price approach to the analysis of tax policy in a particular simple context. Note that all that is necessary to evaluate the effects of implementing any given tax policy path, is knowledge of the profit function F(k) and the investment schedule I(q). Both are estimable from observable data and do not depend on commeasurable expectations. Given knowledge of these

functions, equations (3) and (4), together with an initial condition on the capital stock and the terminal condition (6) can be used to calculate the evolution of V, K, and I. Formally, solution of a two-point boundary value problem is involved. While this can be difficult in models with multiple assets, Lipton, Poterba, Sachs, and Summers (1982) have developed an algorithm that can be used to solve problems of moderate size.

III. Summary of Research on Taxation and Asset Prices

In Summers (1981), I developed a q theory of investment. The linkage between the "average q" as measured on financial markets, and marginal q, the shadow price of investment in a dynamic model of firm investment decisions when adjustment is costly is established. The model considered is stochastic and includes a fairly detailed tax structure. The performance of standard q investment equations, and equations using a q variable which is adjusted for the effect of taxation, in explaining fluctuations in investment at both the firm and the aggregate level are then contrasted. The econometric results support the theory. The tax adjusted q variable outperforms the standard variable in explaining both aggregate and firm investment. These results are confirmed using data on individual firms in Salinger and Summers (1983).

The next stage in this research also described in Summers (1981) involves using these econometric results to calibrate a partial equilibrium simulation model capable of examining the effects of alternative tax reforms on investment and stock market valuation. The model used is partial equilibrium in the sense that it takes as exogenously fixed the real after tax rate of return required by equity investors. Results of simulations suggest that the interaction of inflation and the tax system can significantly reduce investment and the level of the stock market. The estimates suggest that indexation of the tax system would raise the stock market by about 20 percent and investment by about 15 percent. Various statutory tax reforms are then considered. The results suggest that measures directed at reducing capital gains taxes and accelerating depreciation have the largest impact on investment per dollar of revenue foregone.

Summers (1982) takes a first step towards the construction of a general equilibrium model in which the effect of taxation on asset prices and investment can be studied. The model incorporates owner-occupied housing and land as well as corporate capital. In the model, consumption is determined by intertemporal optimization. The model is designed to capture the wealth effects of fiscal policies which are ignored in standard models used in public finance. Three substantive con-

clusions emerge from the analysis. First, the supply of funds to the nonfinancial corporate sector is likely to be highly elastic so that tax policies will have relatively little impact on required rate of return. Second, indexation of the tax system would generate significant windfall gains for equity owners and stimulate corporate investment. Large losses would be suffered by bond owners. Home owners and landowners would also lose as portfolio reallocations towards corporate capital reduced the value of their investment. Third, the form of tax incentives has a major impact. The elimination of the corporate income tax, and the implementation of an accelerated depreciation program like that recently enacted, have similar effects on long-run corporate capital intensity. However, they have very different effects on the stock market in the short-run. The former measure raises the value of the market by about 80 percent relative to the latter. The consumption caused by the greater increase in wealth leads to higher interest rates, so the crowding out effects of eliminating corporate taxes are much greater than those of instituting accelerated depreciation.

The research described so far is directed at developing estimates of the effects of tax reforms; assuming the validity of the assumptions underlying the asset price approach. A major virtue of working with asset price information is that it can be used to provide tests of alternative models of the effects of tax changes.

Microeconomic tests of the asset price model are presented in Summers (1981). The tests rely on differences between the firms in the tax effects on inflation. The "tax effects" hypothesis predicts that high leverage firms, using LIFO inventory accounting, for which depreciation is a small part of cash flow, should benefit from increases in inflation relative to firms with opposing characteristics. The "inflation illusion" view of Modigliani and Cohn, has the opposite implications. These hypotheses are tested using a sample of 1,200 firms drawn from the compustat tapes. The econometric results are generally favorable to the tax effects hypothesis. The data suggest that FIFO firms lose substantially from inflation, relative to others. Highly levered firms appear to benefit from inflation. The evidence on depreciation is more mixed, with the results suggesting that inflation illusion was present in the 1960's but had almost vanished by the late 1970's. The cross-sectional results are then used to try to explain the disastrous performance of the market during the 1970's. I conclude that tax effects can explain about a 15 percent decline, with another 25 percent potentially attributable to increasing awareness of the need to adjust reported historic cost depreciation.

The adjustment of nominal interest rates to changes in expected inflation plays a critical role in any analysis of

inflation-tax interactions. This issue is taken up in Summers (1982b). A simple general equilibrium model in which the effects of taxation on the Fisher relationship can be studied is developed. Theoretical analysis with almost any plausible parameter values suggests that in the presence of taxes, steady inflation should raise nominal interest rates by more than point for point. Theoretical analysis does not identify the short-run relationship between interest rates and inflation, which depends on the sources of stochastic shocks. Standard econometric procedures are therefore not well suited to testing the predictions of the model. Tests of the Fisher relationship are presented which use band-spectrum regression to filter out high frequency movements in the variables. The results are disappointing in suggesting the failure of nominal interest rates to adjust for inflation as fully as theory would predict. This conclusion is robust, holding over 120 years of American data. The possibility that the failure of interest rates to rise with inflation, is the result of correlation between inflation and measures of either the marginal product of capital or the measures of risk is considered and rejected. The possibility that financial markets exhibit inflation illusion is entertained tentatively.

Recognition of the importance of changes in asset prices has crucial implications for the analysis of the effects of

taxation of risky assets. Bulow and Summers (1982) demonstrate that previous analyses which have typically assumed that depreciation rates are constant and that the future price of capital goods is known with certainty are very misleading as guides to the effects of corporate taxes. In an environment where asset prices are variable, the concept of economic depreciation requires careful definition. We show that an appropriate ex ante depreciation schedule depends on future asset price risk. Some empirical calculations suggest that the appropriate adjustments for risk are large and greatly affect the estimated burden of the corporate income tax.

Data on asset prices can also be used to test alternative hypotheses regarding corporate financial policy. Poterba and Summers (1983) exploit the substantial variations in British dividend taxation that have occurred over the last 30 years, to contract the "tax capitalization" and "traditional" models of the effects of dividend taxation. The tests rely on the specification of investment equations based on alternative specifications of "tax adjusted q" variable.

Asset prices can also be used to study questions in other areas of public finance. Rosen (1982) uses information on housing prices to assess the effects of California's Proposition 13 on individual localities. Potentially this approach could be extended to consider other types of governmental spending programs. These might include agricultural measures whose incidence is reflected in changes

in the price of farm land, and direct or indirect subsidies to industries which affect stock prices. The research described here illustrates two propositions. First, the effect of tax policies on asset prices can be estimated and used to measure their incidence. Second, asset price data can be used to answer otherwise very difficult empirical questions in public finance. Future research on the issues mentioned here and others will contribute to our understanding of the effects of the functioning of taxation on our economy.

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