Economics 230a, Fall 2021
Lecture Note 7: Taxation and Business Investment

We now turn to investment behavior. Although we traditionally think of plant and equipment, of growing importance is investment in intangible assets, as through research and development (R&D) spending.

The User Cost of Capital

A basic concept for analyzing the impact of taxes on investment is the user cost of capital, as originally derived by Jorgenson (*AER* 1963) and used in both theoretical and empirical analysis. We consider the decisions of a firm wishing to maximize its value at date t,

$$(1) \qquad V_t = \int_t^{\infty} e^{-r(s-t)} X_s ds,$$

where r is the discount rate relevant for the corporation's cash flows from real activities at each date s, X_s. One can show that r is a weighted average of the firm's debt and equity capital costs.

We assume that the firm uses capital and labor in production, so that its cash flows at date s are:

$$(2) \qquad X_s = (1-\tau_s)[p_s F(K_s, L_s) - wL_s] - q_s I_s (1-k_s) + \tau_s \int_{-\infty}^{s} D_u(s-u) q_u I_u du$$

where p_s is the output price, w is the wage (assumed constant), K_s and L_s are capital and labor used in production $F(\cdot)$, q_s is the price of new capital, and I_s is the flow of real investment. The corporate tax system has three components: τ_s, the corporate tax rate, k_s, the initial subsidy to investment (e.g., an investment tax credit), and $D_u(s-u)$, the date-s depreciation deduction per dollar of investment made at an earlier date u. This deduction depends not only on the age of the asset, $(s-u)$, but also on the tax depreciation rules as of date u. Inserting (2) into (1) yields:

$$V_t = \int_t^{\infty} e^{-r(s-t)} \left((1-\tau_s)[p_s F(K_s, L_s) - wL_s] - q_s I_s (1-k_s) + \tau_s \int_{-\infty}^{s} D_u(s-u) q_u I_u du \right) ds$$

$$= \int_t^{\infty} e^{-r(s-t)} \left((1-\tau_s)[p_s F(K_s, L_s) - wL_s] - q_s I_s (1-k_s) + \tau_s \int_t^{s} D_u(s-u) q_u I_u du + \tau_s \int_{-\infty}^{t} D_u(s-u) q_u I_u du \right) ds$$

$$= \int_t^{\infty} e^{-r(s-t)} \left((1-\tau_s)[p_s F(K_s, L_s) - wL_s] - q_s I_s (1-k_s) + \tau_s \int_t^{s} D_u(s-u) q_u I_u du \right) ds + \overline{V}_t$$

where we break depreciation allowances down into those attributable to investment after date t and before t. The second piece, with value $\overline{V}_t$, affects firm value at date t, but not decisions from date t onward, and so may be ignored in the optimization. The remaining expression for firm value can be simplified by changing the order of integration for depreciation allowances (starting with date of allowances, rather with date of investment):

$$(3)\quad \begin{aligned} V_t &= \int_t^\infty e^{-r(s-t)}\left((1-\tau_s)\left[p_s F(K_s,L_s) - wL_s\right] - q_s I_s(1-k_s) + q_s I_s \int_s^\infty e^{-r(u-s)}\tau_u D_s(u-s)du\right)ds + \overline{V}_t \\ &= \int_t^\infty e^{-r(s-t)}\left((1-\tau_s)\left[p_s F(K_s,L_s) - wL_s\right] - q_s I_s(1-\Gamma_s)\right)ds + \overline{V}_t \end{aligned}$$

where $\Gamma_s = k_s + \int_s^\infty e^{-r(u-s)}\tau_u D_s(u-s)du$ is the value of tax benefits per dollar invested at *s*.

The firm seeks to maximize its value at time *t*, as defined in expression (3), through the choice of labor and investment at each subsequent date. For labor the first-order condition will be simple, that $p_s F_L = w$. Determining the optimal investment policy requires further specification of the firm's technology. It is usually assumed that capital depreciates exponentially at rate δ, that is:

$$(4)\qquad \dot{K}_t = I_t - \delta K_t$$

Note that δ is capital's rate of actual, or <u>economic depreciation</u>, and is generally distinct from the pattern of depreciation allowances specified by the function $D(\cdot)$ defined above. Inserting (4) into (3), one can then solve for the optimal capital stock path using the calculus of variations. The Euler equation, $\frac{\partial V_t}{\partial K_s} - \frac{d\left(\partial V_t / \partial \dot{K}_s\right)}{ds} = 0$, yields the following solution for marginal product of capital:

$$(5)\qquad F_K = \frac{q_s^*}{p_s}\frac{\left(r + \delta - \dot{q}_s^*/q_s^*\right)}{(1-\tau_s)}$$

where $q_s^* = q_s(1-\Gamma_s)$, which one may think of as the *effective* price of capital goods, taking into account the present value of tax benefits directly associated with investment. The expression on the right-hand side of (5), the implicit rental price of capital, is commonly referred to as the user cost of capital. With a constant tax system, $\dot{q}_s^*/q_s^*$ is just $\dot{q}_s/q_s$ and the term in parentheses in the numerator is just the real required return to investors $r - \dot{q}_s/q_s$ plus the rate of depreciation, δ.

Special Cases (with tax parameters constant over time):

Immediate expensing: $\Gamma_s = \tau_s$, so the user cost becomes $\frac{q_s}{p_s}\left(r + \delta - \dot{q}_s/q_s\right)$; the tax system potentially affects investment only through its impact on the required rate of return, *r*.

Economic depreciation allowances (at replacement cost): $D_s(u-s) = \frac{q_u}{q_s}\delta e^{-\delta(u-s)}$; for a constant inflation rate, this implies that $\Gamma_s = \tau\frac{\delta}{r+\delta-\dot{q}/q}$, so the user cost becomes $\frac{q_s}{p_s}\left(\frac{r-\dot{q}_s/q_s}{1-\tau} + \delta\right)$. The tax system effectively taxes the net (after depreciation) return to investment, $r - \dot{q}_s/q_s$.

Temporary Tax Policy

Tax policy is not static, particularly where investment incentives are concerned. For example, the United States adjusted the value of Γ, as defined above, through a program known as bonus depreciation, several times within the past two decades, in response to recessions. How do such changes affect the incentive to invest and the timing of investment? We can consider the impact on the user cost expression in (5) when tax policy is changing. In particular, note that $\dot{q}_s^* / q_s^* = \dot{q}/q - \dot{\Gamma}/(1-\Gamma)$, so that the user cost is:

$$(5') \qquad \frac{q_s}{p_s} \frac{(r + \delta - \dot{q}_s / q_s)(1-\Gamma_s) + \dot{\Gamma}_s}{(1-\tau_s)}$$

Thus, there is an extra term influencing the incentive to invest, $\dot{\Gamma}$. When tax incentives are increasing, it is like deflation in the price of capital goods, increasing the user cost and discouraging immediate investment. Let us consider now the incentives associated with an increase in the value of Γ, through bonus depreciation. When the system is in place and assumed permanent, it lowers the user cost (encouraging investment) by raising Γ. If the incentive is perceived to be temporary, this reduces the user cost even more, as $\dot{\Gamma}$ is negative. On the other hand, just prior to the incentive being introduced, if it is anticipated, the user cost will be elevated above its value with no special incentives, as $\dot{\Gamma}$ is positive. Thus, there is a danger that frequent use of investment incentives can be destabilizing by leading firms to delay investment as a downturn approaches. As shown in Auerbach (*AER* 2009), changes in US investment incentives have been quite predictable in recent decades, therefore giving cause for concern.

The most recent U.S. episode of this type was in the 2017 Tax Cuts and Jobs Act, which offers full expensing of qualifying investment for five years, with expensing then gradually phased out over five years. Its impact will depend in part on how credible the announced phase-out is.

Investment: Empirical Evidence

Empirical evidence on fixed investment suggests that firms do respond to changes in the user cost of capital. One additional issue is the extent to which liquidity influences investment, that is, the extent to which capital market imperfections have an important effect, in the aggregate, on business investment. Zwick and Mahon, using administrative tax data (which allows them to look at a broad range of firms), find that investment incentives do affect investment, particularly strongly for smaller firms, but that these strong effects depend on the incentives providing "up front" tax benefits, rather than simply a higher present value of tax benefits. This suggests that, at least for smaller firms, liquidity constraints are important.

Although investment incentives are aimed directly at increasing investment, they are often rationalized as a way of increasing employment and earnings, with capital increases arguably increasing worker productivity. However, lowering the cost of capital may also stimulate firms to substitute capital for workers, so the net impact on employment and wages is not clear. Relatively few papers have considered the impact of investment incentives on labor. One such recent paper, by Garrett et al., examines the period starting in 2002, when the U.S. firms began receiving bonus depreciation, taking advantage of the fact that the benefits of bonus depreciation varied across industries according to the type of capital purchased. Using county-level observations and corresponding information on industry composition, they use a difference-in-differences approach and find that counties with stronger "treatment" by the policy experienced significant increases in earnings and employment (although not earnings per worker).

The Corporate-Noncorporate Distinction

We have already discussed a variety of important elements missing from the Harberger model of the corporate tax. One is dynamics. Another issue is the assumption that the corporate and noncorporate sectors represent different industries. While this may have been reasonable in the 1960s, when much of noncorporate capital was found in the farming and residential sectors, it is less justifiable now, when roughly half of US business income is not subject to the corporate income tax. Indeed, some of these companies, called S corporations, are legally corporations but are able to avoid the corporate tax by satisfying restrictions on the dispersion of ownership. How should we model a firm's decision of whether to operate as a corporation? For very large companies, capital market access may still require organization as a traditional corporation (called a C corporation), but for smaller (and yet still reasonably large) firms, there may be a substantive choice. Among the factors that might be most relevant are differences between corporate and individual tax rates. A small literature has considered this decision.

The corporate-noncorporate distinction also provides a setting for empirical work, where tax provisions affect corporate and noncorporate entities differently. Yagan uses administrative data to study the effects of the 2003 U.S. dividend tax cut on investment. As that tax reform affected only C corporations, S corporations present a possible control group. A potential problem with this natural experiment is that the size distributions of C and S corporate sectors are quite different, with the largest companies being almost entirely C corporations. However, given data with broad coverage, Yagan is able to construct treatment and control samples that are comparable in size and other attributes, and finds that the impact of the dividend tax cut on C corporate investment was not just statistically insignificant, but very close to zero. This occurs even though corporations did increase dividend payouts in response to the dividend tax cut, indicating that they may have used financial policy (e.g., changes in borrowing) to generate the funds needed for additional payouts. As Yagan discusses, one possible explanation for the finding of no impact on investment is the "new view" of dividend taxation, which argues that for mature companies, dividend taxes have no net impact on the cost of capital when investment can be financed through the retention of earnings. (This view is discussed more extensively in Auerbach' chapter in volume 3 of the *Handbook of Public Economics*, pp. 1258-9.)

Intangible Investment

R&D investment can be tangible (e.g., laboratories) or intangible (e.g., intellectual property). Many governments offer special tax incentives in this area. In the United States, for example, there is a Research and Experimentation (R&E) tax credit (which would show up as the term k in the user cost expression). Also, much of R&D spending (on researchers' wages, for example) is deducted immediately; as discussed above, immediate expensing already eliminates the effective corporate tax on investment. Why give R&D such generous tax treatment? The most common argument is that R&D spending produces social spillovers, i.e., that companies can't fully appropriate the social returns to their investments; thus, a Pigouvian subsidy may be in order. Several papers have found that R&D incentives increase R&D investment. More difficult to determine is the size of the productivity spillovers used to rationalize such incentives. Also, more than fixed investment, which is relatively easy to identify, R&D spending is subject to "relabeling" (i.e., firms characterizing other expenses as research and development to qualify for tax benefits), so that observed increases in R&D spending in response to tax incentives may include relabeling as well as "real" responses. Chen et al. estimate the magnitude of both types of response to a Chinese R&D tax policy that created notches, i.e., levels of R&D investment at which the tax benefit increased discontinuously by reducing a firm's *average* tax rate. Using a bunching estimator approach developed originally by Kleven and Waseem (*QJE* 2013), they find large R&D responses to the tax incentive. They also estimate, using patterns of changes in other expenses, that roughly a quarter of these responses occurred through relabeling of expenses. Even so, they find a substantial increase in a firm's *own* productivity in response to induced increases in R&D investment and estimate that only a small productivity spillover to other firms would be needed to justify the policy.