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Effective tax rates and the user cost of capital when interest rates are low

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HIGHLIGHTS

- Capital user cost and ETRs are regularly used to test for tax-investment effects.
- At low interest rates the two measures are not monotonically related.
- This feature can generate perverse estimates of tax-investment effects.

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ABSTRACT

Interest rates are a key component of both user cost and effective tax rate measures of company taxation, and each is regularly used in empirical tests of tax impacts on investment. However, it is shown that when interest rates are low the two measures are not monotonically related. Using a simulated sample of observations, this feature is found to generate perverse estimates of the effects of taxation on the investment plans of firms.

1. Introduction

Following the seminal papers of Hall and Jorgenson (1967), Auerbach (1979, 1983) and King and Fullerton (1984), the concept of the *user cost of capital* has become a standard approach to assessing how the cost of financing a firm's investment, and its tax treatment, affect the firm's investment decision. The user cost concept refers to the capital rental, the before-tax rate of return, at the firm's profit-maximising position. The user cost is thus such that the after-tax cost of capital is equal to the after-tax rate of return, so that it is intimately related to the effective marginal tax rate (defined as the propor tional difference between before- and after-tax rates of return). It may therefore be expected that both the user cost and the effective marginal tax rate increase as real and nominal interest rates increase. When modelling investment behaviour, some studies have used the effective marginal tax rate as an independent variable, while others have used user cost measures and, given this anticipated relationship between the two concepts, the choice would appear at first sight to be innocuous.

However, this paper shows that when real interest rates are low the user cost of capital and its analogue the effective marginal tax rate are not even approximately monotonically related (Section 2). As a result, in a low-interest environment, empirical tests of the relationship between taxation and investment are capable of generating very different outcomes depending on which measure is used (Section 3). In the current environment where interest rates are very low, and are likely to remain low for some time, this complexity is potentially important.

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2. The user cost and effective tax rates

2.1. User cost

Hall and Jorgenson (1967) established that, in the case of a profit-maximising firm, the value of an additional dollar of investment, the capital rental, is equal in equilibrium to its cost, measured by the rate of interest. This rental associated with the profit-maximising position is referred to as the *user cost* of capital. In the simplest case, where there is no taxation and no inflation or capital gains, the gross-of-depreciation user cost, c_g, is given by:

$$c_g = r + \delta \tag{1}$$

where δ is the geometric rate of economic depreciation per period, and r is the real rate of interest available in the market. A net-of-depreciation equivalent, the *net user cost*, c_n, is simply $c_n = c_g - \delta$. Hence, in this special case, $c_n = r$.

Taxation complicates the user cost calculation in a number of ways. In addition to the statutory tax rate (here assumed to be constant) applied to investment income, the existence of fiscal depreciation allowances and tax credits – valued at ξ per dollar of investment – implies that the cost of a dollar of capital is effectively reduced to $1 - \xi$. Suppose the statutory marginal corporate tax rate applied to taxable income is τ. The relevant interest rate is therefore the after-tax real rate, given by $r^* = r(1 - \tau)$. The equilibrium condition defining the user cost now requires that the after-tax cost of capital, $r^* (1 - \xi)$, associated with the effective investment of $1 - \xi$ is equal to the after-tax rate of return. The latter is the after-tax rental, $c_g (1 - \tau)$, arising from the real before-tax gross user cost, c_g, minus depreciation of $\delta (1 - \xi)$. From this condition the gross user cost is obtained as:

$$c_g = \frac{(r^* + \delta)(1 - \xi)}{1 - \tau}. \tag{2}$$

This result, using different terminology, corresponds to the original statement by Hall and Jorgenson (1967, p. 393).

Two typical components of the ξ term are a *fiscal* depreciation allowance at the geometric rate, δ', and 'special allowances' or 'loadings', k. Here, k is the proportion of the investment eligible for these allowances It is sometimes specified as a tax credit, τk. It can be shown that total fiscal depreciation can be expressed in present value terms as $\xi = \tau (k + Z)$, where $Z = \delta' / \left(i + \delta'\right)$, and i is the nominal interest rate.[1] Substituting into (2) then gives a user cost expression for c_g in terms of the real after-tax rate of interest and fiscal parameters:

$$c_g = \left(r^* + \delta\right)\{1 - \tau (k + Z)\}\frac{1}{1 - \tau}. \tag{3}$$

Using the relationship between the real rate, r^*, the nominal after-tax rate of interest, i^*, and the inflation rate, π, given by:

$$r^* = \frac{i^* - \pi}{1 + \pi}. \tag{4}$$

Eq. (3) can be rewritten as:

$$c_g = \left(\frac{i^* - \pi}{1 + \pi} + \delta\right)\{1 - \tau (k + Z)\}\frac{1}{1 - \tau} \tag{5}$$

with, as before, $c_n = c_g - \delta$.

2.2. The effective marginal tax rate

The effective marginal tax rate is generally defined as the proportional difference between relevant before- and after-tax rates of return. Defining $\widetilde{p}$ as the required equilibrium pre-tax real rate of return that is necessary to produce a post-tax real rate of return of r^*, the tax-inclusive effective rate, *EMTR* is expressed as:

$$EMTR = \frac{\widetilde{p} - r^*}{\widetilde{p}}. \tag{6}$$

Since c_n is the before-tax rental which ensures that the after-tax-and-depreciation return from the marginal investment is equal to the after-tax real rate of return, r^*, the user cost, c_n, is equivalent to $\widetilde{p}$. This allows (6) to be rewritten as:

$$EMTR = 1 - \frac{r^*}{c_n} \tag{7}$$

and using (4), this relationship between the effective tax rate and the user cost becomes:

$$EMTR = 1 - \frac{i^* - \pi}{(1 + \pi)c_n}. \tag{8}$$

Inspection of (8) shows that in considering variations in *EMTR* with c_n there is a singularity where $c_n = 0$. Importantly, the net user cost, c_n, is not restricted to take only positive values. From (5), if depreciation allowances and tax credits are generous relative to economic depreciation, and statutory corporate rates are high, this can lead to net subsidies to some forms of investment, resulting in $c_n < 0$.

Similarly, given that c_n varies systematically with the nominal interest rate, i^*, as shown by (5), there is a singularity in the relationship between the *EMTR* and the nominal interest rate. Depending on whether i^* is greater than or less than π, there are both positive and negative asymptotes. Hence the effective marginal tax rate and the net user cost can move in opposite directions as the nominal interest rate increases.

2.3. Variation in EMTRs with interest and inflation rates

Examples of the large variation in the *EMTR* with the nominal before-tax interest rate, i, where $i^* = i(1 - \tau)$, are shown in Fig. 1 for two values of the inflation rate, $\pi = 0.02$ and $\pi = 0.04$. The *EMTR* profiles are obtained for $\tau = 0.3$, $k = 0.2$ and $\delta = \delta' = 0.15$. For low values of i, and the low inflation rate, the *EMTR* is increasing and above the statutory rate, as it moves towards the asymptote at the singularity. At higher nominal interest rates the *EMTR* is increasing from its asymptote but below the statutory tax rate.

This relationship is highly sensitive to the inflation rate, as can be seen by a comparison with the profile for $\pi = 0.04$, where the nature of the variation is reversed: the *EMTR* is decreasing from its asymptote but above the statutory tax rate.[2] This sensitivity arises because, for a given *real* interest rate in (8), the present value of fiscal depreciation, Z, in c_n is a determined by the *nominal* interest rate as shown above. These highly nonlinear relationships between the *EMTR* and i do not simply occur in association with negative real interest rates. For example, the singularity for the *EMTR* profile when $\pi = 0.02$ (0.04) occurs around a nominal before-tax interest rate of, $i = 0.03$ (0.05).

Fig. 1 also confirms the linear upward sloping relationship of c_n with respect to i, which, like the *EMTR* profiles, become approximately linear as nominal interest rates rise towards 10% or

[1] See Creedy and Gemmell (2016) for a derivation and survey of results.

[2] For examples of profiles with similar characteristics, see King and Fullerton (1984, p. 288).