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Corporate taxation and capital accumulation: Evidence from sectoral panel data for 14 OECD countries

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ABSTRACT

We present new empirical evidence that sector-level capital–output ratios are strongly influenced by corporate tax incentives, as summarised by the tax component of a standard user cost of capital measure. We use sectoral panel data for the USA, Japan, Australia and eleven EU countries over the period 1982–2007. Our panel combines internationally consistent data on capital stocks, value-added and relative prices from the EU KLEMS database with corporate tax measures from the Oxford University Centre for Business Taxation. Our results for equipment investment are particularly robust, and strikingly consistent with the basic economic theory of corporate investment.

1. Introduction

The last three decades have seen substantial changes to corporate income taxes in many OECD countries, starting with major reforms to corporate tax rates and allowances in the UK in 1984 and in the USA in 1986. Similar rate-cutting, base-broadening reforms have followed in other countries, with the statutory corporate tax rate in the Netherlands, for example, falling from 48% in 1982 to 26% in 2007. Conveniently, these changes to corporate income taxes have occurred at different times and to differing degrees in different jurisdictions. This paper exploits the resulting variation across countries and over time to study the impacts of corporate taxation on fixed investment in the short run and on fixed capital accumulation in the long run. These effects are important in assessing the welfare implications of taxes on corporate income. Reliable evidence on their nature and magnitude is also important for the design of fiscal incentives that are intended to stimulate private sector business investment.

One innovation in this study is that we exploit the recently developed EU KLEMS database, which provides sectoral data on capital, output and relative prices for the USA, Japan, Australia and most of the EU countries. The key advantage of EU KLEMS is the availability of internationally comparable capital stock measures, constructed from the underlying investment series using consistent procedures across countries. This contrasts with different methodologies which are used to construct capital stock series in different national accounts and inherited, for example, in OECD datasets based on national accounts sources. We combine EU KLEMS with tax measures from the Oxford University Centre for Business Taxation's corporate tax database, which provides detailed information on corporate tax regimes for developed countries. Combining these sources and focusing on countries with data available before 1995 gives annual observations for 11 manufacturing sectors in 14 OECD countries over the period 1982–2007, which is the main sample used in our econometric analysis. We focus mainly on sectors within manufacturing because most manufacturing investment is undertaken by private sector companies that are subject to corporation tax; this would not be the case if we included other sectors such as health and education in our analysis, although we find broadly similar results when we extend our sample to include non-manufacturing sectors. We use sectoral data because we can exploit within-country sectoral variation in the measures of output and relative prices, although we also find similar results when we restrict our sample to aggregate manufacturing in each country.

We consider a standard econometric model in which, consistent with the basic economic theory of investment, sectoral capital–output ratios depend inversely in the long run on the tax-adjusted user cost of capital. Our data allow us to consider separately the corporate tax and relative price components of a standard user cost measure, and

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the main focus of our empirical analysis is on the relationship between capital accumulation and tax incentives as summarised by the tax component of the user cost of capital. Short-run capital stock adjustment dynamics are estimated from the data. We present empirical results using a range of dynamic specifications and econometric methods.

Our main finding is that tax incentives matter for the evolution of sector-level capital stocks. Our preferred specifications suggest long-run elasticities of capital–output ratios with respect to the tax component of the user cost of around −0.4 in the case of total capital, and around −0.7 if we focus on equipment. These are well within the rather wide range of estimates suggested by previous empirical research. Specifications which allow for rich cross-sectional heterogeneity in parameters also suggest quite rapid adjustment of capital stocks to changes in the user cost of capital. Our results for equipment are strikingly consistent with the basic economic theory of corporate investment in two respects: (i) the theoretical prediction that the tax and relative price components of the user cost have the same long run effect on capital–output ratios is supported by the data; (ii) the prediction that tax effects are summarised by the tax component of the user cost of capital is also consistent with the evidence. For total capital, however, we estimate a larger effect from the relative price of capital than from the tax component of the user cost. Perhaps related to this, if we focus only on structures, we find no significant tax effect in our preferred dynamic specifications. We discuss further below why our specifications may not be well suited to modelling investment in structures.

Our study contributes to an extensive body of empirical research on the relationship between corporate taxation and fixed capital investment, much of which builds on the seminal paper by Hall and Jorgenson (1967), which pioneered the use of tax-adjusted user cost of capital measures. Much of this literature has focused on evidence from the United States, using either aggregate or firm-level data on investment[1]; as we illustrate in Section 3 below, by pooling data from 14 OECD countries, we obtain much richer variation over time in our measures of tax incentives than would be available for any single country. While we are not the first to consider cross-sectional variation across countries in this context, so far as we know we are the first to do so in a framework that directly estimates long-run elasticities of sectoral capital–output ratios with respect to the tax component of the user cost of capital. In particular, the focus of Cummins et al. (1996) is on short-run responses of firm-level investment to tax reforms, while the specifications estimated by Djankov et al. (2010) are not derived explicitly from a theoretical model of optimal investment. Other contributions of this study are that we estimate separate effects from tax and non-tax components of the user cost of capital, testing the theoretical prediction that these effects should be equal in the long-run, and we present separate results for investment in equipment, as well as for total investment.

The remainder of the paper is organised as follows. Section 2 briefly outlines the basic neoclassical investment model. Section 3 presents the data that we use in our empirical analysis and illustrates the sample variation in our measures of the corporate tax factors suggested by the basic neoclassical framework. Section 4 discusses our econometric specifications, and Section 5 presents our empirical results. Section 6 concludes.

2. Investment model

Our econometric model is based on the value-maximising investment behaviour of a firm with a Constant Elasticity of Substitution production technology and an isoelastic demand schedule. We assume that investment in year t adds to the stock of productive capital in the same year, which depreciates at the constant rate δ. In the absence of any adjustment costs, the optimal capital stock in year t (K_t^*) can be expressed as: [2]

$$K_t^* = \alpha Q_t^{\left(\sigma+\frac{1-\sigma}{\nu}\right)} C_t^{-\sigma} \tag{1}$$

where Q_t is value-added and C_t is the user cost of capital. The parameters σ and ν are respectively the elasticity of substitution between capital and labour and the returns to scale in the production function, and α also depends on the production function parameters. In the case of constant returns to scale ($\nu = 1$), this implies an inverse proportional relationship between the desired capital–output ratio (K_t^*/Q_t) and the user cost of capital.[3]

If we assume that marginal investment is financed using retained earnings, and that the corporate income tax rate (τ_t), other parameters of the tax system, relative prices and inflation rates are expected to remain constant over time, the user cost of capital can be expressed as:

$$C_t = \frac{P_t^K}{P_t\left(1-\frac{1}{\eta}\right)} \frac{(1-A_t)}{(1-\tau_t)} \frac{(r_t+\delta)}{(1+r_t)} \tag{2}$$

where P_t^K is the price of capital goods, P_t is the price of output, A_t is the net present value of current and future tax depreciation allowances associated with a unit of investment in year t, r_t is the real discount rate, and η is the price elasticity of demand. We focus on this case since the vast majority of corporate investment in developed countries is financed using retained earnings.[4] Below we refer to the term $[(1 - A_t) / (1 - \tau_t)]$ as the tax component of the user cost of capital. This basic theoretical framework predicts that the elasticity of the capital–output ratio with respect to the tax component, the relative price (P_t^K/P_t) and other components of the user cost should be the same, and that the effects of corporate taxation on capital–output ratios should be summarised by this tax component of the user cost.

The underlying model of production assumes that value-added is produced using labour and a single capital input. Interpreting this input as the total capital stock measured in the data requires very strong assumptions, for example, that different assets such as equipment and structures contribute to production in technologically fixed proportions, or that they are perfect substitutes.[5] Interpreting this input as the total stock of equipment requires that structures do not contribute directly to production and treats costs related to structures as fixed costs. Neither approach is compelling, and we present results from both specifications for comparison. We note that the former approach is standard in studies which use firm-level data, where measures of investment and capital disaggregated by asset type are rarely available. Interpreting the single capital input as the stock of structures makes little sense in this context, and we present results from this specification mainly to shed light on some differences between our results for equipment and for total capital.

Before considering further details of our econometric specifications, we first present the datasets used in this study. We illustrate the variation over time and across countries in our measures of some of the key variables suggested by this basic theoretical framework, with a particular focus on the tax component of the user cost of capital.

[1] Prominent examples of studies using aggregate US data include Auerbach and Hassett (1992) and Schaller (2006). Important studies using US microdata include Cummins et al. (1994), Caballero et al. (1995) and Chirinko et al. (1999).

[2] Appendix A provides details.

[3] This also holds for any returns to scale if the production technology is Cobb–Douglas ($\sigma = 1$), in which case the elasticity of the capital–output ratio with respect to the user cost is −1.

[4] See, for example, Corbett and Jenkinson (1997). Abstracting from personal taxation of shareholder income, the same expression for the tax-adjusted user cost applies in the case of new equity finance. For debt finance, the user cost is lower, reflecting the deductibility of interest payments in a standard corporate income tax. See, for example, Devereux and Griffith (2003).

[5] See, for example, Epstein (1983).