Corporate taxation and capital accumulation: evidence from firm-level data

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Abstract

We estimate the long-run elasticity of the capital stock with respect to the user cost of capital using two firm-level datasets from Amadeus, which cover 31,740 domestic independent firms and 10, 666 subsidiaries of multinational companies in the manufacturing sector from 7 European countries over the period 1999-2007. Consistent with the results based on the industry-level data in Bond and Xing (2010), we find that capital intensity at the firm level is strongly responsive to changes in the tax-adjusted user cost of capital. Our benchmark estimation results remain robust when we deal with short panel issues and the endogeneity of explanatory variables using the Generalised Methods of Moments estimator suggested by Arellano and Bond (1991). Our preliminary investigation suggests that firms with different tax status may respond differently to corporate tax incentives. Furthermore, using a sample of subsidiaries of multinational companies, we do not find multinational companies' capital intensity, conditional on their location choice of investment, responds to changes in corporate tax incentives in a different way.

JEL category: E22, D92

Key words: corporate taxation, capital intensity, user cost of capital

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1 Introduction

How does firms' long-run capital accumulation respond to corporate tax incentives summarized by the tax-adjusted user cost of capital? According to the neo-classical investment theory, the long-run user cost elasticity would be -1 for a firm with Cobb-Douglas production technology. Netherless, previous studies (for example, Chirinko, Fazzari and Meyer, 1999) often identify a much smaller user cost elasticity than what the theory predicts. As pointed out by Chirinko, Fazzari and Meyer (2002), a consensus on the magnitude of the user cost elasticity remains elusive.

Most existing studies use data from a single country, notably the United States. Nevertheless, there is often limited variation in the tax-adjusted user cost, either across firms or over a short period of time. The lack of variation in the user cost may contribute to the empirical difficulty in identifying the user cost elasticity at the firm (plant) level, which may help explain the range of estimates found in this literature. We deal with this limitation by pooling firm-level data across different countries, which is one way to introduce more variation to the user cost of capital. More specifically, we stimate the long-run user cost elasticity using two firm-level panel datasets. The first dataset covers 31,740 domestic independent firms in the manufacturing sector from 7 OECD countries over the period 1999-2007. The second dataset consists of 10, 666 subsidiaries of multinational companies in the manufacturing sector from the same 7 OECD countries over the same period.

This paper compliments with a previous aggregate-level study by Bond and Xing (2010), who find a long-run user cost elasticity of close to -1 at the industry level for 14 OECD countries during the period 1982-2007.[1] Results obtained from firm-level data could be different from those obtained from aggregate data for many reasons. Most importantly, as the elasticity of the capital stock with respect to the user cost corresponds to the substitution elasticity between capital and labour in the standard neoclassical investment model, it is not implausible to expect different substitution elasticities at the industry level and at the firm level. For example, if in response to a fall in the user cost, capital intensive firms grow faster than labour intensive firms within an industry, or if there are more entries (or fewer exits) of capital intensive firms over time, in the most extreme case we may observe a substantial substitution elasticity between capital and labour at the industry level even if the production technology for individual firms is Leontief. Therefore, it remains an empirical question whether we will reach similar or different conclusions as found

[1] All 7 countries in this study are included in Bond and Xing (2010).

at the aggregate level.

The structure of this paper is as follows. Section 2 reviews existing micro-level studies. Section 3 describes the data. Section 4 introduces the empirical model. Section 5 presents the estimation results. Section 6 concludes.

2 Literature review

Surprisingly, there is only a small number of micro-level studies which attempt to estimate the user cost elasticity and no consensus has been reached on its magnitude. As Cummins, Hassett, and Hubbard (1994) point out, tax reforms are infrequent and hence, there is limited variation in the user cost in most years within a single country. Other factors, such as cyclical output fluctuations, may then have greater explanatory power for the variation in investment. Moreover, if tax policy is endogenous and such endogeneity problem is not properly dealt with, the estimated user cost elasticity will be biased and the related inference will be invalid. To address these two issues, Cummins, Hassett, and Hubbard (1994) use US tax reforms as natural experiments to estimate the user cost elasticity. Focusing on major US business tax reforms between the early 1960s and the early 1990s, the authors estimate the user cost elasticity to be substantial (between -0.5 and -1.0) and significantly different from zero in the years just following a major tax reform, but not during non-reform years. Similar results are found using the same approach in their subsequent study (Cummins, Hassett, and Hubbard, 1996) based on firm-level panel data collected from 14 OECD countrie.

Caballero, Engel and Haltiwanger (1995) also find that investment is highly responsive to changes in the cost of capital by examining large sample of plants in the US manufacturing sector over the period 1972-1988. The authors argue that the capital-output ratio and the user cost are both likely to be non-stationary series. Hence, they estimate the cointegrated relationship between the capital-output ratio and the user cost of capital. Their estimates of the long-run user cost elasticity for firms in different sectors range from -0.01 to -2, with an average about -1, the predicted long-run elasticity in the standard neo-classical investment model with Cobb-Douglas technology. Nevertheless, we do not find evidence of non-stationarity in the user cost series in our dataset and therefore, it would be inappropriate to apply the cointegration technique.

In contrast, Chirinko, Fazzari and Meyer (1999) find a much smaller long-run user cost elasticity. Using Compustat firm-level data for 4,905 US manufacturing firms over the period 1981-1991, Chirinko, Fazzari and Meyer (1999) obtain a range of estimates of the long-run user cost elasticity from close to zero to roughly -0.5. Their preferred Instrumental Variables estimates of the long-run user cost elasticity are in a narrow range around -0.25, with a standard error of 0.03 to 0.06.

It is worth noting that other than estimating a model based on the user cost approach, there has been a large number of micro-level studies on firm investment based on the q model (for example, Hayashi and Inoue 1991, Blundell et al. 1992, and Devereux, Keen and Schiantarelli 1994). It is suggested that the q model is well suited to company data because stock market valuations of publicly traded companies are readily reported. Nonetheless, it is well known that the q model has not been successful in explaning firms' investment behavior. For example, the estimated coefficient on the average q ratio is often unreasonably low, indicating implausibly high adjustment costs of investment.

3 Data description

3.1 Firm-level data

Our firm-level data are from Bureau van Dyck's Amadeus database, which provides balance sheet and profit & loss account information for a large number of European companies. Amadeus also provides ownership information, which helps us to distinguish between domestic companies and foreign subsidiaries. We compile two datasets for this study. The first dataset consists of domestic independent companies. We further distinguish between domestic stand-alone companies from domestic group companies. We define a firm to be a domestic stand-alone if its major shareholder is itself and it has no subsidiary.[2] We define a firm to be a domestic group company if its major shareholder is itself and it has no foreign subsidiary.[3] We then collect the unconsolidated accounts for the domestic stand-alone companies and the consolidated accounts for the domestic group companies.[4] The second dataset consists of subsidiaries of multinational companies. We define a firm to be a multinational company if it has at least one subsidiary located outside of its

[2] A major shareholder controls more than 50.1% of the total shares of the company.

[3] Amadeus report the number of subsidiaries and their locations for each companies. Nevertheless, we find discrepencies between the number of reported subsidiaries with information on their locations and the reported number of total subsidiaries. We therefore exclude firms whose list of subsidiaries is incomplete.

[4] Most domestic stand-alones only provide the unconsolidated accounts to Amadeus.

home country.[5] We define a firm to be a subsidiary of a multinational company if a multinational company owns more than 50.1% of its total shares. We then collect the unconsolidated accounts of those subsidiaries.

The key firm-level variables for our empirical analysis are real tangible fixed assets (K) and real value-added (Q). Nominal tangible fixed assets are deflated using the sector-level price indices of investment goods obtained from EU KLEMS. Value-added for each firm is obtained by adding depreciation, staff costs and interest payment to earnings before interest and taxes. Nominal value-added is deflated using the sector-level price indices of value-added also obtained from EU KLEMS. Both price indices have their base year in 1995.

Mismeasurement can be a serious problem with firm-level data and estimations could be sensitive to observations with extreme values.[6] Therefore, we drop observations in the top or the bottom one percentile of the distributions of the growth rate of the capital-output ratio, the growth rate of real capital stock, and the growth rate of real value-added. We drop firm-year observations where the number of months is different from 12. We also drop firm-year observations that do not report the basic information used to construct our measures of capital and value-added. We then only keep firms with at least three consecutive years of observations. We do not allow gaps between year in the panel data estimations. Therefore, if a firm reports two sequences of at least three consecutive years of observations, we retain the longest sequence or the earlier of the two sequences in the case of ties. Consequently there are no missing observations in terms of these key variables in the resulting samples.

It is worth noting that there could be major discrepancies between data obtained from company accounts and that obtained from industry-level dataset as used in Bond and Xing (2010). Most importantly, tangible fixed assets in company accounts are generally measured at historical costs when these assets are first acquired.[7] Furthermore, ideally we would need to adjust the nominal capital stock

[5] Again, we exclude companies whose list of subsidiaries is incomplete.

[6] For example, balance sheet measures of the stock of capital are generally at historic purchase cost rather than at current replacement cost, and our measure of value-added neglects the distinction between sales and production. As the available time series for each firm are short and lack information about changes in inventories, we have not attempted to adjust the basic measures obtained from company accounts in this study.

[7] Asset revaluation is often a last resort for companies in a difficult position as it would enable them to improve their solvency. Countries may also have different practices regarding the revaluation of assets in company accounts. For example, France, Netherlands, and the UK authorise

using quality-constant price indices, in particular for assets which are subject to rapid technological change, notably computers and related equipment. Nonetheless, we do not have proper indices to adjust the stock data to reflect changes in asset quality over time. In contrast, to adjust the capital stock, the EU KLEMS uses the US Bureau of Economic Analysis (BEA) estimates of asset depreciation rates which are based on the re-sale prices of assets on second-hand markets. This can be regarded as adjusting the nominal capital stock by a quality-constant price index.

3.2 Industry-level data

We allocate firms in the sample into 11 manufacturing industries by their NACE 2 industry classifications.[8] Tangible fixed assets in company accounts are a mixture of different asset types (equipment and buildings, for example) and limited by the available information, we cannot distinguish between different asset types. Hence, we assume that firms in the same industry in a certain country and in a certain year have the same asset structures. Assuming investment is totally financed by retained earnings, we calculate the tax-adjusted user cost of capital for firms in industry j, country k, and in year t using the formula below:

$$C_{j,k,t} = \sum_{s} w_{j,k,s,t} \frac{P^K_{j,k,t}}{P_{j,k,t}} (r_{k,t} + \delta_{k,t}) \frac{(1 - A_{j,k,s,t})}{(1 - \tau_{k,t})} \quad (1)$$

where $w_{j,k,s,t}$ is the share of capital type s in total capital in industry j, country k, and in year t. The non-tax component of the user cost corresponds to the relative price P^K/P , where P^K is the industry-level price of investment goods and P is the industry-level price of output. Both price indices are provided by EU KLEMS and are only available until the year 2007. By matching the industry-level relative prices of investment goods with the firm-level data, we implicitly assume that firms within the same industry in the same country face the same relative prices of investment goods. As in Bond and Xing (2010), we do not directly measure the real discount

revaluation under certain conditions. Spain and Italy allow this possibility only periodically. On the other hand, Germany forbids the revaluation of assets.

[8] The 11 manufucturing industries are: basic metals and fabricated metal; chemicals, rubber, plastics and fuel; electrical and optical equipment; food, beverages and tobacco; machinery not elsewhere classified; manufacturing not elsewhere classified and recycling; other non-metallic mineral; pulp, paper and printing; textiles, leather and footwear; transport equipment; and wood and cork. This industry classification corresponds to the one used in Bond and Xing (2010).

rate r and economic depreciation rate δ. Therefore, we control for the time-series variation in the term $(r_t + \delta_t)$ by including time effects in the estimated models.[9]

We measure the tax-component of the user cost of capital, $\frac{(1-A_{j,k,s,t})}{(1-\tau_{k,t})}$, at the country-industry level, combinding data provided by the Oxford University Centre for Business Taxation with those provided by the EU KLEMS. More specifically, we obtain information on the statutory corporate income tax rate $(\tau_{k,t})$ and the net present value of depreciation allowances $(A_{j,k,s,t})$ for different types of assets for each of the 7 countries during the sample period.[10] With this information, we first compute the user cost for different types of capital for each country-industry pair. Then, we calculate the user cost of total capital as a weighted average, where the weights are the proportions of different types of assets in total capital stock within each country-industry pair. The country-industry specific tax-adjusted user cost is then matched with the firm-level capital and output data.

4 The empirical model

As shown in Bond and Xing (2010), according to the basic neoclassical investment model, the relationship between the long-run optimal capital stock (K), output (Q) and the user cost of capital (C) for a profit-maximising firm can be written down as the following equation:

$$K^* = \alpha Q^{\left(\sigma + \frac{1-\sigma}{v}\right)} C^{-\sigma} \tag{2}$$

where σ measures the elasticity of substitution between capital and labour, and v measures the returns to scale. We allow for short-run adjustment dynamics using an Error Correction Model as follows:

$$\begin{aligned} \gamma(L)\Delta \ln K_{i,t} &= -\phi(\ln K_{i,t-k} - \ln K^*_{i,t-k}) + \beta(L)\Delta \ln K^*_{i,t} \\ &= -\phi[\ln K_{i,t-k} - (\sigma + \frac{1-\sigma}{v}) \ln Q_{i,t} + \sigma \ln C_{i,t}] + \beta(L)\Delta \ln K^*_{i,t} \end{aligned} \tag{3}$$

where ϕ measures the speed of convergence of the actual capital stock towards its optimal level. $\gamma(L)$ and $\beta(L)$ are polynomials in the lag operator, and the order of differencing and the lag structures are left to be empirically determined. In practice,

[9] For example, if r and δ are the same for all firms within a certain country, it is sufficient to control for the variations in $(r_t+\delta_t)$ by including country-specific year dummies in the estimations.

[10] The different types of assets include: equipment and machinery, buildings and structures, and other types of assets. For assets defined as "other assets", we measure the user cost by taking the average of the user cost of equipment asset and that of structures.

we choose to estimate the following AR(3) model with firm-specific fixed effects:

$$\begin{aligned}\Delta \ln K_{i,t} &= -\phi[\ln K_{i,t-3} - \alpha_1 \ln Q_{i,t-3} - \alpha_2 \ln C_{i,t-3}] + \beta_1 \Delta \ln K_{i,t-1} + \beta_2 \Delta \ln K_{i,t-2} \\ &+\beta_1 \Delta \ln Q_{i,t} + \beta_2 \Delta \ln Q_{i,t-1} + \beta_3 \Delta \ln Q_{i,t-2} + \beta_4 \Delta \ln C_{i,t} + \beta_5 \Delta \ln C_{i,t-1} \\ &+\beta_6 \Delta \ln Q_{i,t-2} + j_t + \mu_i + \epsilon_{i,t} \end{aligned} \quad (4)$$

We assume that the error term has additive components j_t a time-specific effect, μ_i a firm-specific effect and $\epsilon_{i,t}$ is the residual component. In this setting, α_1 corresponds to ($\sigma + \frac{1-\sigma}{v}$) and $\alpha_2$corresponds to $-\sigma$, the user cost of elasticity as well as the elasticity of substitution between capital and labour. If the production technology is constant returns to scale (CES), we would obtain $\alpha_1 = 1$. If the production technology is Cobb-Douglas, we would obtain $\alpha_1 = 1$ and $\alpha_2 = -1$. We can also impose long-run constant returns to scale on the technology by restricting α_1 to be unity, and effectively we then estimate:

$$\begin{aligned}\Delta \ln K_{i,t} &= -\phi[\ln(\frac{K}{Q})_{i,t-3} - \alpha_2 \ln C_{i,t-3}] + \beta_1 \Delta \ln K_{i,t-1} + \beta_2 \Delta \ln K_{i,t-2} \\ &+\beta_1 \Delta \ln Q_{i,t} + \beta_2 \Delta \ln Q_{i,t-1} + \beta_3 \Delta \ln Q_{i,t-2} + \beta_4 \Delta \ln C_{i,t} \\ &+\beta_5 \Delta \ln C_{i,t-1} + \beta_6 \Delta \ln Q_{i,t-2} + j_t + \mu_i + \epsilon_{i,t} \end{aligned} \quad (5)$$

5 Estimation results

In this section, we first present our estimation results of Equation 5 based on the sample of domestic stand-alone companies and domestic group companies. Section 5.1 reports the fixed-effects within-groups estimation results. We deal with the potential endogeneity of the explanatory variables in Equation 5 using the Generalised Method of Moments (GMM) estimator in different specifications in Section 5.2. In Section 5.3, we control for effects of tax asymmetries. Finally, in Section 5.4, we present the GMM estimation of Equation 5 based on the sample of subsidiaries of multinational companies.

5.1 Fixed-effects within-groups estimations

We first estimate Equation (5) using the fixed-effects within-groups (WG) estimator. The results are reported in Table 1. In the first column, we include a set of year dummies that is common for all countries, which controls for common business cycles. In Column 2, we include country-specific year dummies as a control for country-specific business cycles. In Column 3, we control for industry-specific business cycles by including industry-specific year dummies.

Panel A of Table 1 presents the basic results. The estimated coefficient on $\ln(\frac{K}{Q})_{i,t-3}$ corresponds to the speed of convergence of the actual capital stock towards its long-run target. In all three columns, the estimated coefficient ϕ is around 0.7, suggesting considerably fast speed of convergence. Panel B reports the implied long-run elasticity of the capital stock with respect to the user cost of capital (α_2). The estimated long-run user cost elasticities in these different specifications are all significantly different from zero, and the t-tests results in Panel C suggest that these elasticities are not significantly different from -1, consistent with the findings in Bond and Xing (2010) using more aggregated data.

5.2 GMM estimations

It is known that with the presence of individual fixed effects, for dynamic panel estimations with the lagged dependent variable on the right-hand side, the WG estimate of the coefficient on the lagged dependent variable ($\ln(\frac{K}{Q})_{i,t-3}$ in Equation 5) is likely to be biased downwards in short panels due to the within-groups transformation. Consistent estimates in short panels may be obtained using the Generalised Method of Moments (GMM) estimators discussed in Arellano and Bond (1991), which uses lagged levels of endogenous variables as instruments for the set of equations in first-differences. If the error term $\epsilon_{i,t}$ in Equation (5) is simply a white noise process and there is no serial correlation in the measurement errors for $\ln K$, we can use lags of $\ln K$ dated $t-2$ and earlier as instruments for each of these first-differenced equations. If there is AR(1) tyep of serial correlation in the error term, due to the serial correlation in the measurement errors in $\ln K$ for example, we can use instead lags of $\ln K$ dated $t-3$ and earlier as instruments. We can instrument any other endogenous variable in the same way.

We start by estimating Equation (5) treating the capital stock and output as endogenous while treating the user cost of capital as exogenous. We find AR(1) and AR(2) types of serial correlations but no higher-order serial correlation in the first-differences of the error term (Panel C), which suggests to use lags of $\ln K$ and $\ln Q$ dated $t-3$ and earlier as the instruments for the current capital stock and output terms. By treating the user cost as exogenous initially, we use $\ln C$ dated t and earlier as instruments for $\ln C_t$.[11] We summarize the GMM estimation results

[11] To preserve the informativeness of the instruments, we use the lags of $\ln K$ and $\ln Q$ dated

in Columns 1-3 in Table 2, with different sets of year dummies in each specification. As expected, we now estimate a much smaller convergence rate ϕ, suggesting the WG estimate is biased downward. We continue to find a long-run user cost elasticity close to -1, although the Hansen test rejects the validity of the instruments in all three columns.

In Columns 4-6, we treat the user cost as endogenous and use $\ln C$ dated $t-3$ and earlier as instruments for $\ln C_t$. With common year effects and country-specific effects, the estimated long-run user cost elasticity is negative and insignificant, but the Hansen test continues to reject the validity of the instruments. With industry-specific year effects (Column 6), however, the Hansen test cannot reject the validity of the instruments and the estimated long-run user cost is significant at the 1 per cent level. Nevertheless, the point estimate is -2.029 with a standard error of 1.086. As the point estimate is so imprecise, we cannot formally reject the null hypothesis that $\alpha_2 = -1$.

Arguably, while it is possible for the non-tax component of the user cost, the relative price of investment goods measured at the industry-level, to be correlated to firm-specific shocks, it is unlikely for the tax component of the user cost measured at the industry level to be correlated with idiosyncratic shocks at the firm level.[12] Even if there are systematic shocks at the industry or country level, it may take a long time for the government to adjust its corporate income tax system in response to such shocks. Furthermore, while constructing the user cost at the industry level, we use the weights of different types of assets measured for each country-industry pairs. These weights are also unlikely to be endogenous to firm-level shocks. As a further exploration, in Table 3 we treat the user cost as endogenous and instrument $\ln C_t$ by its different components, namely, the non-tax component $\frac{P^K}{P}$ (Columns 1-3), the tax component $\frac{(1-A)}{(1-\tau)}$ (Columns 4-6), and the proportion of equipment type capital $w^{Equipment}$ (Columns 7-9). We use these three variables dated t and earlier as instruments for $\ln C_t$. We control for common business cycles, country-specific time effects, and industry-specific time effects separately in different specifications.

In Columns 1-3, the Hansen test rejects the validity of using the relative price of investment goods $\frac{P^K}{P}$ as instruments, suggesting possible correlation between firm-level shocks and industry-level shocks in these price terms. However, the Hansen

from $(t-3)$ to $(t-6)$ as instruments for capital stock and output, and use the lags of $\ln C$ dated from t to $(t-6)$ as instruments for the user cost.

[12] Recall that we assume firms within the same industry in the same country face the same tax-adjusted user cost of capital.

test cannot reject the validity of using the tax component $\frac{(1-A)}{(1-\tau)}$ and the proportion of equipment type capital $w^{Equipment}$ as instruments for $\ln C_t$. Moreover, by using $\frac{(1-A)}{(1-\tau)}$ and $w^{Equipment}$ dated t and earlier as instruments, the estimated long-run user cost elasticities in Columns 4-9 are all close to -1 and are more accurately estimated compared with $\widehat{\alpha}_2$ in Column 6 of Table 2.[13]

In summary, when we deal with the potential endogeneity of the user cost using the GMM estimation, we continue to find that capital accumulation in the long run at the firm level is highly responsive towards corporate income tax incentives summarized by the tax-adjusted user cost. The estimated long-run user cost elasticity is in line with the findings in our previous study using industry-level data (Bond and Xing, 2010), suggesting there is sustantial substitution elasticity between capital and labour at *both* the industry level and the firm level.

5.3 The effects of tax asymmetries

One general feature of the corporate income tax system is the asymmetric treatment of profits and losses. In the derivation of the user cost of capital, we assume that taxable profit is always positive. In reality, firms may experience tax losses (i.e. negative values of taxable profit). When this occurs, the tax loss in a particular year may be carried forward or backward. Nevertheless, when tax losses are carried forward, there is usually no interest markup, and this may only be allowed for a limited period of time. This delay before tax allowances can be utilised reduces their present value, so that the value of tax incentives for investment will differ across firms with different tax status.

This aspect of the corporate income tax system has been analysed in studies such as Auerbach and Poterba (1987), Altshuler and Auerbach (1990), and Mintz (1988). In particular, Devereux, Keen and Schiantarelli (1994) incorporate tax asymmetries into the firm's optimisation problem and derive the implied tax-adjusted q ratio and user cost of capital. They find that accounting for tax asymmetries generally decreases the value of q and increases the user cost of capital. Essentially, the existence of tax asymmetries introduces measurement error in our standard measure of the user cost of capital and as a result, it may confound the estimation of the

[13] It is worth noting that in Column 9, where we use $w^{Equipment}$ dated t and earlier as instruments while controlling for industry-specific time effects, the point estimate on $\ln C_{i,t-3}$ loses significance. This is not surprising as the weights could be rather uninformative in this specification. Nevertheless, the long-run estimate remains significant??

user cost elasticity. The importance of this measurement problem is an empirical question that we begin to explore in this section.

We do not have accurate information to identify each firm's tax status and hence, we rely on data from company accounts to construct an indicator for which firms are more likely to be in a tax loss position. More specifically, we define a firm to be in a loss-making status in a particular year if its reported profit before tax is negative. Using this definition, 13,320 out of the total 86,888 (or around 15 per cent of) firm-year observations in our sample are in a loss-making status. Slightly more than 34 per cent of these loss-making firm-year observations are in a loss-making sequence for at least three years.

Table 4 presents the GMM estimation results for extended model specifications where we account for the presence of tax losses in two simple ways. We first interact a dummy LS_i indicating a firm is making loss in a certain year with all explanatory variables (Columns 1-2). Secondly, we construct a dummy $LS_i^{\geq 3}$ indicating a firm is in the loss-making situation for at least three consequtive years, and then we interact this dummy with all explanatory variables (Columns 3-4). The estimated coefficients on these interaction terms indicate whether and how tax asymmetries affect the response of firms' capital accumulation. We treat capital and output as endogenous with AR(1) serial correlation in the measurement errors, and we instrument the user cost using either its tax compent or the proportion of equipment type capital $w^{Equipment}$. We control for common-business cycles in these columns but similar results are found with alternative specifications of the time effects. In all four specifications, we find evidence that in the long run firms in loss-making situations are less responsive to changes in the tax-adjusted user cost, as indicated by the positive estimated coefficients on $LS_i \times \ln UC_{t-3}$ and $LS_i^{\geq 3} \times \ln UC_{t-3}$. On the other hand, we continue to find a close to -1 long-run user cost elasticity for firms in the control group when we take into account the effects of tax asymmetries.

5.4 Results from subsidaries of multinational firms

So far, our analysis focus exclusively on the sample of domestic firms. It remains an interesting question whether multinational companies repond to domestic tax incentives in the similar way. Multinational companies could face different tax incentives compared with purely domestic companies. On the one hand, Devereux and Griffith (1998) show that multinational companies' investment location choice is affected not by the user cost (or the effective marginal tax rate) but by the effective average tax rate (EATR), which measures firms' average tax burden. On the other hand, there is little theoretical background suggesting the tax-adjusted user cost would affect the scale of multinational companies' investment, conditional on their location choice, in different ways. Nonethess, there is little empirical analysis on this point as far as we know.

In Table 5, we report the GMM estimation results based on Equation 5 using the sample of subsidiaries of multinational companies. We treat both capital and output as endogenous with AR(1) type of serial correlation in the measurement errors. In the first three columns, we treat the user cost as exogenous. The estimated long-run user cost elasticity remains significantly different from 0 but insignificantly different from -1. In the last three columns, we treat the user cost as endogenous and use different instruments in each column.[14] Apart from Column 4, we still find a substantial and significant long-run user cost elasticity, although these estimates become more impricise.

6 Conclusions

In this study, we estimate the long-run elasticity of the capital stock with respect to the user cost of capital using two firm-level dataset from Amadeus, which covers 31,740 domestic independent firms and 10, 666 subsidiaries of multinational companies in the manufacturing sector from7 countries over the period 1999-2007. This study contributes to the literature on this topic by pooling data for a large number of firms across countries and industries, which is one way to introduce more variation in the user cost of capital. This study also complements Bond and Xing (2010) which find a substantial long-run user cost elasticity at the industry level.

Consistent with the results based on the industry-level data in Bond and Xing (2010), we find that capital intensity at the firm level is strongly responsive to changes in the tax-adjusted user cost of capital for both domestic independent firms and subsidiaries of multinational companies. The implied long-run user cost elasticity is close to -1.0 in within-groups estimations, and this result remains robust when we deal with short panel issues and the endogeneity of explanatory variables using the Generalised Methods of Moments estimator suggested by Arellano and Bond (1991). Our preliminary investigation also suggests that firms with different tax status may respond differently to corporate tax incentives.

[14] In Columns 4-6, we include country-specific year dummies as the control for time effects. Similar results are found when we use alternative specification of the time effects.

As mentioned in the Introduction, it is plausible that in response to a fall in the user cost, capital intensive firms grow faster than labour intensive firms within an industry. It is also plausible that falling user cost induces more entries (or fewer exits) of capital intensive firms. These factors could be other possible explanations for the substantial long-run user cost elasticity we find at the aggregate level in Bond and Xing (2010), which remains as interesting questions for future research.

References

[1] Arellano, Manuel, and Stephen Bond. 1991. Some tests of specification for panel data: Monte Carlo evidence and an application to employment equations. The Review of Economic Studies 58(2): 277-297.

[2] Blundell, Richard W., Stephen R. Bond, Michael P. Devereux, and Fabio Schiantarelli. 1992. Investment and Tobin's Q: Evidence fromcompany panel data. Journal of Econometrics 51: 233–257.

[3] Bond, Stephen R, and Costas Meghir. 1994. Dynamic investment models and the firm's financial policy. Review of Economic Studies LXI: 197–222.

[4] Caballero, Ricardo J., Eduardo M. A. Engel, and John C. Haltiwanger. 1995. Plant-level adjustment and aggregate investment dynamics. Brookings Papers on Economic Activity 2: 1–39.

[5] Chirinko, Robert S., Steven M. Fazzari, and Andrew P. Meyer. 1999. How responsive is business capital formation to its user cost?: An exploration with micro data. Journal of Public Economics 74 (1): 53-80.

[6] Cummins, J.G., Hassett, K.A., Hubbard, R.G. 1994. A reconsideration of investment behaviour using tax reforms as natural experiments. Brookings Papers on Economic Activity 2: 1–59.

[7] Cummins, J.G., Hassett, K.A., Hubbard, R.G. 1996. Tax reforms and investment: A cross-country comparison. Journal of Public Economics 62: 237-273.

[8] Devereux, Michael. P., and Fabio Schiantarelli. 1990. Investment, Financial Factors, and Cash Flow: Evidence from U.K. Panel Data. NBER Chapters, in: Asymmetric Information, Corporate Finance, and Investment, pp. 279-306. National Bureau of Economic Research, Inc.

[9] EU KLEMS Growth and Productivity Accounts, Version 1.0. EU KLEMS.

[10] Hayashi, Fumio., and Tohru Inoue. 1991. The relation between firm growth and q with multiple capital goods: Theory and evidence from Japanese panel data. Econometrica 59(3): 731–754.

[11] Hoshi, Takeo, Anil Kashyap, and David Scharfstein. 1991. Corporate structure, liquidity, and investment: Evidence from Japanese industrial groups. The Quarterly Journal of Economics 106(1): 33-60.

[12] Roodman, David. 2006. How to do xtabond2: An introduction to "difference" and "system" GMM in Stata. Working Paper 103. Centre for Global Development.

Table 1: Fixed-effects within-groups estimations (domestic firms)

Dependent variable: $\Delta \ln K_t$	(1)	(2)	(3)
Panel A			
$\ln(K/Q)_{t-3}$	-0.736***	-0.737***	-0.736***
	(0.00834)	(0.00835)	(0.00834)
$\ln UC_{t-3}$	-0.777***	-0.701***	-0.834***
	(0.0564)	(0.0608)	(0.0737)
$\Delta \ln K_{t-1}$	-0.637***	-0.638***	-0.637***
	(0.00619)	(0.00619)	(0.00619)
$\Delta \ln K_{t-2}$	-0.705***	-0.706***	-0.705***
	(0.00738)	(0.00738)	(0.00737)
$\Delta \ln Q_t$	0.302***	0.300***	0.300***
	(0.00825)	(0.00827)	(0.00828)
$\Delta \ln Q_{t-1}$	0.471***	0.469***	0.470***
	(0.00953)	(0.00955)	(0.00956)
$\Delta \ln Q_{t-2}$	0.610***	0.609***	0.610***
	(0.00951)	(0.00953)	(0.00953)
$\Delta \ln UC_t$	-0.769***	-0.806***	-0.777***
	(0.0310)	(0.0335)	(0.0376)
$\Delta \ln UC_{t-1}$	-0.539***	-0.537***	-0.565***
	(0.0401)	(0.0438)	(0.0491)
$\Delta \ln UC_{t-2}$	-0.668***	-0.603***	-0.707***
	(0.0502)	(0.0533)	(0.0649)
Panel B: LR coefficients			
$\ln UC\ (\alpha_2)$	-1.056***	-0.952***	-1.133***
	(0.076)	(0.082)	(0.100)
Panel C: Tests (p-values)			
$\alpha_1 = 1$			
$\alpha_2 = -1$	0.463	0.559	0.183
Common time effects	Yes		
Country-specific time effects		Yes	
Industry-specific time effects			Yes
No. of firms	31,740	31,740	31,740
No. of obs.	86,888	86,888	86,888
R-squared	0.339	0.340	0.341

Notes: 1.The long-run elasticity α_1 is obtained in separate estimations without restricting the long-run elasticity of capital stock towards output to be 1; 2. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table 2: GMM estimations-treating the user cost exogenous (Columns 1-3) and endogenous (Columns 4-6) (domestic firms)

Instruments	User cost exogenous			User cost endogenous		
$\ln K_t$	Lag(3,6)	Lag(3,6)	Lag(3,6)	Lag(3,6)	Lag(3,6)	Lag(3,6)
$\ln Q_t$	Lag(3,6)	Lag(3,6)	Lag(3,6)	Lag(3,6)	Lag(3,6)	Lag(3,6)
$\ln UC_t$	Lag(0,6)	Lag(0,6)	Lag(0,6)	Lag(3,6)	Lag(3,6)	Lag(3,6)
Dependent variable: $\Delta\ln K_t$	(1)	(2)	(3)	(4)	(5)	(6)
Panel A						
$\ln(K/Q)_{t-3}$	-0.290***	-0.284***	-0.290***	-0.257***	-0.267***	-0.261***
	(0.052)	(0.053)	(0.049)	(0.056)	(0.057)	(0.053)
$\ln UC_{t-3}$	-0.300***	-0.269***	-0.347***	-0.084	-0.109	-0.530**
	(0.078)	(0.080)	(0.097)	(0.234)	(0.263)	(0.268)
$\Delta \ln K_{t-1}$	-0.486***	-0.471***	-0.472***	-0.383***	-0.381***	-0.449***
	(0.108)	(0.104)	(0.110)	(0.116)	(0.113)	(0.122)
$\Delta \ln K_{t-2}$	-0.274***	-0.268***	-0.276***	-0.243***	-0.254***	-0.245***
	(0.054)	(0.055)	(0.051)	(0.058)	(0.060)	(0.055)
$\Delta \ln Q_t$	0.845***	0.834***	0.827***	0.670***	0.603***	0.837***
	(0.142)	(0.146)	(0.132)	(0.209)	(0.212)	(0.186)
$\Delta \ln Q_{t-1}$	0.374**	0.378**	0.445***	0.369**	0.449**	0.284
	(0.151)	(0.165)	(0.158)	(0.182)	(0.198)	(0.183)
$\Delta \ln Q_{t-2}$	0.301***	0.296***	0.310***	0.271***	0.286***	0.267***
	(0.058)	(0.061)	(0.057)	(0.065)	(0.068)	(0.062)
$\Delta \ln UC_t$	-0.936***	-0.930***	-0.947***	-0.607***	-0.609***	-0.612***
	(0.045)	(0.046)	(0.050)	(0.139)	(0.133)	(0.218)
$\Delta \ln UC_{t-1}$	-0.476***	-0.432***	-0.550***	-0.130	-0.066	-0.346
	(0.098)	(0.097)	(0.111)	(0.164)	(0.160)	(0.248)
$\Delta \ln UC_{t-2}$	-0.358***	-0.318***	-0.369***	0.023	0.044	-0.376
	(0.072)	(0.071)	(0.089)	(0.259)	(0.285)	(0.295)
Panel B: LR coefficients						
$\ln UC\ (\alpha_2)$	-1.036***	-0.946***	-1.197***	-0.328	-0.408	-2.029***
	(0.281)	(0.309)	(0.330)	(0.906)	(0.970)	(1.086)
Panel C: Tests (p-values)						
$\alpha_2 = -1$	0.898	0.862	0.551	0.459	0.542	0.344
AR(1)	0.001	0.001	0.003	0.001	0.001	0.002
AR(2)	0.005	0.004	0.006	0.027	0.021	0.027
AR(3)	0.956	0.851	0.963	0.883	0.929	0.86
AR(4)	0.668	0.664	0.637	0.668	0.806	0.583
Hansen	0.029	0.087	0.084	0.022	0.068	0.144
Common time effects	Yes			Yes		
Country-specific time effects		Yes			Yes	
Industry-specific time effects			Yes			Yes
No. of firms	24,186	24,186	24,186	24,186	24,186	24,186
No. of obs.	55,148	55,148	55,148	55,148	55,148	55,148

Notes: 1. We treat capital and output as endogenous with AR(1) type serial correlation in measurement errors. We use lags of $\ln K_t$ and $\ln Q_t$ dated from t-3 to t-6 as instruments for capital stock and output. 2. We treat the user cost as exogenous in Columns 1-3. We treat the user cost as endogenous in Column 4-6 and use the lags of $\ln UC_t$ dated from t-3 to t-6 as instruments. 4. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table 3: GMM estimations using different components of the user cost as its instruments (domestic firms)

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Instruments	Non-tax component			Tax component			Weights		
$\ln K_t$	Lag(3, 6)	Lag(3, 6)	Lag(3, 6)	Lag(3, 6)	Lag(3, 6)	Lag(3, 6)	Lag(3, 6)	Lag(3, 6)	Lag(3, 6)
$\ln Q_t$	Lag(3, 6)	Lag(3, 6)	Lag(3, 6)	Lag(3, 6)	Lag(3, 6)	Lag(3, 6)	Lag(3, 6)	Lag(3, 6)	Lag(3, 6)
$\ln UC_t$	Lag(0, 6)	Lag(0, 6)	Lag(0, 6)	Lag(0, 6)	Lag(0, 6)	Lag(0, 6)	Lag(0, 6)	Lag(0, 6)	Lag(0, 6)
Panel A									
$\ln(K/Q)_{t-3}$	-0.270***	-0.277***	-0.274***	-0.300***	-0.321***	-0.287***	-0.370***	-0.340***	-0.343***
	(0.051)	(0.053)	(0.048)	(0.048)	(0.047)	(0.043)	(0.047)	(0.044)	(0.048)
$\ln UC_{t-3}$	-0.276***	-0.272***	-0.318***	-0.417*	-0.425***	-0.490*	-0.406***	-0.493***	-0.168
	(0.077)	(0.080)	(0.096)	(0.226)	(0.160)	(0.264)	(0.145)	(0.146)	(0.131)
$\Delta \ln K_{t-1}$	-0.452***	-0.469***	-0.459***	-0.455***	-0.499***	-0.446***	-0.542***	-0.482***	-0.486***
	(0.108)	(0.105)	(0.112)	(0.104)	(0.092)	(0.105)	(0.102)	(0.096)	(0.113)
$\Delta \ln K_{t-2}$	-0.254***	-0.260***	-0.259***	-0.287***	-0.309***	-0.275***	-0.361***	-0.330***	-0.335***
	(0.053)	(0.054)	(0.050)	(0.049)	(0.048)	(0.044)	(0.048)	(0.045)	(0.049)
$\Delta \ln Q_t$	0.791***	0.806***	0.799***	0.441***	0.715***	0.430***	0.765***	0.668***	0.729***
	(0.138)	(0.146)	(0.139)	(0.143)	(0.134)	(0.143)	(0.132)	(0.130)	(0.161)
$\Delta \ln Q_{t-1}$	0.329**	0.351**	0.388**	0.551***	0.583***	0.562***	0.761***	0.703***	0.698***
	(0.152)	(0.163)	(0.158)	(0.127)	(0.143)	(0.132)	(0.127)	(0.135)	(0.145)
$\Delta \ln Q_{t-2}$	0.280***	0.288***	0.292***	0.322***	0.346***	0.313***	0.406***	0.371***	0.379***
	(0.058)	(0.060)	(0.056)	(0.052)	(0.053)	(0.049)	(0.051)	(0.049)	(0.054)
$\Delta \ln UC_t$	-0.926***	-0.926***	-0.952***	-0.678***	-0.878***	-0.645***	-0.933***	-0.847***	-0.863***
	(0.045)	(0.046)	(0.052)	(0.145)	(0.080)	(0.151)	(0.063)	(0.065)	(0.065)
$\Delta \ln UC_{t-1}$	-0.444***	-0.425***	-0.535***	-0.608***	-0.427***	-0.627***	-0.527***	-0.359***	-0.541***
	(0.097)	(0.097)	(0.111)	(0.172)	(0.110)	(0.188)	(0.103)	(0.105)	(0.118)
$\Delta \ln UC_{t-2}$	-0.334***	-0.315***	-0.350***	-0.338	-0.217	-0.326	-0.290**	-0.211	-0.118
	(0.071)	(0.071)	(0.089)	(0.207)	(0.169)	(0.226)	(0.130)	(0.137)	(0.124)
Panel B									
$\ln UC\ (\alpha_2)$	-1.022***	-0.982***	-1.161***	-1.392***	-1.323***	-1.708***	-1.099***	-1.453***	-1.490***
	(0.296)	(0.318)	(0.342)	(0.716)	(0.492)	(0.916)	(0.403)	(0.448)	(0.375)
Panel C									
$\alpha_2 = -1$	0.938	0.957	0.638	0.584	0.512	0.440	0.806	0.312	0.175
AR(1)	0.001	0.001	0.002	0.002	0.001	0.003	0.005	0.001	0.003
AR(2)	0.009	0.004	0.009	0.001	0.000	0.002	0.000	0.001	0.003
AR(3)	0.942	0.866	0.963	0.901	0.915	0.793	0.766	0.805	0.792
AR(4)	0.663	0.680	0.637	0.391	0.889	0.373	0.961	0.950	0.820
Hansen	0.026	0.066	0.099	0.491	0.167	0.254	0.144	0.200	0.139
Common year effects	Yes			Yes			Yes		
Country-specific year effects		Yes			Yes			Yes	
Industry-specific year effects			Yes			Yes			Yes
No. of firms	24,186	24,186	24,186	24,186	24,186	24,186	24,186	24,186	24,186
No. of obs.	55,148	55,148	55,148	55,148	55,148	55,148	55,148	55,148	55,148

Notes: 1. We treat capital and output as endogenous with AR(1) type serial correlation in measurement errors; 2. We treat the user cost as endogenous and instrument it by its non-tax component in Columns 1-3, its tax component in Columns 4-6, and the weights of equipment type assets in total assets in Columns 7-9; 4. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table 4: Tax asymmetries, GMM estimations (domestic firms)

VARIABLES	(1)	(2)	(3)	(4)
Instruments	Tax component	Weights	Tax component	Weights
$\ln K_t$	Lag(3, 6)	Lag(3, 6)	Lag(3, 6)	Lag(3, 6)
$\ln Q_t$	Lag(3, 6)	Lag(3, 6)	Lag(3, 6)	Lag(3, 6)
$\ln UC_t$	Lag(0, 6)	Lag(0, 6)	Lag(0, 6)	Lag(0, 6)
Panel A				
$\ln(K/Q)_{t-3}$	-0.297***	-0.324***	-0.308***	-0.352***
	(0.058)	(0.060)	(0.041)	(0.041)
$LS_{\text{i}} \times \ln(K/Q)_{t-3}$	-0.073	-0.060		
	(0.077)	(0.083)		
$LS_{\text{i}}^{\geq 3} \times \ln(K/Q)_{t-3}$			0.011	0.009
			(0.035)	(0.035)
$\ln UC_{t-3}$	-0.694***	-0.548***	-0.387*	-0.441***
	(0.239)	(0.162)	(0.223)	(0.137)
$LS_{\text{i}} \times \ln UC_{t-3}$	0.276**	0.190		
	(0.137)	(0.136)		
$LS_{\text{i}}^{\geq 3} \times \ln UC_{t-3}$			0.414**	0.398**
			(0.208)	(0.198)
$\Delta \ln UC_t$	-0.851***	-0.951***	-0.699***	-0.995***
	(0.172)	(0.081)	(0.143)	(0.075)
$LS_{\text{i}} \times \Delta \ln UC_t$	0.246	0.029		
	(0.195)	(0.113)		
$LS_{\text{i}}^{\geq 3} \times \Delta \ln UC_t$			1.003*	1.196*
			(0.591)	(0.612)
$\Delta \ln UC_{t-1}$	-0.816***	-0.483***	-0.463***	-0.327***
	(0.190)	(0.129)	(0.168)	(0.105)
$LS_{\text{i}} \times \Delta \ln UC_{t-1}$	0.197	-0.061		
	(0.186)	(0.170)		
$LS_{\text{i}}^{\geq 3} \times \Delta \ln UC_{t-1}$			-1.298*	-1.580**
			(0.671)	(0.640)
$\Delta \ln UC_{t-2}$	-0.556**	-0.320**	-0.340*	-0.343***
	(0.229)	(0.157)	(0.202)	(0.126)
$LS_{\text{i}} \times \Delta \ln UC_{t-2}$	0.144	-0.083		
	(0.199)	(0.184)		
$LS_{\text{i}}^{\geq 3} \times \Delta \ln UC_{t-2}$			-0.391	-0.737
			(0.650)	(0.573)
Panel B: Tests (p-values)				
AR(1)	0	0	0	0
AR(2)	0	0	0	0
AR(3)	0.805	0.744	0.987	0.854
AR(4)	0.382	0.717	0.02	0.298
Hansen	0.661	0.133	0.547	0.207
Common year effects	Yes	Yes	Yes	Yes
No. of firms	24,186	24,186	24,186	24,186
No. of obs.	55,148	55,148	55,148	55,148

Notes: 1. Differences of $\ln K$, $\ln Q$, $\ln UC$ (as in Equation 5) and their interactions with the dummies indicating loss-making firm-years are also included in these specifications; 2. We treat capital and output as endogenous with AR(1) type serial correlation in measurement errors; 3. We treat the user cost as endogenous as instrument it by its tax component or the weights of equipment type assets. 4. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table 5: GMM estimations using the sample of subsidiaries of multinational companies

	User cost exogenous			User cost endogenous		
VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)
Instruments						
$\ln K_t$	Lag(3, 6)	Lag(3, 6)	Lag(3, 6)	Lag(3, 6)	Lag(3, 6)	Lag(3, 6)
$\ln Q_t$	Lag(3, 6)	Lag(3, 6)	Lag(3, 6)	Lag(3, 6)	Lag(3, 6)	Lag(3, 6)
$\ln UC_t$	Lag(0, 6)	Lag(0, 6)	Lag(0, 6)	Lag(3, 6)	Lag(0, 6)	Lag(0, 6)
Panel A						
$\ln(K/Q)_{t-3}$	-0.231***	-0.148**	-0.298***	-0.104	-0.157**	-0.239***
	(0.062)	(0.070)	(0.058)	(0.079)	(0.068)	(0.068)
$\ln UC_{t-3}$	-0.235***	-0.326***	-0.203**	-0.012	-0.330***	-0.435**
	(0.071)	(0.084)	(0.081)	(0.308)	(0.083)	(0.199)
$\Delta \ln K_{t-1}$	-0.354***	-0.342***	-0.380***	-0.269*	-0.318**	-0.396***
	(0.095)	(0.126)	(0.099)	(0.150)	(0.129)	(0.118)
$\Delta \ln K_{t-2}$	-0.216***	-0.127*	-0.290***	-0.080	-0.137**	-0.217***
	(0.062)	(0.071)	(0.059)	(0.081)	(0.069)	(0.069)
$\Delta \ln Q_t$	0.428***	0.184	0.524***	0.061	0.175	0.327***
	(0.099)	(0.120)	(0.107)	(0.146)	(0.119)	(0.118)
$\Delta \ln Q_{t-1}$	0.295**	0.134	0.536***	0.017	0.135	0.289**
	(0.120)	(0.139)	(0.122)	(0.175)	(0.135)	(0.137)
$\Delta \ln Q_{t-2}$	0.250***	0.162**	0.340***	0.110	0.168**	0.253***
	(0.064)	(0.073)	(0.061)	(0.086)	(0.071)	(0.072)
$\Delta \ln UC_t$	-0.862***	-0.801***	-0.911***	-1.115***	-0.804***	-0.885***
	(0.060)	(0.059)	(0.065)	(0.282)	(0.058)	(0.163)
$\Delta \ln UC_{t-1}$	-0.438***	-0.395***	-0.525***	-0.536	-0.386***	-0.558**
	(0.091)	(0.118)	(0.097)	(0.364)	(0.119)	(0.281)
$\Delta \ln UC_{t-2}$	-0.240***	-0.223**	-0.304***	0.059	-0.228***	-0.117
	(0.070)	(0.087)	(0.080)	(0.357)	(0.086)	(0.231)
Panel B: LR coefficient						
$\ln UC_t\ (\alpha_2)$	-1.021***	-2.198***	-0.682***	-0.118	-2.251***	-1.823**
	(0.319)	(0.981)	(0.255)	(2.956)	(1.005)	(0.919)
Panel C: Tests (p-values)						
$\alpha_2 = -1$	0.948	0.222	0.212	0.766	0.213	0.370
AR(1)	0.001	0.02	0.002	0.033	0.015	0.011
AR(2)	0.036	0.019	0.028	0.055	0.038	0.021
AR(3)	0.629	0.596	0.665	0.436	0.553	0.564
AR(4)	0.271	0.768	0.227	0.375	0.748	0.557
Hansen	0.005	0.741	0.196	0.975	0.649	0.443
Common year effects	Yes					
Country-specific year effects		Yes		Yes	Yes	Yes
Industry-specific year effects			Yes			
Number of firm	8,728	8,728	8,728	8,728	8,728	8,728
Observations	19,555	19,555	19,555	19,555	19,555	19,555

Notes: 1. We treat capital and output as endogenous with AR(1) type serial correlation in measurement errors; 2. We treat the user cost as exogenous in Columns 1-3. We treat the user cost as endogenous in Columns 4-6. In Column 4, we use the lags of $\ln UC_t$ dated from t-3 to t-6 as instruments. In Column 5, we use the tax component as the instrument for the user cost. In Column 6, we use the weights as instruments as the instruments for the user cost; 3. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1