The Impact of Tax Changes on the Short-run Investment Behaviour of New Zealand Firms

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Abstract

This paper examines firm-level investment responses to exogenous changes in the forward-looking user cost of capital associated with reforms to the corporate and personal tax system over the last decade. Adjustments to personal tax rates and fiscal depreciation allowances provide a direct lever through which government policy can affect the cost of capital faced by firms. The effect of these tax adjustments differs across firms according to their asset structure, providing both inter-temporal and inter-firm variation in UCCs and enabling an assessment of the short-run impact of UCC changes on investment behaviour. This analysis shows that while tax-induced changes in the UCC have significantly affected investment behaviour among some firms, the aggregate impacts are likely to have been negligible as the industries in which investment impacts are observed make a very small contribution to aggregate investment.

JEL Classification: D22; H20

Keywords: User Cost of Capital; Tax; Investment

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1 Introduction

Labour productivity in New Zealand is low relative to other OECD countries (OECD, 2013). While the reasons for this productivity gap are complex, one proximate cause which has received attention over recent years is relatively low levels of capital per unit of labour (eg, Treasury, 2008). We examine two factors which may affect firms' investment decisions, and hence their capital intensity – the firm-level, forward-looking user cost of capital (UCC), and the availability of external finance.

Firms' incentives to invest rely on the gap between expected returns to investment and the cost of capital required to make that investment. Although a wide range of factors, both aggregate and firm-specific, determine the cost of capital experienced by any particular firm, government policy can also affect both the overall level and the distribution of capital costs within a country. In particular, changes to both marginal tax rates and fiscal depreciation allowances directly affect the forward-looking cost of capital (Fabling, Gemmell, Kneller & Sanderson, 2013, hereafter FGKS). The primary focus of this paper is to examine whether firms' short-run investment decisions have been affected by exogenous changes in the UCC caused by tax reforms over the last decade.

A secondary focus of the paper is to consider whether there is prima facie evidence of finance constraints among New Zealand firms. If capital markets functioned perfectly, firms with profitable investment opportunities would be able to access external finance to support their investment requirements, regardless of their current cashflow or profit levels. As such, an observed positive relationship between current cashflow and investment behaviour may be indicative of finance constraints, as firms are more dependent on internal financing to support their capital investment.

To examine these two factors, we estimate a structural Euler equation, derived by Bond, Elston, Mairesse & Mulkay (2003) (hereafter BEMM), including the FGKS measure of the firm-level forward-looking cost of capital. This model relates changes in observed cashflow and firm-specific UCCs to changes in firm-level investment rates, while imposing adjustment costs in moving towards the optimal level of capital. The structural modelling approach accounts for the fact that current cashflow and profitability are likely to be indictors of expected future returns to capital, which may induce a positive relationship between current cashflow and investment (ie, reverse causality).

The analysis shows no evidence for financial constraints among large New Zealand firms, with contemporaneous cashflow being insignificantly related to investment across almost all specifications, consistent with BEMM's findings for Belgium, Germany and France.

Evidence for exogenous shocks to the UCC affecting short-run investment rates is mixed. In particular, while models estimated across all industries show the expected negative relationship between UCCs and investment, estimates for the manufacturing sector (the sector studied by BEMM) are not significantly different from zero. Rather, we find a significant negative relationship between investment and the user cost only in industries with low capital intensity. Given that our approach focuses on short-run changes, this is consistent with greater flexibility in the timing of investment for firms where capital plays a relatively small role in the production process. However, as significant impacts on investment decisions are observed only among firms in low capital intensity industries, the impact of the tax-induced changes in UCCs appear to have had negligible impact on aggregate investment over the past decade.

This result differs somewhat from earlier studies using firm data, such as Chirinko et al. (1999), which find a significant negative relationship between the user cost of capital and investment behaviour of US firms. This may reflect a number of factors, including industry coverage, estimation methodology, and data definitions. In particular, in order to isolate the impact of exogenous UCC changes from other possible factors affecting investment behaviour, this paper examines investment behavior associated with tax-induced changes in UCC across firms with differing asset structures. In contrast, Chirinko et al. (1999) use a 2-digit industry-level definition of the UCC, including finance costs and relative prices which vary over time but are assumed constant within industry-years. Much of the variation in UCCs they report is therefore directly linked to aggregate economic conditions.

By focusing on cross-firm variation in the UCC we are better able to control for changes in the economic environment which may be simultaneously affecting finance costs and wider investment incentives. This gives us the ability to draw causal inferences about the impact of exogenous changes in the UCC, at the cost of a reduction in generality of our results. That is, our paper does not attempt to determine whether there are potential policy reforms which could affect the UCC and hence lead to increased investment. Rather, we look at whether the specific tax policy changes which occurred over the last decade have had any observable effect on short-run investment, through their effect on the UCC.

This distinction, combined with the finding of minimal impact from tax changes, makes it difficult to draw lessons for future policy reform. A positive finding of systematic investment impacts would imply that future policy adjustments to reduce the UCC should also be expected to increase investment. However, the reverse does not necessarily apply. A failure to find economically significant changes in aggregate investment rates may simply reflect that the tax-induced UCC changes are too small or too complex for firms to react to. Moreover, the results reported here refer to short-run changes in investment decisions, in the year immediately following a tax reform. If firms take time to adjust their investment plans, the long-run impact of UCC changes may be stronger than that observed in the short run. Conversely, if firms adjust by shifting capital purchases between adjacent years in response to depreciation changes, long-run investment impacts may be weaker than short-run estimates imply.

2 Empirical Methodology

We examine whether firms' investment patterns change in response to exogenous changes in the forward-looking user cost of capital caused by changes in the corporate and personal tax regime over the past decade. Firm-level data for the tax years from 1999/00 to 2011/12 are sourced from Statistics New Zealand's Longitudinal Business Database (LBD), and supplemented with information on changes in the tax regime which occurred in 2005/06, 2009/10, 2010/11 and 2011/12.

The key tax reforms over this period include an increase in the fiscal depreciation rates applicable to most types of assets from April 2005, the removal of depreciation loadings from most depreciation rates in May 2010, and adjustments in the top marginal personal tax rate which rose from 33 to 39 percent in April 2000 before falling to 38 percent on 1 April 2009 and then to 33 percent on 1 October 2010. Full details of these reforms are shown in table 1. Due to differences in asset structures and non-linearities inherent in the definition of the user cost, these changes do not uniformly affect the cost of capital faced by firms, providing the cross-firm variation needed to identify investment impacts.

2.1 Data and measurement

Data on investment, output, profit, and fixed assets are sourced from the Annual Enterprise Survey (AES), an annual postal survey of between 16,000 and 25,000 firms. AES includes detailed questions on asset composition, including opening and closing book values, acquisitions, disposals and revaluations by asset type. As AES is designed to support the production of national accounts aggregates, the sample targets large firms. Within the LBD, we draw industry classifications from the Longitudinal Business Frame (LBF) and employment information from the Linked Employer-Employee Data (LEED).

Measures of the net user cost under shareholder-level taxation are calculated following FKGS. We distinguish between six fixed asset types: land; buildings; furniture and fittings; plant, machinery, equipment and other fixed assets (PME); computer hardware & software; and motor vehicles.[1]

The decision to focus on shareholder-level taxation reflects both conceptual and pragmatic aspects. Conceptually, New Zealand's imputation system requires that UCC measures take account of taxation at the shareholder level. Under this system, the corporate tax rate is merely a withholding tax, with shareholders' final tax liabilities based on the marginal personal tax rate.[2]

From a practical perspective, calculation of user costs based on corporate-level taxation requires knowledge of the method of financing investments. While interest on debt is generally tax deductable at the corporate level (with the corresponding interest income

1 Unlike FKGS, we exclude intangibles as AES does not collect data on investment in intangible assets. In addition, closing book values for intangible assets are more volatile than other fixed asset types, potentially suggesting a greater degree of measurement error.

2 In practice, if domestic shareholders are able to avoid personal-level taxation (for example through the use of trusts or incorporation), the (lower) corporate tax rate may be more applicable. However, it is not possible to determine the extent to which the shareholders of AES companies are using such instruments to reduce their tax liability.

subject to tax by domestically-resident recipients), equity financing is typically not eligible for a tax deduction (with dividend income facing taxation at the personal level). Although AES collects balance sheet information from firms that would allow the calculation of the debt/equity ratio (a proxy for the source of investment financing, under the assumption that future investments are financed according to the current balance of debt and equity), prior to 2009 this information was only collected from a sub-sample of firms, severely limiting the potential analysis sample. Focusing on shareholder-level taxation abstracts from this issue as, in equilibrium, the opportunity cost of both forms of finance should be equal from the shareholders' perspective.[3]

Under shareholder-level taxation, variation in the user cost across firms is driven solely by differences in the asset structure across assets with different economic depreciation rates and fiscal depreciation allowances, while variation over time is driven by changes in the firm's asset structure along with changes in personal tax rates and fiscal depreciation allowances. At any point in time, the net firm-level user cost of capital is defined as:[4]

$$C = \frac{[(1 - m(Z^*)](r^* + \delta)}{1 - m} - \delta \qquad (1)$$

where:

- m is the top marginal personal tax rate (assumed to be the appropriate tax rate faced by shareholders);
- Z^* is the present value of depreciation allowances, $\delta^* = (1 + k)\delta'$, discounted at the nominal interest rate, i^*. Thus $Z^* = \delta^*/(i^* + \delta^*)$, where δ' reflects the fiscal depreciation rate applicable to each asset type and k captures the value of depreciation loadings;[5]
- r^* is the real cost of funds, equal to the required after-tax rate of return, assumed to be constant at 5 percent; and
- δ is the rate of economic depreciation, assumed constant at the 2011/12 fiscal depreciation rates shown in table 1.

The user costs associated with different asset structures across firms are captured by calculating an asset-specific UCC based on the formula above, and then aggregating to the firm level by weighting the asset-specific UCCs according to the share of each asset type in the firm's total fixed assets (ie, under the assumption that new investment will mirror the composition of the existing capital stock). To isolate exogenous changes in the user cost due to tax reforms from changes in the asset mix which may occur in response

3 As shareholder-level taxation is relevant only when the marginal investor is tax-resident in New Zealand, we exclude from the analysis firms which have ever been foreign owned over the analysis period.

4 See FKGS for a complete derivation and discussion of this formula.

5 In New Zealand, depreciation loadings are calculated as a proportion of the fiscal depreciation rate, $Z^* = (1 + k)Z$. The nominal interest rate i^* is assumed constant both across firms and across time at an expected world interest rate of 5 percent. While the interest rate is an important aspect of the UCC calculation, it is not clear that changes in aggregate interest rates are directly relevant for the UCC experienced at the firm level. Firm decisions regarding investments should be based not on current interest rates but rather on the expected interest rate over either the life of the asset or the term of the loan required for investment. These expected interest rates are likely to be much more stable than the spot rates observed in the market. We also note the possibility that interest rates differ substantially across firms, due to differences in negotiating positions, loan terms, risk levels, etc. However, information on the interest rates faced at the firm level is not available.

to those reforms, we calculate the user cost using lagged asset structures from the year prior to the tax reform (ie, $t-2$ weights), and focus on the short-run (contemporaneous) investment response.

Table 2 reports the average user cost and and the average change in the user cost across the different tax regimes outlined in table 1. Changes in user cost are calculated using constant, two-period lagged asset weights to isolate the impact of the tax policy change. Increases in the top personal tax rate in April 2000 and in depreciation allowances in April 2005 both resulted in a decrease in user costs on average, while the removal of depreciation loading in May 2010 caused a sharp increase in UCCs in the 2010/11 year. Overall, the mean UCC was higher at the end of the sample period than at the beginning.

2.2 Linking user costs and investment behaviour

To identify the impact of changes in the user cost on investment behaviour, we follow the approach of BEMM. Estimates are based on a Euler-equation specification of the investment function, derived from a dynamic optimisation problem under the assumption of symmetric, quadratic adjustment costs for the capital stock. Given this maintained assumption, the Euler-equation specification controls for expectations of future changes in sales or profitability which might influence investment decisions. That is, the observed effects of financial variables such as cashflow can be interpreted as affecting investment solely through their influence in reducing financial constraints, rather than as a signal of future profitability which might directly increase the desired level of investment.[6]

In BEMM's model, current investment, $(I/K)_{it}$, is shown to be positively related to expected future investment, $E_t(I/K)_{i,t+1}$, and the current average profit rate, $(\Pi/K)_{it}$ (the measure of profitability or cashflow), and negatively related to the user cost of capital. In their empirical modelling, BEMM focus on the impacts of the cashflow variable, $(\Pi/K)_{it}$, assuming that the firm-level user cost of capital can be approximated by firm and time fixed effects. This gives their empirical specification:

$$(I/K)_{it} = \beta_1(I/K)_{i,t-1} - \beta_2(I/K)^2_{i,t-1} - \beta_3(\Pi/K)_{i,t-1} + \beta_4(Y/K)_{i,t-1} + d_t + \eta_i + \nu_{it} \quad (2)$$

where I_{it} denotes gross investment, K_{it} the capital stock, Y_{it} is gross output, d_t and η_i are time and firm fixed effects respectively, and Π_{it} is gross operating profit, defined as gross income less adjustment costs of capital and the cost of variable factor inputs.

We augment this specification by including time-varying measures of the user cost of capital C_{it}, giving the empirical specification:

$$(I/K)_{it} = \beta_1(I/K)_{i,t-1} - \beta_2(I/K)^2_{i,t-1} - \beta_3(\Pi/K)_{i,t-1} + \beta_4(Y/K)_{i,t-1} - \beta_5 C_{it} + d_t + \eta_i + \nu_{it} \quad (3)$$

To accommodate both firm specific effects and potential endogeneity of the financial variables we estimate the model in first differences using GMM and instrument changes in the four endogenous control variables, $(I/K)_{i,t-1}$, $(I/K)^2_{i,t-1}$, $(\Pi/K)_{i,t-1}$ and $(Y/K)_{i,t-1}$,

6 See BEMM (p.156) for the full derivation and discussion of the investment model.

with their lagged levels over the period $t-2$ to $t-6$. In the case of tax reforms, year t is the first fiscal year over which the new tax rates apply. This modeling strategy directly replicates that used by BEMM (p.161), allowing the greatest possible comparability with their results for Belgium, France, Germany and the UK. We also follow BEMM as closely as possible with respect to data preparation, including data cleaning (dropping outliers and capping the investment rate at 1), proxying output by sales and profit by value-added less total wages, and restricting attention to firms with at least 100 employees in the first year of observation.[7] We then introduce the user cost as an exogenous variable, calculated by applying current tax treatments to lagged $(t-2)$ asset shares. Thus, changes in the UCC reflect only the change in tax treatment which occurs between periods t-1 and t, abstracting from any contemporaneous change in asset composition.

Under this methodology, the impact of UCC changes are identified based on the variation across *firms* in the UCC impact of tax changes at any point in time. We abstract from influences which vary over time but are constant (or assumed constant) across firms, such as changes in the interest rate or aggregate economic conditions, controlling for these aggregate changes through the inclusion of year dummies. This strategy serves to isolate the impacts of a specific, identifiable source of UCC variation which is due to policy reform from other potential influences on the UCC.

This formulation requires a total of seven consecutive years of data for each firm which, combined with firm-size restrictions and the removal of outliers, leaves a sample of 1,290 observations over 291 firms for all industries pooled.[8] For comparison with BEMM, we also show results restricted to manufacturing firms.

Table 3 reports summary statistics of the variables used in the model, alongside the (unweighted) average of the four European countries reported by BEMM. The New Zealand mean values of I/K, Π/K and Y/K are all substantially higher than those of the four countries reported by BEMM . This likely reflects the use of closing book values as a measure of capital in the New Zealand data where BEMM instead use a perpetual inventory measure. As all variables are normalised by K, a lower estimate of the capital stock in New Zealand would raise the apparent values of all the model variables proportionately.[9]

7 As well as providing greater comparability with BEMM, the exclusion of small and medium-sized firms reduces noise in investment data due to lumpy investment patterns. While 82 percent of firms with 100+ employees invest in every year of the sample (and a further 13 percent invest in at least three out of four years), among small to medium-sized firms only around half invest every year, with a further 23 percent investing in at least three out of four years.

8 All firm counts have been random rounded base three in accordance with Statistics New Zealand confidentiality requirements.

9 BEMM note that alternative measures of the capital stock based on book values do not substantively affect their results. Construction of perpetual inventory measures is not possible for New Zealand due to the relatively short time period over which data is available.

3 Results

Table 4 reports the results of the GMM model for the full sample and for manufacturing firms only. Columns 1 and 3 replicate the table 7 specification of BEMM, for all industries and manufacturing respectively.

Coefficients on the lagged investment terms show a positive relationship between current and past investment rates, diminishing at higher levels of investment. When the full sample is used, the size of these coefficients is reasonably consistent with those shown by BEMM (0.278 for New Zealand compared to 0.366-0.434 in BEMM). Restricting to the manufacturing sample substantially increases the coefficients, in line with those expected under the null hypothesis of no financial constraints ($\beta_1 \geq 1, \beta_2 \geq 1$), as discussed by BEMM (p.156). Neither profits nor output are significantly related to investment rates, further supporting a conclusion that financial constraints are not significantly limiting investment among large firms.

In columns 2 and 4 we introduce time-varying measures of the UCC. While we see the expected negative relationship between the user cost and investment for the full sample of firms, there does not appear to be a significant relationship among manufacturing firms. For the sample as a whole, point estimates suggest that a one standard deviation increase in the UCC (a change of 0.0019 based on the years in which tax reforms occurred) is associated with a reduction of 0.0019 $\times$ 13.685 = 0.026 in the investment rate, a material change relative to the average investment rate of 0.230.

Manufacturing firms tend to have substantially higher overall capital intensity (lower output and profit per unit of capital) than the average firm (table 3). To determine whether the lack of response in manufacturing reflects a more general relationship associated with high capital intensity, table 5 re-estimates the model separately for three groups of industries – those in the top quartile, the bottom quartile, and the two middle quartiles of capital intensity (defined here by capital per worker).[10]

Table 5 shows that there is indeed a relationship between industry capital intensity and the responsiveness of investment to changes in the UCC. Exogenous increases in the UCC have a strong negative effect on investment in low capital intensity industries, but no significant effects in medium or high intensity industries.[11] This result cannot be explained by differences in the strength of the policy shock across groups, as the absolute size of policy-induced UCC changes do not vary systematically with industry capital intensity.

The relationship between capital intensity and UCC responsiveness is somewhat counter-intuitive, as one might have predicted that high capital intensity industries might be more attuned to changes in the cost of capital and hence more responsive to changes in the UCC. In table 6 we therefore check whether the apparent link between capital intensity and investment response is actually explained by a third, correlated factor – the intensity of computer hardware and software usage. Because we use closing book values as our measure of assets, firms which invest heavily in computer hardware and software tend to

10 Similar results are found when the sample is split by industry-level average investment rates (I/K) or investment per worker (I/L). Industry-level averages are calculated at the 2-digit ANZSIC96 industry level or, where there are less than 20 observations in a 2-digit industry, at the 1-digit level.

11 Restricting to the low capital intensity industries, a one standard deviation increase in the UCC would results in a decrease in investment of $0.0021 \times 54.974 = 0.115$, a dramatic shift compared to the average investment rate of 0.270 in those industries.

show up as being low capital intensity both because computers are, relatively speaking, quite inexpensive (compared to, say, land and buildings) but also because accounting rules allow these assets to be depreciated much more quickly. At the same time, because computer equipment depreciates more quickly in real terms, firms with high computer intensity may be more responsive to UCC changes because they are investing more regularly in order to maintain up-to-date technology.

Table 6 therefore estimates the model for low and medium-high capital intensity industries, further disaggregated by whether the industry tended to have high, medium, or low computer intensity. The results for low capital intensity industries (columns 1-3) suggest that there may be greater UCC responsiveness in high computer-use industries (consistent with more regular investment in those assets). However, differences in computer usage do not explain the difference between low and high capital intensity industries. That is, in the low capital intensity industries we see a negative relationship between investment and the UCC in both high and low computer-using industries (columns 1-3), while in high capital intensity industries, the UCC change is never significantly related to investment regardless of computer usage (columns 4-6).

Together, these results are consistent with a situation where, at least in the short-run, the firms which are most responsive to changes in the UCC are those which have more discretion in terms of their capital purchases, as capital assets play a relatively less important role in their production process. Thus, while the exogenous shifts in the UCC do seem to affect some firms' investment decisions, their impact on aggregate investment will be negligible, because firms in the affected industries jointly account for a mere 2.5 percent of total investment (in the sample).

This contrasts with a more general finding of negative UCC impacts on investment in Chirinko et al. (1999), and references therein, with elasticities ranging from -0.25 to -1. This may reflect both the time-frame considered and the nature of the shocks used to estimate the UCC impacts in the various studies. By focussing on tax-induced changes in UCCs and differentiating across firms according to asset composition, the variation in the UCC in our study is based on differences across firms in any given year. In contrast, Chirinko et al. (1999) consider an industry-level definition of the UCC, including time-varying financing costs and prices, and focus on the long-run investment impacts. Firms may react more strongly to these headline influences on the UCC, rather than the more complex, and potentially smaller, impacts driven by tax policy reforms.

4 Conclusion

Reforms to the tax system over the last decade provide an opportunity to examine the effect of exogenous shocks in the UCCs faced by individual firms on firm-level investment behaviour. We show that while some groups of firms react strongly to tax-induced UCC changes, the short-run impact of recent tax reforms on aggregate investment is negligible. In particular, the expected negative relationship between UCCs and investment is significant only among firms in low capital intensity industries. As these industries account for only a small proportion of aggregate investment, even substantial changes at the firm level will not translate into material changes in aggregate investment rates.

We also fail to find any evidence that the availability of external finance prevents firms from realising their optimal investment decisions, consistent with results for three of the four European economies studied by BEMM. However, as our sample (like that of BEMM) is restricted to larger firms, we cannot exclude the possibility that finance constraints are significant for smaller or less established firms.

Finally, it is important to note that this analysis considers only the short-run impacts of tax-induced UCC changes.[12] Long-run impacts are likely to differ from the results presented above, and the direction of these differences is not clear. If firms take time to adjust their investment plans, for example because they have multi-year purchase agreements in place for capital items, then the long-run effect of UCC changes may be stronger than the short-run impact. Conversely, if firms are adjusting their investment purely by shifting purchases across adjacent years in response to depreciation changes, the long-run impact on investment behaviour may be weaker than the short-run estimates imply.

[12] We restrict our attention to short-run changes largely for reasons of data availability – only the 2005 annual tax reform takes place early enough to enable investment patterns to be followed across a number of years, while the later tax reforms are further complicated by involving a range of (often conflicting) changes in the UCC over a short period. At the same time, longer term responses may be more difficult to identify as the pre-reform asset shares used to identify inter-firm variation in the UCC could become less representative of the asset structure over time.

Tables

Table 1: Tax regime, 1999/00 - 2011/12

Tax year	Top personal tax rate	Representative fiscal depreciation rates including loading					
		Land	Buildings	F&F	PME	Computers	Vehicles
1999/00	0.330	0.000	0.040	0.180	0.264	0.480	0.264
2000/01 – 2004/05	0.390	0.000	0.040	0.180	0.264	0.480	0.264
2005/06 – 2008/09	0.390	0.000	0.030	0.192	0.300	0.600	0.300
2009/10	0.380	0.000	0.030	0.192	0.300	0.600	0.300
2010/11	0.355*	0.000	0.030	0.160	0.250	0.500	0.250
2011/12	0.330	0.000	0.000	0.160	0.250	0.500	0.250

F&F: Furniture and fittings; PME: plant, machinery, equipment and other fixed assets; Computers: computer hardware and software. Representative depreciation rates are chosen by selecting a benchmark asset from within each asset class (eg, the vehicles asset type is represented by the 'general lorry' asset). *As the fall in the top marginal tax rate from 38 percent to 33 percent occurred in the middle of the tax year (1 October 2010), IRD applies a composite rate of 35.5 percent to annual incomes in the 2010/11 tax year.

Table 2: Tax-related changes in UCC, 1999/00 - 2011/12

Tax year	Mean UCC	Mean Δ UCC (tax reform years)
1999/00	-	-
2000/01 – 2004/05	0.044	-0.0012
2005/06 – 2008/09	0.042	-0.0019
2009/10	0.042	0.0003
2010/11	0.045	0.0032
2011/12	0.046	0.0015

Mean UCCs are calculated using all available observations of firms which ever appear in the regression sample. Firm counts change over the period due to firm entry and exit and missing observations in some years. Mean UCCs are unavailable in the first tax period due to the use of two-period lagged asset weights. Mean changes in UCC are calculated using constant, two-period lagged asset weights to isolate the impact of the tax policy changes which occur at the beginning of each reported time period.

Table 3: Summary statistics

	Full sample		Manufacturing only		BEMM 4-cty
	Mean	Std. Dev.	Mean	Std. Dev.	average
I/K	0.230	0.184	0.172	0.130	0.108
$(I/K)^2$	0.087	0.136	0.046	0.065	0.017
Π/K	3.066	46.28	0.485	0.659	0.219
Y/K	32.81	426.7	7.257	6.687	2.720
UCC	0.043	0.004	0.043	0.004	
ΔUCC	0.0007	0.0016	0.0008	0.0014	
ΔUCC (tax reform years)	0.0012	0.0019	0.0014	0.0016	
N. observations (tax reform years)	1290	(738)	267	(156)	
N. firms	291		66		

UCCs calculated using $t-2$ asset weights. Final column shows the (unweighted) average across the four countries reported in Table 2 of BEMM. Summary statistics for changes in the UCC are presented for the full set of years covered by the analysis, and restricting to only those years in which tax reforms occurred.

Table 4: Euler-equation model: GMM first differences

	All firms		Manufacturing only	
	(1)	(2)	(3)	(4)
I/K	0.278**	0.300**	1.255***	1.241***
	[0.135]	[0.136]	[0.485]	[0.473]
$(I/K)^2$	-0.232	-0.270	-2.331**	-2.301**
	[0.249]	[0.250]	[0.927]	[0.896]
Π/K	0.008	0.008	0.016	0.012
	[0.010]	[0.010]	[0.029]	[0.029]
Y/K	0.001	0.001	-0.012	-0.010
	[0.001]	[0.001]	[0.012]	[0.011]
UCC		-13.685**		18.037
		[6.532]		[15.627]
Observations	1,290	1,290	267	267

Robust standard errors in brackets. Significant at: *** 1%, ** 5%, * 10%. UCCs calculated using $t-2$ asset weights.

Table 5: Euler-equation model, by industry average capital intensity

	Low	Medium	High
	(1)	(2)	(3)
I/K	0.405*	0.188	0.422*
	[0.236]	[0.193]	[0.230]
$(I/K)^2$	-0.380	-0.108	-0.302
	[0.386]	[0.376]	[0.473]
Π/K	-0.006	0.096**	0.006
	[0.008]	[0.042]	[0.017]
Y/K	0.004	-0.002*	-0.003*
	[0.004]	[0.001]	[0.002]
UCC	-54.974***	2.004	0.352
	[18.539]	[10.350]	[8.857]
Observations	414	456	420

Robust standard errors in brackets. Significant at: *** 1%, ** 5%, * 10%. Industries are allocated to low (bottom quartile), medium (middle two quartiles) or high (top quartile) capital intensity based on the average capital-labour ratio of firms in that industry.

Table 6: Euler-equation model, by industry average capital intensity and computer intensity

	Low capital intensity industries			Med-high capital intensity industries		
	Industry computer intensity:					
	Low	Medium	High	Low	Medium	High
	(1)	(2)	(3)	(4)	(5)	(6)
I/K	-0.332	-0.052	0.635**	0.202	0.607**	0.151
	[0.264]	[0.215]	[0.324]	[0.179]	[0.267]	[0.186]
$(I/K)^2$	0.099	0.441	-0.986**	-0.781**	-0.742	0.061
	[0.416]	[0.526]	[0.420]	[0.389]	[0.458]	[0.380]
Π/K	-0.012	0.011	-0.005	0.042	-0.009	0.028
	[0.014]	[0.010]	[0.007]	[0.030]	[0.037]	[0.026]
Y/K	-0.004	-0.002	0.008*	0.000	0.003	-0.001
	[0.004]	[0.003]	[0.005]	[0.003]	[0.004]	[0.001]
UCC	-31.257**	-20.497	-67.972***	4.169	-8.015	8.600
	[15.470]	[38.317]	[18.931]	[9.401]	[10.200]	[16.293]
Observations	48	231	138	300	381	192

Robust standard errors in brackets. Significant at: *** 1%, ** 5%, * 10%. Industries are allocated to low (bottom quartile), medium (middle two quartiles) or high (top quartile) computer intensity, based on the average value of computer assets per worker in that industry.

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