Heterogeneous Tax Sensitivity of Firm-level Investments*

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March 29, 2016

Abstract

Firms are heterogeneous in size, productivity, ownership concentration, governance, financial structure and other dimensions. This paper introduces a stylized theoretical framework to account for such differences, suggesting that the tax sensitivity of firm-level investments is heterogeneous across partly observed and partly unobserved firm types. We econometrically test and confirm the theoretical predictions, taking account of selection of firms into different regimes. We find evidence of important differences in the tax sensitivity of investment of small entrepreneurial and larger managerial firms in different unobserved financial regimes. In general, corporate taxes are found to be more relevant for investment behavior than dividend taxes. Managerial firms are more sensitive to corporate taxation than entrepreneurial firms, while high dividend taxes are especially harmful for smaller managerial firms and cash-constrained entrepreneurial firms.

JEL classification: D22, G32, H25, L21.
Keywords: Corporate tax; Personal taxes; Firm heterogeneity; Access to capital; Manager-shareholder conflicts.
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*Keuschnigg appreciates financial support from the Swiss National Science Foundation (project no. 100018_146685). We are grateful for comments by participants of the Tuebingen 2014 Workshop on Tax Policy and the Activities of Multinational Firms, the Transatlantic Public Economics Seminar 2014 in Vienna and, in particular, by our discussants Dominika Langenmayr and Harry Huizinga.

1 Introduction

A salient feature of firm distributions is their heterogeneity along several dimensions. Firms differ by age and assets (young and mature), R&D intensity (innovative and less innovative), ownership structure (concentrated and dispersed), types of governance and other characteristics. Firm characteristics are related to specific agency problems and financial regimes. Young innovative firms tend to be entrepreneur centered with concentrated ownership, have large growth potential but little own assets and are, thus, often financially constrained. Financial constraints arise from moral hazard limiting the amount of earnings that can be pledged for repayment of external funds. Lacking the possibility of internal funding (due to limited own assets and current profits), they heavily rely on external funding and do not pay dividends. A firm's debt capacity and thereby the tightness of financial constraints on external financing depends on firm-specific factors (e.g., availability of own funding and of collateral), country specific institutional factors (e.g., accounting standards, bankruptcy regulations, financial sector efficiency) and on country specific tax factors (e.g. personal income tax, including tax progressivity, and profit tax rates). These firms earn an excess return on capital and tend not to respond to user costs. Taxes affect investment not via the user cost of capital, but rather by their effect on pledgeable earnings. Medium sized companies with still relatively concentrated ownership have more own funds and larger earnings and have less problems in raising credit. The user cost of capital, reflecting both personal income (dividend) and profit taxes, should become a more important determinant of investment.

At some point the entrepreneur wishes to sell out to diversify her wealth and the firm may become public. Large firms are less dependent on external credit. Investment tends to be financed by retained earnings at the margin. Shareholders install an independent

management and form a board to supervise the firm. The self-interest and independence of managers leads to a preference for retained earnings over dividend payouts and to partly inefficient investment associated with perks and other benefits in the interest of management. If funds are relatively scarce, firms refrain from paying dividends to maximize retained earnings which are partly diverted to inefficient projects serving the interest of management. Investment depends on dividend and corporate taxes and is also driven by institutional and corporate governance variables such as board composition, voting rights and investor protection. If more internal funds are available, firms pay dividends. In large, dividend paying firms, investment depends on the user cost of capital while dividend payouts are driven by institutional and corporate governance variables.

Distinguishing these different types of firms is especially important when deriving policy implications: Being subject to regime specific agency problems, firms might react to a given tax schedule in different ways. So far, however, empirical research on the tax determinants of investment falls in three unintegrated groups. First, a large traditional literature does not specifically take account of financial frictions and problems of corporate governance and investigates mainly how investment depends on the user cost of capital. Hassett and Hubbard (2002) review the empirical literature and report estimates of investment elasticities with respect to the user cost in the range between -0.5 and -1.0. Auerbach and Hassett (2003) show how the effect of dividend and corporate taxes depend on the marginal source of funds.[1] A second strand of the empirical literature emphasizes the prevalence of credit constraints. When firms are finance constrained, investment becomes sensitive to cash flow, own collateral and institutional country characteristics

[1]See Auerbach (2002) for a review of corporate financial policy and investment and Gordon and Dietz (2008) for tax explanations of dividend policies.

(see Hubbard, 1998, for an early survey). In general, young and small firms are more likely to be credit constrained than large firms (Beck et al., 2005; Aghion et al., 2007). Both entry and subsequent firm growth are limited by financial frictions (see Hubbard, 1998; Beck and Demirguc-Kunt, 2006; Aghion et al., 2007). Empirical research also finds that innovative firms tend to face tighter financing restrictions than non-innovative firms (Himmelberg and Petersen, 1994; Guiso, 1998; Hall and Lerner, 2010). Chirinko and Schaller (1995) and Hoshi, Kashyap and Scharfstein (1991) report elasticities of physical capital investment to cash flow around 0.4-0.5. Estimates for total working capital are significantly higher and vary between 0.8 to 1.3 (see Fazzari and Petersen, 1993; Calomiris and Hubbard, 1995; and Carpenter and Petersen, 2002). Ellul et al. (2015, 2010) find taxes to have a significant impact on investment and to importantly interact with institutional or firm specific characteristics that relate to credit constraints. Finally, a third strand of the literature discusses taxes and other determinants of investment and dividend payout behavior in large firms with a manager-shareholder conflict. Chetty and Saez (2005, 2006, 2010) theoretically and empirically consider the effects of dividend and corporate taxes on investment and dividend behavior. Desai et al. (2007) show that corporate taxes interact with investment and rent diversion by managers.

This paper outlines a theoretical model featuring relatively small entrepreneurial firms that are financially constrained, and large firms with dispersed ownership and manager-shareholder tension. Depending on the level of own assets and ownership structure, firms respond in different ways to personal and firm level taxes and are affected by different types of institutional variables. These different characteristics lead to a heterogeneity of tax elasticities which could not be explained by taxation in a first-best world.

The paper sheds light on the heterogeneity of investment responses to effective (per-

sonal plus corporate plus dividend) income taxation empirically. We make use of accounting information from a large data-set on individual firms. This data-set provides information on profits, sales, financial assets and ownership structure of 44,863 firms in a set of 25 European countries. We pursue an empirical approach which unifies two features: (i) estimating the flexible (regime specific) impact of taxes and costs of capital on firm-level investment, and (ii) accounting for the potential endogeneity of self-selection into different firm types. One merit of this approach is that it determines empirically the sensitivity of investments across different firms in terms of observable characteristics with special emphasis on different taxes.

The empirical analysis largely confirms theoretical predictions. In small entrepreneurial firms subject to credit rationing and in cash-poor managerial firms that are subject to a manager shareholder conflicts, investment depends positively and significantly on own funds. Corporate taxes negatively affect investment of all firms with the effect being most pronounced for non-dividend paying managerial firms. Dividend taxes seem to be less relevant for investment decisions in general but financially constrained entrepreneurial firms and non-dividend paying managerial firms are sensitive to these taxes.

The paper is organized as follows. Section 2 sets out a theoretical model to explain the heterogeneous tax sensitivity of investment in response to personal and corporate income taxes. Section 3 describes the data set and introduces econometric methodology. Section 4 presents the main empirical findings and Sections 5 and 6 report on inference and robustness checks. Finally, Section 6 concludes.

2 The Model

Entrepreneurial firms are run by managing owners and may be financially constrained or unconstrained. Financial constraints root in the tension between the entrepreneur and external investors and could lead to underinvestment coupled with an excess return on capital. In contrast, large managerial firms are run by a professional manager and owned by external equity investors. So there is a manager-shareholder conflict, potentially leading to overinvestment and below normal returns on investment.

Entrepreneurial firms have no independent board that protects shareholder interests and, therefore, have no access to external equity but are rather dependent on bank credit. External equity financing is associated with the entrepreneur 'going public' to raise funds on the stock market or selling out a substantial share to other investors.[2] To obtain the cross section, we may assume that entrepreneurs have a higher discount rate than investor owned firms (see Michelacci and Suarez, 2004), $r > i$, so that managerial firms have larger firm value, all else equal. On the other hand, selling out to investors requires to set up a board and hire a manager which reduces the value to owners. Given this trade-off, smaller firms with limited own assets remain entrepreneurial and larger ones choose a managerial structure with diversified ownership.

2.1 Entrepreneurial Firms

We introduce a simple model of a manager owned entrepreneurial firm. Investment is possibly credit rationed. The firm invests I to generate net earnings $\theta f(I)$ where

[2]We do not equate 'going public' with stock market listing. Many medium sized firms remain unlisted but have several owners, establish a board of directors and hire a professional manager.

$f' > 0 > f''$. Investment is financed by own funds A and external debt B. Dividends in periods zero and one are D and D_1. Capital must earn a rate of return or interest equal to r. By subtracting opportunity costs of own funds $(1+r)A$, we define firm value as a surplus over own funds. Financial identities are

$$D = A + B - I - \tau \cdot T, \quad D_1 = \theta f(I) + I - (1+r)(B+A) - \tau \cdot T_1, \tag{1}$$

where τ is the tax rate and $T \equiv -eI$ and $T_1 \equiv \theta f(I) + eI - rB$ are tax bases. For simplicity, we do not model any current taxable earnings in period 0 so that T is negative. In period 1, we need to take account of disinvestment, leading to an extra tax τeI. Dividends thus amount to $D = A + B - (1 - e\tau) I$ and

$$D_1 = (1-\tau)\theta f(I) + (1-e\tau) I - (1 + (1-\tau) r) B - (1+r) A. \tag{2}$$

Beginning of period firm value (surplus) is the present value of dividends net of assets,

$$V^E = \max_{I,D} \ (1-t_D) D + \frac{(1-t_D) D_1}{1+r} \quad s.t. \quad (2), \tag{3}$$

or $V^E = (1-t_D)\left[(1-\tau)(\theta f(I) - (1-e\tau) rI) + \tau r (D-A)\right] / (1+r)$.

First-Best: Optimality conditions are

$$\frac{dV^E}{dI} = \frac{(1-t_D)(1-\tau)\left[\theta f'(I) - (1-e\tau) r\right]}{1+r} = 0, \quad \frac{dV^E}{dD} = \frac{1-t_D}{1+r} \cdot \tau r > 0. \tag{4}$$

The firm invests until the marginal return is equal to the user cost,[3]

$$\theta f'(I) = (1-e\tau) \cdot r \equiv u. \tag{5}$$

Raising dividends today reduces dividends tomorrow. In the absence of tax, the effect on net firm value is zero. If the firm pays more dividends, it must raise more external debt.

[3]If interest on debt were not deductible, $T_1 = \theta f(I) + eI$, the user cost would be $u = \frac{1-e\tau}{1-\tau} \cdot r$ so that $u > r$ for any $e < 1$. Here, deductibility of interest on debt combined with deduction of investment costs subsidizes the user cost, $u < r$, as often happens in reality for 100% debt financing (at the margin).

Since interest on debt is deductible, repayment is tax subsidized tomorrow, leaving a net gain to the firm by shifting investment financing from retained earnings to external debt, $(1-e\tau)\,I=(A-D)+B$. The firm raises dividends as much as possible by raising more debt which is limited to $B\leq(1-e\tau)\,I$, or $D\leq A$.

Financing Constraint: We follow Ellul et al. (2010, 2015) for a simple way of modeling credit constraints. In period 1, investment and financing (I, B and D) are pre-determined. Suppose insiders can divert earnings $\phi' I$. Depending on the legal environment (investor protection, antidirector laws etc.), diversion is limited to $\phi'\in[0,\phi]$. If the entrepreneur is honest, she can promise external investors at most a repayment of $\theta f+I-\tau T_1\geq(1+r)\,B$. If the entrepreneur diverts funds, she reduces pledgeable earnings by $\phi' I$ and can get external funds to the extent that reported profits remain positive, $\pi_1=\theta f+I-\tau T_1-\phi' I-(1+r)\,B\geq 0$. Given high earnings and a small cost of diversion, she never benefits from diverting minor amounts since total income $\pi_1+\phi' I=\theta f+I-\tau T_1-(1+r)\,B$ (prior to getting a return on equity) is not affected.

If earnings are low and the firm is loaded with too much external funds, there might be a situation of $\theta f+I-\tau T_1-(1+r)\,B>0>\theta f+I-\tau T_1-\phi I-(1+r)\,B=\pi_1$. Since small amounts of diversion don't add to final wealth, she is clearly better off in diverting the maximum amount ϕI, reporting negative book earnings and declaring bankruptcy. Given limited liability, the entrepreneur is left with zero residual profit, but keeps diverted earnings ϕI. In this case, external investors recover only part of the promised repayment, $\theta f+I-\tau T_1-\phi I<(1+r)\,B$. To prevent this scenario, they stop lending as soon as the no-diversion constraint becomes binding, $(1-\tau)\,\theta f\,(I)+(1-e\tau)\,I-(1+(1-\tau)\,r)\,B\geq\phi I$. When access to external funds is limited, the firm is forced to cut dividends and keep retained earnings to economize on external funds, $B=(1-e\tau)\,I-(A-D)$. We also

assume that the entrepreneur needs at least an amount $\bar{D}$ of current, after tax dividends for private needs. This leaves the no-diversion constraint [use $R \equiv 1 + (1-\tau) r$]

$$(1-\tau)\left[\theta f(I) - (1-e\tau) rI\right] \geq \phi I - R(A-D), \quad (1-t_D) D \geq \bar{D}. \tag{6}$$

We assume that access to external debt requires a minimum amount of self-financing:

Assumption 1 *With unconstrained investment, $\theta f'(I^*) = (1-e\tau) r$, the financing constraint is violated when retained earnings are zero, $(1-\tau)\left[\theta f(I^*) - (1-e\tau) rI^*\right] < \phi I^*$.*

Entrepreneurial firms may be in two regimes, see Appendix A for an analytical solution. Cash-poor firms are severely constrained and must cut dividends. The financing constraint in (6) binds even if the firm pledges a maximum of own funds by reducing dividends to $D = \bar{D}/(1-t_D)$. Investment is implicitly determined by (6) and depends on inside equity or the legal environment as measured by ϕ, and on determinants of pledgeable earnings, including tax payments,[4]

$$\begin{aligned} dI_c &= \frac{R}{k} \cdot dA - \frac{D}{1-t_D} \frac{R}{k} \cdot dt_D + \frac{(1-\tau) f}{k} \cdot d\theta - \frac{I}{k} \cdot d\phi \\ &: \quad -\frac{(1-\tau) B}{k} \cdot dr + \frac{(1-\tau) \tau r I}{k} \cdot de - \frac{T_1 + RT}{k} \cdot d\tau, \end{aligned} \tag{7}$$

where $k \equiv \phi - (1-\tau)(\theta f' - u) > 0$ and $R \equiv 1 + (1-\tau) r$.

Figure 1 illustrates how the financing constraint in (6) determines investment. Investment rises with own funds and declines with higher cost of capital, with deteriorating institutional quality (higher ϕ), and with a higher dividend tax. Cash-poor firms with little own funds are heavily constrained and cut dividends to preserve retained earnings

[4] Write $[\theta f - (1-e\tau) rI - (1-\tau) erI + rA] \cdot d\tau = (T_1 + RT) \cdot d\tau$ by using the definition of tax bases and $B = (1-e\tau) I - A + D$.

for self-financing, $D = \bar{D}/(1 - t_D)$. A higher dividend tax thus requires larger gross dividends, thereby limiting retained earnings and reducing investment. Being constrained, firms are left with unexploited investments and earn an excess return.

Insert Figure 1 here

If a firm is endowed with relatively high own funds, it starts to pay larger dividends. It could invest at the first-best level, pay out dividends and raise external debt such that the financing constraint 'just binds', see the first inequality in (6). At that point, pushing for higher dividends would reduce retained earnings even further and restrict investment. Given the tax advantage of debt, this strategy is value increasing since a small cut in investment doesn't affect firm value while a small increase in debt financed dividends is strictly value increasing due to tax savings, see (4). Therefore, optimal investment is reduced below the first-best level and still earns an excess return, see the discussion of (A.3) and the illustration in Figure 1,

$$\theta f'(I_n) - (1 - e\tau) r = \frac{\tau}{1 - \tau} \frac{r\phi}{1 + r} > 0.$$

Since the financing constraint becomes binding only for tax reasons while the firm would be unconstrained in the absence of tax, we call this regime 'tax-constrained' as opposed to 'cash-constrained'. Investment of a tax constrained entrepreneurial firm changes by

$$\begin{aligned} dI_n &= -\frac{\tau r}{(1 - \tau)(1 + r)} \frac{1}{-\theta f''} \cdot d\phi - \left[1 - e\tau + \frac{\tau\phi}{(1 - \tau)(1 + r)^2}\right] \frac{1}{-\theta f''} \cdot dr \qquad (8) \\ &: \quad + \frac{f'}{-\theta f''} \cdot d\theta - \left[\frac{1}{(1 - \tau)^2} \frac{\phi}{1 + r} - e\right] \frac{r}{-\theta f''} \cdot d\tau + \frac{\tau r}{-\theta f''} \cdot de. \end{aligned}$$

Results are as expected. A constant dividend tax rate has no impact any more since it doesn't constrain the firm's choice between present and future dividends. A higher corporate tax rate reduces investment because it makes firms to pay out even more

dividends today to exploit the larger tax advantage of debt, accepting a somewhat smaller level of investment due to diminishing internal funds. A slight ambiguity remains since a larger tax rate magnifies the value of the investment tax credit which in itself strengthens cash flow and investment. This effect is unimportant if the tax credit is small ($e \to 0$).

Insert Figure 2 here

Firm Values: Firms differ in own funds A. Given low own funds, the *financing constraint binds* even if dividends are cut to $D = \bar{D}/(1-t_D)$ to strengthen retained earnings, implying an external debt of $B = (1-e\tau)I - A + D$. Investment follows from (6) and depends on A. Noting (2), firm value rises with own funds, at least for small taxes ($\tau \to 0$),

$$\frac{dV_c^E}{dA} = (1-t_D)\frac{(1-\tau)(\theta f' - u)\frac{dI}{dA} - \tau r}{1+r}, \quad \frac{dV_n^E}{dA} = 0. \tag{9}$$

When own funds are larger, investment I_n is *tax-constrained* and is independent of A, see (8). Given interest deductibility of debt, the firm wants to raise as much external debt as possible. Given I_n, the financing constraint yields the minimum level of retained earnings, $R(A-D) = \phi I_n - (1-\tau)(\theta f(I_n) - uI_n)$, and thereby the maximum level of external debt, $B = (1-e\tau)I_n - (A-D)$. Hence, both investment and external debt, I_n and B, are independent of A so that current dividends $D = A + B - (1-e\tau)I_n$ rise one to one with own funds while period 1 dividends decline in proportion to $1+r$. The net discounted effect is zero. The firm's surplus is not affected by larger own funds.

Clearly, a cash-poor firm is *cash-constrained* so that more own funds boost investment and add to firm value in proportion to the excess return. The effect eventually disappears when investment and dividend pay-out are exclusively driven by the tax advantage of debt. Figure 2 illustrates. There is a cutoff value A_c such that firms with $A < A_c$ are

cash-constrained and do not pay dividends while richer firms $A > A_c$ are constrained only for tax reasons and pay dividends. Figures 2 and 3 compare entrepreneurial and managerial firms and display how firm values and investment change with assets.

Insert Figure 3 here

2.2 Managerial Firms

We assume that entrepreneurial firms have no access to external equity. Their marginal source of finance is debt. Once the entrepreneur has largely exhausted excess returns (cash-rich firm), she wants to sell out by going public. The firm becomes managerial, subject to a new agency problem. Since enough own funds are available, the marginal source of finance is retained earnings, as in the new view on dividend taxation. We thus exclude further investment financing with new equity in addition to the acquisition of A. Firms do not pay dividends, not because of a shortage of own funds but rather because of manager's overinvestment in perks and pet projects.

2.2.1 Agency Model

In large firms (high A), entrepreneurs divest and sell out to external investors who require a lower return on their diversified portfolio, $i < r$, but are passive owners and must hire a manager (possibly the founding entrepreneur). It is now the manager who can divert a part J of the firm's funds, instead of productively investing it. In total, she spends $I + J$ where J does not add to the firm's earnings $\theta f(I)$. After spending on investment, managers use the remaining funds to pay out dividends. Abstracting from new equity issues, the marginal source of finance is retained earnings, leading to the first period

financial identity $(1-e\tau)(J+I) = A - D$. In the second period

$$D_1 = (1-\tau)\,\theta f(I) + (1-e\tau)(I+J) - (1+i)\,A. \tag{10}$$

Defining firm value as a surplus net of opportunity costs, we must subtract $(1+i)\,A$ before dividends are shared with managers and other stakeholders. Using financial identities, the present value of dividends is $V = (1-t_D)\,[D + D_1/(1+i)]$, or

$$V = (1-t_D)\left[D + \frac{(1-\tau)\,\theta f(I) + A - D - (1+i)\,A}{1+i}\right], \tag{11}$$

which yields $V = (1-t_D)\,[(1-\tau)\,\theta f(I) - (1-e\tau)\,i\,(I+J)]\,/\,(1+i)$.

Managers decide on investment and dividend policy. Part J of total investment spending doesn't add to earnings but yields private benefits $g(J)$ to the manager. Active shareholders sit on the board, provide oversight and control and set executive compensation (dividend share α) to realign manager and shareholder interests. Firm value is divided among managers and shareholders,

$$V^M = \alpha \cdot V + \frac{g(J)}{(1+i)\,q} - B^M, \quad V^B = (1-\alpha)\cdot V + B^M, \quad V^* = V + \frac{g(J)}{(1+i)\,q}. \tag{12}$$

Active owners (board members) acquire the firm and cede a share α to managers, possibly against a payment B^M. The board thus keeps a residual share of $1-\alpha$. Private benefits from less productive investment J are reduced by tighter monitoring by board members and higher institutional quality relating to investor protection, antidirector rights, accounting standards etc. Given that our focus is on investment decisions, we refrain from endogenizing board monitoring. In our simplified framework, parameter q thus captures the effects of monitoring and institutional quality.

2.2.2 First Best

Suppose shareholders can observe private benefits (institutional quality $q \to \infty$). Maximizing the joint surplus V^* thus yields

$$\begin{aligned} \frac{dV^*}{dI} &= \frac{1-t_D}{1+i}(1-\tau)\left[\theta f'(I) - \frac{1-e\tau}{1-\tau} i\right] = 0, \\ \frac{dV^*}{dJ} &= -\frac{1-t_D}{1+i}(1-\tau)\theta f'(I) + \frac{g'(J)}{(1+i)q} \leq 0. \end{aligned} \tag{13}$$

The first condition yields I and the second implies J. As long as $g'(0)$ is finite, $q \to \infty$ implies $J \to 0$ and residual dividends $D = A - (1-e\tau) I$. In the first-best, there is no diversion of funds. Investment exclusively depends on the user cost of capital.

If managers are not wealth constrained, the first-best can be implemented by selling the firm to them (set $\alpha = 1$) at a price that extracts their surplus, $B^M = V + \frac{g(J)}{(1+i)q}$, giving a value $V^B = B^M$ to board members. Managers maximize $V + \frac{g(J)}{(1+i)q}$ and choose investments as in (13), leading to $J = 0$ for $q \to \infty$ as before. Since the price B^M extracts all rent from managers, board members get the entire surplus,

$$V^B = V = (1-t_D)\frac{(1-\tau)\theta f(I) - (1-e\tau) iI}{1+i}. \tag{14}$$

Comparing (3) and (14), a managerial firm – in the absence of tax – is larger and has greater value in the first-best than an entrepreneurial firm since $i < r$ implies $V^E < V^B$. They would be exactly equal if $i = r$. With taxes, there is a countervailing effect in our model. Entrepreneurial firms are favored since interest on external debt is deductible while opportunity costs of equity (internal finance) of managerial firms are not.

2.2.3 Investment and Dividend Policy

To discourage unproductive investments that is directed towards private benefits, managers are offered a share α to boost incentives for value maximization. We assume

that managers are wealth constrained, $B^M = 0$, leaving them with rents at the expense of board members. Total rent consists of monetary income and private benefits, $V^M = \alpha V + \frac{g(J)}{(1+i)q}$, where V is stated in (11). Given a contract α, the manager maximizes rent by setting investment and dividends subject to $J = (A - D)/(1 - e\tau) - I$,

$$V^M = \max_{I,D} \ \alpha \cdot (1 - t_D) \left[D + \frac{(1-\tau)\,\theta f(I) + A - D - (1+i)\,A}{1+i} \right] + \frac{g(J)}{(1+i)\,q}. \tag{15}$$

The trade-off is in paying out funds to investors or retaining for investment and managerial perks.[5] Optimality requires

$$\begin{aligned} \frac{dV^M}{dI} &= \frac{(1-t_D)\,\alpha\,(1-\tau)\,\theta f'(I) - g'(J)/q}{1+i} = 0, \\ \frac{dV^M}{dD} &= \frac{(1-t_D)\,\alpha\,(1-e\tau)\,i - g'(J)/q}{(1-e\tau)\,(1+i)} \leq 0. \end{aligned} \tag{16}$$

Depending on the sign of the second condition, one must distinguish two cases.

No Dividend, $D = 0$: If paying dividends reduces the manager's rent, $\frac{dV^M}{dD} < 0$, she sets $D = 0$. Investment follows from

$$(1 - t_D)\,(1 - \tau)\,\alpha \cdot \theta f'(I) = g'(J)/q, \quad J = \frac{A}{1 - e\tau} - I. \tag{17}$$

This condition implicitly determines productive investment I and, in turn, yields J. Investment no longer depends on user cost but rises with internal funds A, higher managerial profit share α, better governance or higher institutional quality (larger q). Using $\nabla \equiv -(1 - t_D)\,(1 - \tau)\,\alpha\theta f'' - g''/q > 0$, we have[6]

$$\begin{aligned} dI &= \frac{-g''}{(1-e\tau)\,q\nabla} \cdot dA + \frac{g'}{q\theta\nabla} \cdot d\theta + \frac{g'}{q\alpha\nabla} \cdot d\alpha + \frac{g'}{q^2\nabla} \cdot dq \\ &: \quad -\frac{(1-\tau)\,\alpha\theta f'}{\nabla} \cdot dt_D - \frac{(1-t_D)\,\alpha\theta f'}{\nabla} \cdot d\tau + \frac{-g''}{q\nabla} \frac{I+J}{1-e\tau} (e \cdot d\tau + \tau \cdot de). \end{aligned} \tag{18}$$

[5]Given diversified ownership, none of the shareholders has committed a dominant share of their portfolio to a single firm. In contrast to (6), we thus ignore the need for minimum dividends.

[6]Using the first order conditiion, we can also write $\frac{dI}{dA} = \frac{g''/g'}{f''/f' + g''/g'} \frac{1}{1-e\tau} < \frac{1}{1-e\tau}$.

A larger profit share and better governance or a better institutional environment lead managers to focus more on value maximization and productive investment. Taxes or lower firm level productivity reduce firm value relative to the value of private benefits and thereby induce managers to shift resources from productive investments to unproductive ones. Unproductive investment changes by $dJ = d\frac{A}{1-e\tau} - dI$ and total spending by

$$d\left(I+J\right) = \frac{1}{1-e\tau}\cdot dA + \frac{A}{\left(1-e\tau\right)^2}\left(e\cdot d\tau + \tau\cdot de\right).$$

Dividend Payout, $D>0$: If the firm pays dividends, investment is given by

$$(i): \theta f'\left(I\right) = \frac{1-e\tau}{1-\tau}i, \quad (ii): \left(1-t_D\right)\left(1-e\tau\right)\alpha i = \frac{g'\left(J\right)}{q}. \tag{19}$$

The manager productively invests I as in (i) and diverts J as in (ii) which, in turn, yields residual dividends $D = A - \left(1-e\tau\right)\left(I+J\right)$. Cash-rich firms choose productive investment to maximize firm value so that the return on investment is equal to the user cost of capital. In particular, productive investment is independent of own funds A. The manager-shareholder conflict merely concerns the use of excess funds for dividend payments versus diversion of funds to perks and managerial benefits. We have

$$\begin{aligned}
dI &= \frac{f'}{-\theta f''}\cdot d\theta - \frac{f'}{-if''}\cdot di + \frac{\tau}{1-\tau}\frac{i}{-\theta f''}\cdot de - \frac{1-e}{\left(1-\tau\right)^2}\frac{i}{-\theta f''}\cdot d\tau, \qquad (20)\\
dJ &= -\frac{g'}{-ig''}di - \frac{g'}{-g''}\left[\frac{dq}{q}+\frac{d\alpha}{\alpha}\right] + \frac{g'}{-g''}\frac{dt_D}{1-t_D} + \frac{g'}{-g''}\left(e\frac{d\tau}{1-e\tau} + \tau\frac{de}{1-e\tau}\right),\\
d\left(I+J\right) &= \frac{f'}{-\theta f''}d\theta - \left[\frac{f'}{-if''}+\frac{g'}{-ig''}\right]di - \frac{g'}{-g''}\left[\frac{dq}{q}+\frac{d\alpha}{\alpha}\right]\\
&: \quad + \frac{g'}{-g''}\frac{dt_D}{1-t_D} + \left[\frac{f'}{-f''}+\frac{g'}{-g''}\right]\tau\frac{de}{1-e\tau} - \left(\frac{1-e}{1-\tau}\frac{f'}{-f''} - e\frac{g'}{-g''}\right)\frac{d\tau}{1-e\tau}.
\end{aligned}$$

Dividends $D = A - \left(1-e\tau\right)\left(I+J\right)$ are residual and change by

$$\begin{aligned}
dD &= dA - \left(1-e\tau\right)\frac{f'}{-\theta f''}\cdot d\theta + \left(1-e\tau\right)\frac{g'}{-g''}\cdot\left[\frac{dq}{q}+\frac{d\alpha}{\alpha}\right]\\
&: \quad + \left(1-e\tau\right)\left[\frac{f'}{-if''}+\frac{g'}{-ig''}\right]\cdot di - \left(1-e\tau\right)\frac{g'}{-g''}\cdot\frac{dt_D}{1-t_D} \qquad (21)\\
&: \quad + \left[\left(I+J\right)e + \frac{1-e}{1-\tau}\frac{f'}{-f''} - e\frac{g'}{-g''}\right]\cdot d\tau + \left[I+J-\frac{f'}{-f''}-\frac{g'}{-g''}\right]\tau\cdot de.
\end{aligned}$$

Table 1 summarizes the empirical predictions of how various shocks affect the intensive margin of investment.

Insert Table 1 About Here

Clearly, the predictions contained in the table are sharp and rich. It would be rather extreme to expect full alignment of the data with all of those hypotheses. However, we would hope to find a ranking of coefficients across firm types as distinguished in terms of A. Moreover, we would expect the signs on coefficients to be aligned with the signed effects in Table 1. Finally, it is conceptually impossible to point-identify predicted zero relationships in Table 1, but we would hope to see the corresponding effects to be empirically weaker and economically smaller than those of signed relationships.

Firm Values: In the interior regime (see 19), $D = A - (1 - e\tau)(I + J) > 0$, i.e., the firm pays dividends. Investments I, J are independent of A so that firm value is flat, $dV/dA = 0$. Increased own funds are one to one paid out as dividends, $\frac{dD}{dA} = 1$. If the firm is in the constrained regime and thus cannot pay dividends, $D = 0$ and $A = (1 - e\tau)(I + J)$, managers divert funds for perks and managerial benefits at the expense of productive investment and shareholder value. We have $\frac{dD}{dA} = 0$ as well as $\frac{1}{1-e\tau} > \frac{dI}{dA} > 0$ and $\frac{1}{1-e\tau} > \frac{dJ}{dA} > 0$ where both derivatives add up to $\frac{d(I+J)}{dA} = \frac{1}{1-e\tau} \geq 1$. Firm value thus changes by

$$\begin{aligned} \text{corner} \quad &: \quad \frac{dV}{dA} = \frac{(1 - t_D)(1 - \tau)\left[\theta f'(I)\frac{dI}{dA} - \frac{1-e\tau}{1-\tau} i \frac{dI+dJ}{dA}\right]}{1 + i} \gtrless 0, \\ \text{interior} \quad &: \quad \frac{dV}{dA} = 0. \end{aligned} \tag{22}$$

Cash-poor firms do not pay dividends. Investment rises by less than A, $0 < \frac{dI}{dA} < 1$, since managers divert funds to unproductive uses serving only managerial benefits. Hence, $J = A - I$ also rises. The returns f' and g' shrink until (16b) holds with equality, moving

the firm to the interior regime. For low assets, productive investment is constrained, i.e. $\theta f'(I) > \frac{1-e\tau}{1-\tau} i$. If the excess return is large, then $dV/dA > 0$, even if some funds are invested unproductively. When moving to the interior regime, $\theta f'(I) \to \frac{1-e\tau}{1-\tau} i$, firm value starts to decline, $dV/dA < 0$, although the manager's payoff still rises since she obtains private benefits. In the limit, firm value $\frac{dV}{dA} = \frac{(1-t_D)(1-\tau)}{1+i} \left[\theta f'(I) \frac{dI}{dA} - \frac{1-e\tau}{1-\tau} i \frac{1}{1-e\tau}\right]$ shrinks with assets near the cut-off: $\theta f' \to \frac{1-e\tau}{1-\tau} i$ yields $\frac{dV}{dA} \approx \frac{(1-t_D)(1-e\tau)i}{1+i} \left(\frac{dI}{dA} - \frac{1}{1-e\tau}\right) < 0$ since $\frac{dI}{dA} < \frac{1}{1-e\tau}$. Figure 3 illustrates.

2.3 Cross Section of Firms

The cross section includes entrepreneurial and managerial firms with further distinctions within each class, giving four types in total. In a life-cycle interpretation, firms start out entrepreneurial with concentrated ownership. (i) Those with low own assets are smallest and pay only a minimum amount of dividends to maximize internal funds. Investment is restricted by pledgeable cash flow, i.e., they are *cash-constrained*. (ii) Those with larger funds could invest at a first-best level and pay higher dividends. Given the tax advantage of debt, they prefer external credit relative to retained earnings and thereby end up constrained for tax reasons only, i.e., they are *tax-constrained*. At some level of funds, entrepreneurs sell out. The firm is acquired by diversified investors or goes public, requiring a lower return on equity. A manager is hired and a board is installed to control the firm. (iii) Managerial firms with limited own funds are non-dividend paying. They retain all profits for internal financing and, due to diversion of funds, do not fully exploit their productive investment opportunities. (iv) Cash-rich firms with large internal funds pay dividends and invest at an unrestricted level even though some investment is diverted to non-productive uses and thereby limits the amount of dividend distributions.

We denote the cutoff values of assets by $A_c < A_m < A_d$ as Figures 2 and 3 illustrate.

The cutoff A_m divides firms into managerial and entrepreneurial firms indicating the particular agency problem faced by each subcategory of firm: entrepreneurial firms face financial constraints due to credit rationing, managerial firms face a manager-shareholder conflict arising from the tendency to empire-building and overinvestment. Within each subcategory, defined by the thresholds A_c and A_d, the agency problem is alleviated as own funds rise. The empirical setup allows to identify the subgroups of firms and to test the theoretical predictions regarding tax effects on extensive investment.

3 Empirical Framework

3.1 Data Description

This study employs data from several sources. At the heart of the analysis are annual firm-level data published in Bureau van Dijk's Orbis Database on balance sheets of companies in 25 European countries between the years 2009 and 2013. For the main empirical analysis we restrict our sample to manufacturing firms for two reasons.[7] First, the investment process described in the theoretical model is mainly inspired by a classical manufacturing firm. Second, the investment measure which we will use as the dependent variable is based on physical investments such as machinery but barely reflects 'soft' investments such as ones in human capital that might be relatively more relevant for service companies. We will conduct robustness checks though, where we broaden the sample to include services companies.

[7]We use all firms whose main sector affiliation in the NACE Rev.2 2-digit classification is 10-33.

Other variables are country or country-time specific. For instance, price deflators (for GDP and investment) from the European Commission's AMECO database are used to deflate all monetary variables of the covered countries and years. Indices for bankruptcy laws as well as investor protection are taken from the World Bank's Doing Business 2012 Report. Additional country-level variables are taken from the World Bank's World Development Indicators. Moreover, the paper utilises detailed data from Bösenberg, Egger, and Erhardt (2014) on the taxation of corporate profits, from Bösenberg, Rydzek, and Egger (2014) on the taxation of dividends, and from Egger, Radulescu, and Strecker (2013) on the taxation of personal income across countries and time.

In the empirical analysis, we use a cross section of data for the period 2009-2013. While all of the data come as a panel, some of the core variables to the analysis – e.g., shareholder concentration – change so rarely for most companies that the identification of parameters from the variation of the data over time would rely on an unjustifiably small sample. For that reason, all variables are computed as an average over the respective period of investigation, 2009-2013.[8]

3.1.1 Company Balance-sheet Data

The company data are used to construct the dependent variable and some of the key independent variables. In the theoretical model, own funds reflect both a firm's liquidity as well as its size. While all firms are comparable in the theoretical model, in reality, they differ in age and industry affiliation amongst others. For the latter reason, they live on different sector-specific scales when it comes to firm size (reflected in investment as

[8]While this time period is based on years after the financial crisis, we have conducted robustness checks showing that the fundamental behavioral patterns identified in the main part of the paper are not qualitatively affected by the choice of this time window.

well as own funds). Hence, in order to properly identify behavioral responses of firms to differences in liquidity, we normalize the key dependent and independent variables (reflecting investment and own funds, respectively) in order to abstract from differences which are merely related to firm size (see the subsequent text for details).

Investment: The main dependent variable – investment of firm ℓ, I_ℓ – is constructed from the balance-sheet data as the relative annual increase in fixed assets in the average year between 2009 and 2013 abstracting from depreciation. We deflate investment using an investment deflator from the AMECO database.[9] For instance, a value of 0.1 of the dependent variable indicates a growth rate of real investment of 10%. In order to capture regular investment projects rather than mergers and acquisitions, we exclude firms where I_ℓ exceeds unity.

Determinants of Firm Regimes: In the proposed theoretical framework, the main determinant for selection into the different regimes (cash-constrained and tax-constrained entrepreneurial firms, non-dividend paying and dividend paying managerial firms) are own liquid funds. In the proposed theoretical framework, the four firm regimes emerge from two different kinds of agency problems: a manager-shareholder conflict on the one hand and an entrepreneur-external-investor conflict on the other hand. Legally, a manager-shareholder conflict becomes relevant as soon as none of the individual shareholders does have formal control. Since we observe the shareholder concentration of firms in the data, we can distinguish the two regimes of firms which are (with dispersed ownership) and are not (concentrated ownership) exposed to a potential manager-shareholder conflict. This concentration indicator equals zero for a company, if none of the recorded shareholders holds more than 50% of direct or total ownership.[10] However, whether firms

[9]Price deflator gross fixed capital formation: other investment.

[10]This variable changes rarely. We exclude firms for whom it does change between 2009 and 2013.

are relatively abundant in own liquid funds (within either a concentrated or a dispersed shareholder structure) is unobserved. We choose the cash ratio defined as cash and cash-equivalent holdings over total assets as a measure of size-normalized own liquid funds, A_ℓ, which is supposed to determine if a firm's investment is constrained by the respective agency problem.[11] The cash ratio is a standard measure of liquidity and suits our theoretical approach that firms can resort to own funds rather than raising external debt (entrepreneurial firms) or paying dividends (managerial firms). As said before, scaling own funds by total assets allows us to compare firms of different age and industry type. Clearly, scaled own liquid funds, A_ℓ, do not measure firm size anymore.

Other Firm-level Characteristics: Apart from investment and own liquid funds the interest rate and the productivity of a firm are key behavioral determinants in the theoretical model. We measure the interest rate by the firm-specific ratio of total interest expenses and total liabilities at the beginning of the sample period. In order to obtain a measure of productivity, θ_ℓ, we follow Levinsohn and Petrin (2003).[12] Finally, we use information on firm age (since the date of foundation), the number of employees and deflated total assets.

[11] Within an entrepreneurial regime, a firm's investment is subject to the financing constraint if own funds are low. Within a managerial regime, own funds are partly invested unproductively. Only firms with a high level of own funds will invest productively at the first best level.

[12] They propose an econometric strategy using intermediate inputs to control for correlation between input levels and the unobserved productivity process that commonly arises when estimating production functions. In this paper, we use the profit-adjusted value added to proxy for output, and the number of employees and total assets as primary factors of production and material costs to capture intermediate inputs. We estimate productivity for each firm and year from the panel data covering all firms and years in the data-set, and then average productivity over the time span 2009-2013 to obtain θ_ℓ.

3.1.2 Data on the Institutional Environment

Country-level indicators on investor protection aim at measuring shareholder protection against the unproductive use of corporate assets for perks and pet projects. Based on a disclosure index, a director liability index, and a shareholder suits index, the World Bank develops a *strength-of-investor-protection index*, ranging from 1 (low strength) to 10 (high strength). A *strength-of-legal-rights index* measures the extent to which the rights of borrowers are protected by bankruptcy and collateral laws, and also ranges from 1 (low strength) to 10 (high strength). A greater strength of legal rights or investor protection is expected to facilitate investment financing in a given country. In order to control for the economic state and the general investment climate in a country, we include data on GDP per capita, FDI inflows (in % of GDP), the percentage of bank non-performing loans in total gross loans, domestic credit to the private sector (in % of GDP), domestic credit to the private sector provided by banks (in % of GDP), and total domestic credit by the financial sector (in % of GDP).

3.1.3 Taxation Data

The theoretical model alludes to the role of taxes on profits and dividends for managerial and entrepreneurial firms. Details on the effective marginal tax rate on companies' profits are available from Bösenberg, Egger, and Erhardt (2014). Firms differ in terms of the composition of their investments and assets (with regard to tangible versus intangible investments and also with regard to the type of fixed tangible investments such as those in machinery, buildings, etc.) and the associated specific tax deductibility and depreciation rates. Egger and Loretz (2010) determine industry-specific and firm-specific effective tax rates by taking the nature of typical investments per 4-digit sector of the NACE

industry classification into account, and Bösenberg, Egger, and Erhardt (2014) provide an even more detailed approach, using long panel data covering the most recent years. While effective marginal tax rates on profits vary at the firm level, dividend taxes from Bösenberg, Egger, and Rydzek (2014) do so at the country level. Clearly, firm-level effective tax rates have the advantage that they vary at the deepest level of aggregation in the data. However, for that reason they depend on firm-level behavior, making them endogenous to some extent.[13] We address this issue below by running some of the central regressions to the paper using country-level effective marginal tax rates instead of firm-level effective marginal tax rates.

Finally, while the theoretical model in Section 2 only differentiates between corporate taxes and dividend taxes, we also include income taxes in the empirical analysis.[14] There are two reasons for doing so. First, depending on the legal form of a firm, income or corporate taxes might be relevant for profit taxation. Ex ante, we would expect income taxes being more important for small, constrained entrepreneurial firms. Second, we expect firms to use dividends and wages as (imperfect) substitutes to compensate shareholders and entrepreneurs.[15] We utilise data from Egger, Radulescu, and Strecker (2013) on the personal income tax schedule per country which permits computing effective personal income tax rates for any gross wage level by following the OECD's Taxing

[13]However, we believe that the problem of endogeneity of these tax rates in the present context is minor, as we condition on a relatively large set of exogenous observables that should determine the choices of firms about tax-relevant behavior.

[14]In Section 2, one might set $t_D = 0$ and interpret τ as the entrepreneur's personal income tax rate.

[15]Alstadsaeter and Jacob (2015) find that the Swedish dividend-tax cut in 2006 led owner-managers of closely-held firms to significantly substitute managerial salaries for higher dividends. Sivadasan and Slemrod (2008) found an elimination of the tax penalty on wages paid to partners in partnership firms in 1992 in India let to a significant shift of income from profits to managerial wages.

Wages approach. What mainly matters for the present purpose is that firm profits might be subject to personal income taxation for smaller enterprises. Since we consider manufacturing firms and exclude services, we use the effective marginal tax rate for an income amounting to ten times the average wage income in a given country to approximate the tax bracket for these firms.

3.1.4 Descriptive Statistics

The final data-set of firms for which all the aforementioned data are available covers 44,863 manufacturing companies in 25 different countries.[16] Summary statistics of all firm-specific variables are presented in Table 2. A list of countries is provided and details of all country-specific variables are presented in Table 3.

Insert Tables 2 And 3 About Here

On average, investment I_ℓ amounts to around 0.23 (23%) in the sample. The average firm has scaled own liquid funds (cash holdings relative to total assets) of around 9% and is subject to an interest rate of 2.2%. The majority of firms in the sample (63.3%) has a concentrated ownership structure. The effective marginal corporate tax rate amounts to 22.4% on average. Danish firms are subject to the highest marginal income tax rate of 59%, while Bulgarian firms face 9% only. Merely half of the countries impose dividend taxes, and Swiss firms are subject to the highest dividend-tax rate of 35% in the sample. According to the World Bank's Doing Business Report, British and Latvian borrowers benefit from a very high standard of legal rights, while Italian borrowers are worst off in the sample. Investor protection is most favorable in Ireland among the included countries.

[16] We arrive at this number after deleting all observations with obvious reporting errors, such as negative balance-sheet entries or balance-sheet ratios which are outside of the possible support region.

3.2 Econometric Strategy

Figure 2 suggests that behavioral investment responses of firms depend on their repective firm type. The econometric strategy is aimed at identifying these firm types and test the theoretical implications regarding firm-level investment responses. At the superordinate level, we distinguish managerial and entrepreneurial firms. The data allow us to identify managerial firms by being operated under a dispersed ownership structure as opposed to entrepreneurial firms which are run under concentrated ownership. According to the theoretical model the choice of being managerial or entrepreneurial is endogenous, e.g. smaller firms are more likely to be entrepreneurial than bigger ones. Managerial and entrepreneurial firms are both subject to specific agency problems constraining (productive) investment for some firms. It is however inherently unobservable to the researcher where in own-funds space these kinks in investment occur and they need to be estimated.[17] In light of these features, we propose an econometric strategy which involves estimating an unobservable threshold within an endogenously-chosen observable (entrepreneurial- vs. managerial-firm) regime by combining Hansen's (2000) sample-splitting approach with Heckman's (1979) sample-selection framework.

We use subscripts $\{c, t, m, d\}$ to denote (severely) cash-constrained, tax-constrained, managerial (not-dividend-paying), and dividend-paying firms which are separated by three threshold values of A_ℓ, $\{A_c, A_m, A_d\}$. In a first step, we define a selection rule

[17] According to theory, one might identify the threshold within managerial firms by using observed dividend payments. In reality, however, zero dividend payments would not have to be the right observable cutoff, because shareholders might ask for some small minimum dividend. Since there is no legally binding exogenous reason justifying a zero dividend threshold, we prefer treating that threshold as unobservable and estimating it. Given that dividend payments are a choice variable in theorety and in reality, we use our proxy variable for own funds to parameterize the respective threshold instead (see Hansen, 1997).

for the observable (entrepreneurial vs. managerial) firm type

$$q_\ell^* = z_\ell'\delta + u_\ell,$$

where q_ℓ^* is a latent variable measuring the net gains from concentrated share ownership, z_ℓ is a row vector of observable determinants thereof, δ is a conformable column vector, and u_ℓ is a disturbance term. While q_ℓ^* is unobserved, it generates an observable binary (managerial firm) variable

$$q_\ell = \begin{cases} 0 & \text{if } q_\ell^* \leq 0, \\ 1 & \text{if } q_\ell^* > 0. \end{cases} \tag{23}$$

The binary variable q_ℓ is defined such that all firms with dispersed ownership, i.e., m- and d-type firms, are assigned $q_\ell = 0$ and all firms with concentrated ownership, i.e., c- and t-type firms, are assigned $q_\ell = 1$.

We propose the dependent investment variable, I_ℓ, to be determined by a piecewise-linear function of a vector of independent variables, x_ℓ. The coefficients on these variables are allowed to depend on the observed and unobserved regimes according to:

$$I_\ell = \begin{cases} \alpha_1 + x_\ell'\beta_c + e_{\ell 1} & \text{if } A_\ell \leq A_c, \\ \alpha_1 + x_\ell'\beta_t + e_{\ell 1} & \text{if } A_c < A_\ell \leq A_m, \\ \alpha_0 + x_\ell'\beta_m + e_{\ell 0} & \text{if } A_m < A_\ell \leq A_d, \\ \alpha_0 + x_\ell'\beta_d + e_{\ell 0} & \text{if } A_d < A_\ell, \end{cases} \tag{24}$$

where A_c and A_d are unobserved, whereas A_m is indirectly observed through q_ℓ. We assume the disturbances on I_ℓ for the two states of the entrepreneurial vs. managerial firm indicated by q_ℓ, $(e_{\ell 0}, e_{\ell 1})$, and the disturbances in the process of q_ℓ^*, u_ℓ, to follow a multivariate normal distribution with mean zero and variance-covariance matrix

$$\Omega_\ell(q_\ell = j) = \begin{pmatrix} \sigma_{e_j}^2 & \rho_j\sigma_{e_j} \\ \rho_j\sigma_{e_j} & 1 \end{pmatrix}, \quad j = 0, 1. \tag{25}$$

Note that the covariances between $e_{\ell 0}$ and $e_{\ell 1}$ are zero due to mutual exclusivity.

Let the sample considered and information available consist of $\{I_\ell, x_\ell, A_\ell, q_\ell, z_\ell\}_{\ell=1}^n$, where n denotes the number of firms. Conditional on q_ℓ, the econometric model (24) can be rewritten as:

$$E[I_\ell|q_\ell = 0, x_\ell, z_\ell] = \alpha_0 + x_\ell'\beta_t + \mathbf{1}\{A_\ell \leq A_c\}x_\ell'(\beta_c - \beta_t) + \rho_0\sigma_{e0}\lambda_{\ell 0}, \tag{26}$$

$$E[I_\ell|q_\ell = 1, x_\ell, z_\ell] = \alpha_1 + x_\ell'\beta_d + \mathbf{1}\{A_\ell \leq A_d\}x_\ell'(\beta_m - \beta_d) + \rho_1\sigma_{e1}\lambda_{\ell 1}, \tag{27}$$

where $\lambda_{\ell 0} = \frac{-\phi(z_\ell'\delta)}{1-\Phi(z_\ell'\delta)}$ and $\lambda_{\ell 1} = \frac{\phi(z_\ell'\delta)}{\Phi(z_\ell'\delta)}$ account for endogenous selection into the observable regimes of entrepreneurial and managerial firms. The least-squares estimator for threshold equations such as (26) and (27) proposed by Hansen (2000) corresponds to minimizing the objective functions

$$S_{n,0}^*(\theta_0) = \frac{1}{n_0}\sum_{\ell=1}^{n_0}\left\{I_\ell - \alpha_0 - x_\ell'\beta_t - \mathbf{1}\{A_\ell \leq A_c\}x_\ell'(\beta_c - \beta_t) - \beta_{\lambda 0}\lambda_{\ell 0}\right\}^2, \tag{28}$$

$$S_{n,1}^*(\theta_1) = \frac{1}{n_1}\sum_{\ell=1}^{n_1}\left\{I_\ell - \alpha_1 - x_\ell'\beta_d - \mathbf{1}\{A_\ell \leq A_d\}x_\ell'(\beta_m - \beta_d) - \beta_{\lambda 1}\lambda_{\ell 1}\right\}^2, \tag{29}$$

where $\theta_0 = (\alpha_0, \beta_c', \beta_t', \beta_{\lambda 0}, A_c)$ and $\theta_1 = (\alpha_1, \beta_d', \beta_m', \beta_{\lambda 1}, A_d)$.

Estimation follows a two-step procedure. We first estimate a probit model to obtain estimates of δ and use these estimates to compute $\hat{\lambda}_{\ell 0}$ and $\hat{\lambda}_{\ell 1}$. We then minimize (28) and (29) given $\{\hat{\lambda}_{\ell 0}, \hat{\lambda}_{\ell 1}\}$ through concentration: we minimize the objective functions $S_{n,0}(A_c)$ and $S_{n,0}(A_d)$ given the respective threshold values and then optimize over A_c and A_d. Standard errors are obtained from the asymptotic covariance matrix for threshold regressions with sample-selection bias as developed in Egger and Erhardt (2015).

4 Main Results

The parameter estimates for the probit model are presented in Table 4. While these parameters do not reflect marginal effects, they permit a qualitative interpretation.[18] In general, a positive (negative) sign on a coefficient indicates that a larger value of the respective covariate raises (reduces) the likelihood of a firm's selection into the entrepreneurial regime and reduces (raises) the one of a selection into the managerial regime.

In line with the theoretical model, the cash ratio reflecting own funds has a negative effect on selection into an entrepreneurial regime. Similarly, older and larger (in terms of employees) firms are more likely to be in a managerial (m- or d-type) regimes. Higher corporate taxes seem to lead to selection into managerial regimes. The latter may reflect a mix of a better ability to avoid taxes as a managerial (especially, a dividend-paying) firm and of the mechanisms at work in the model in Section 2, which establishes a heterogeneous tax sensitivity of firms across the considered regimes. Apparently, higher dividend tax rates also increase the probability of being a managerial firm.

Insert Table 4 About Here

The estimates reported in Table 4 are used to compute the control functions $\hat{\lambda}_{\ell 0}$ and $\hat{\lambda}_{\ell 1}$ which enter the threshold-regression framework in the second stage.

Results of the integrated threshold regression are presented in Table 5.[19] This regression yields a critical cash ratio of $\hat{A}_c = 0.0300$ which separates cash- and tax-constrained

[18] Since the probit model only serves as a first stage, we abstain from reporting details on quantitative effects of the covariates on the response probability of self-selection into a managerial- versus an entrepreneurial-firm regime.

[19] A change in any variable which affects both regime selection as well as investment directly changes both the probability of being in one or another regime (reflected in $\hat{\lambda}_{\ell 0}$ and $\hat{\lambda}_{\ell 1}$) as well as investment. This makes any marginal effect of variables determining both regime selection as well as investment

entrepreneurial firms, and $\hat{A}_d = 0.0181$ which separates dividend-paying and non-dividend paying managerial firms. Recall at this point that the empirical measure of liquid funds is normalized and does not capture size effects. For that reason, we do not have a theoretical prediction about the ordering or relative location of $\hat{A}_c$ and $\hat{A}_d$ in cash-ratio space. However, what the results mean is that, conditional on firm size, the critical level of liquid funds where the agency problem becomes relaxed due to a relative abundance of liquid funds is higher for small firms (entrepreneur-external-investor conflict) than for large firms (manager-shareholder conflict). The confidence bounds for the thresholds are based on the likelihood ratio statistic as proposed by Hansen (2000) and indicate a very precise measurement of the threshold $\hat{A}_c$. The threshold $\hat{A}_d$ is found to be statistically different from zero but less precise than the first threshold.[20]

In line with theoretical predictions, liquid funds as approximated by the cash ratio are more important for the investment of cash-constrained entrepreneurial firms and

fundamentally nonlinear (see Cameron and Trivedi, 2005). For simplicity and greater transparency, we focus on the discussion of direct effects conditional on regime status (i.e., the parameter estimates reported in the tables).

[20]Confidence intervals for estimates of unobserved thresholds based on the asymptotic methods developed in Hansen (2000) and extended to models of sample selection by Egger and Erhardt (2015) are asymptotically conservative. The no-rejection set is based on tests of the likelihood ratio statistic for the set of potential threshold variables. In order to assess the conservative benchmark estimates of confidence bounds, we employ bootstrap techniques to construct potentially tighter confidence intervals. Since the sampling distribution of the likelihood ratio is nonstandard and non-pivotal, we use a pre-pivoting strategy developed by Beran (1987, 1988) to create an asymptotic pivot in a first stage. In a second stage, we carry out a further bootstrap sampling to estimate the finite-sample distribution of that pivot. (See Horowitz (2001) for a detailed description of this bootstrap iteration strategy.) The confidence regions based on this methodology are very comparable to the analytical confidence regions, e.g. for $\hat{A}_c$ the bootstrap yields $[0.0269, 0.0547]$ as compared to the analytical $[0.0284, 0.0402]$.

not-dividend-paying managerial firms than for the respective counterparts, namely tax-constrained entrepreneurial and dividend-paying managerial firms, respectively. However, even for the latter investment is affected positively (albeit substantially less) by liquid funds. This might reflect the common conjecture that external finance is more costly than internal finance due to some additional agency problems not explicitly modeled here.

Insert Table 5 About Here

Personal income taxes have a negative impact on investments of all types of firms. As hypothesized before, this might reflect that some firms' legal status makes them subject to income taxation.[21] Compared to income taxes, corporate taxes are more relevant in terms of both size and significance. They affect investment negatively across all types, with the effect being most pronounced for managerial firms where a tax increase of one percentage point leads to a decline in investment by 1.3 percentage points for not-dividend-paying firms and by 0.9 percentage points for dividend-paying firms. Compared to corporate taxation, dividend taxes seem to be less important for investment decisions. As expected, the effect of dividend taxation is most pronounced for cash-constrained entrepreneurial firms and for not-dividend-paying managerial firms with a one-percentage-point increase in taxes leading to a decline in investment of 0.4 and 0.6 percentage points, respectively. However, there is also evidence of a negative effect of dividend taxation on the investment of tax-constrained entrepreneurial firms and on dividend paying-managerial firms.

[21]Unfortunately, we are not able to observe if firms are subject to income taxation or corporate taxation in the data. We can observe the national legal form, but only some national legal forms can be uniquely assigned to a certain tax regime (e.g., publicly traded incorporations are subject to corporate taxes). In many countries, firms of specific legal forms such as limited liability companies may choose to be taxed according to personal income or corporate taxation. Therefore, we decided to include both income and corporate taxation as determinants of investments throughout.

Interest rates affect investment negatively for all firms, while productivity enters positively across all firm regimes. The strength-of-legal-rights index reflecting the strength of bankruptcy laws enters the regression positively as expected, but the effect is not statistically significant. Investor protection appears negatively related to investment for dividend-paying managerial firms. Finally, the Mills' ratios should not be eliminated according to Wald-tests, pointing to endogenous selection effects into the entrepreneurial versus managerial regimes.

Overall, the estimation results in Table 5 are aligned to a large extent with the theory outlined in Section 2, especially, with regard to the effect of taxation on investment. The empirical results point to a statistically significant and economically large effect of corporate taxation, and they indicate that the quantitative impact varies starkly across observable and unobservable firm types, suggesting heterogeneous tax sensitivities of corporate profit taxes and dividend taxes that are qualitatively consistent with the hypotheses drawn from the proposed theoretical model. In particular, the ranking of predicted signed negative, zero, and signed positive effects is in broad accordance with the theoretical model and the relationships outlined in Table 1.

5 Robustness Checks

We conducted several robustness checks to assess the sensitivity of our results. We performed robustness along four lines. First, in the main part, we focused on manufacturing firms. The latter seems natural for reasons outlined above. To see how the results change when including services producers, we present one set of results for a larger sample, where goods and services producers are pooled together. Second, in the above analysis,

we treated firm-level productivity as an observed rather than an estimated variable. This is common practice in applied economic research, but it deflates the estimated standard errors. We had pursued this strategy in order to be able to present analytical model standard errors. However, to assess the sensitivity of the estimates of the parameter variance-covariance matrix, we will present properly jointly bootstrapped results of the full model below. Third, since the confidence set for the unobservable threshold between dividend-paying and not-dividend-paying managerial firms, A_d, is relatively wide we will present results, where we pool these two subsamples together and ignore a possible threshold at A_d. Fourth, one could argue that a manager-shareholder conflict should emerge only if no shareholder holds more than 25% rather than 50% of the shares. Therefore, we will present results based on data where we alter that critical level to consider less firms as to be potentially managerial in order to see how this changes the main results. Finally, we address the issue of a potential endogeneity of firm-level effective marginal tax rates by re-running the base-line results using country-level effective marginal tax rates instead of firm-level ones.

Considering both manufacturing and services firms:

Table 6 presents the results of this sensitivity analysis. The findings are qualitatively in line with the ones based on the smaller sample of manufacturing firms. As expected, in this enlarged sample tax sensitivities of investment seem to be less pronounced. As said before, the considered investment measure is based on fixed assets such as machinery rather than other 'soft' investment that might be more relevant for services firms. Note that the measurement of the threshold is very imprecise in this exercise with the confidence region being the whole set of potential threshold estimates.

Insert Table 6 About Here

Considering firm-level total factor productivity as an estimated regressor:

In Table 7, we report bootstrapped standard errors that take into account the estimation of productivity in a preceding stage.[22] Standard errors are only slightly higher for this specification and the main results remain valid. Only some of the institutional characteristics can no longer be considered statistically significant.

Insert Table 7 About Here

Disregarding the unobservable threshold A_d:

The corresponding results are presented in Table 8 and can be discussed with a focus on the differences in tax sensitivities of the average managerial firm as compared to entrepreneurial firms. Corporate taxation discourages investment of managerial firms by more than of entrepreneurial firms while dividend taxation is more harmful for entrepreneurial firms. Liquid funds are also relevant for the average managerial firm, but

[22]Since productivity is estimated using the panel structure of the data, we block-bootstrap the panel data-set and construct the bootstrap samples for the cross section used in the subsequent steps from the respective block-bootstrap panel samples.

investment is less sensitive to an increase in the cash ratio than in the case of cash-constrained entrepreneurial firms as hypothesized in the theoretical framework.

Insert Table 8 About Here

Altering the definition of managerial firms:

Assuming the manager-shareholder conflict to arise at a concentration of shares of 25% naturally leads to a smaller subsample of managerial firms. Results for this analysis are presented in Table 9. Interestingly, the threshold for entrepreneurial firms remains at the same level as before, underlining its relative robustness to different specifications. The main difference between the results seems to lie in the effect of dividend taxation which no longer is statistically significant. As expected from the theory, the effects of dividend taxation is more harmful to investment of cash-constrained entrepreneurial firms and non-dividend paying managerial firms. Corporate taxation remains more relevant for managerial firms. Some of the coefficients of dividend paying managerial firms are now much larger in size.

Insert Table 9 About Here

Using country-level effective marginal tax rates instead of firm-level ones:

As indicated above, firm-level effective tax rates have the advantage of varying at the deepest level of aggregation used, but they are endogenous to firms' behavior. In order to assess this issue, we re-run the main regressions in Table 5 by using (typical) model-firm, country-level effective marginal tax rates instead of firm-level ones in Table 10. The results in this table suggest that the parameters on the corporate-tax variable are somewhat smaller for country-level effective marginal tax rates than for firm-level ones. However, the source of this change might be measurement error with the use of country-

level tax rates instead of firm-level ones. Moreover, the statistical significance of the (country-level) personal income tax rate effect is lost in Table 10 relative to Table 5, which is owed to the correlation between country-level tax variables. However, overall the ranking of coefficients is very close in Table 10 to the base-line results in Table 5.

Insert Table 10 About Here

Overall, the robustness checks confirm the consistency of the main results, especially, with respect to the effects of taxation. The negative effects of corporate taxes on firm-level investment and their heterogeneity are confirmed throughout the analysis. We also find evidence that dividend taxes have a negative impact on investment especially for cash-constrained entrepreneurial and not-dividend-paying managerial firms. In general, dividend taxes have less pronounced effects than corporate taxes. This might be due to several reasons: first, dividends can be substituted by wages for entrepreneurial firms; second, dividends can easily be smoothed across years thereby weakening their impact on the investment decision in a given year; and, third, dividend taxes vary at the country level only, potentially leading to less accurate point estimates.

6 Conclusions

This paper sets up a theoretical model explaining the heterogeneous investment responses of firms in different unobserved financial regimes. That model postulates that small entrepreneurial firms are dependent on external credit and those with little own assets are most likely to be credit constrained and pay minimum dividends. Larger firms with more own funds could invest at first-best levels but end up debt constrained due to the tax advantage of debt. When own funds are larger, entrepreneurs prefer to divest and

sell to external investors who require a lower rate of return. Investors hire a manager and install a board to provide oversight and control and reduce unproductive self-serving investments by managers. Managers and shareholders have conflicting interests on the use of internal funds which may be allocated to finance productive investments, self-serving projects in the interest of managers, and paying dividends to shareholders. Managerial firms with relatively little own cash do not pay dividends and, since managers divert part of the resources, cannot fully exploit productive investment opportunities to the benefit of shareholders. Large cash-rich managerial firms invest at unconstrained levels while the manager-shareholder conflict with respect to residual funds is over dividend payments versus retained earnings in the interest of managers. Due to these varying agency problems inherent to different types of firms, the model predicts heterogeneous investment sensitivities with respect to corporate and dividend taxes, own funds and institutional variables that affect the self-serving behavior of entrepreneurs and managers.

The empirical analysis employs a sample-splitting method to allocate a cross section of 44,863 European firms to the four regime types identified in the theoretical model. We estimate the differential impact of taxes on investment across these ex-ante unobserved types and find that the empirical analysis confirms the heterogeneous sensitivity of investment to different taxes across firms, pointing to important policy implications. For instance, for all types of firms, corporate taxes are more relevant than dividend taxes, but managerial firms are more sensitive to corporate taxation than entrepreneurial firms. Moreover, dividend taxes are especially harmful for non-dividend paying managerial firms and for cash-constrained entrepreneurial firms.

7 Appendix: Credit Constrained Investment

For an analytical solution, maximize V^E s.t. (2), $B = (1-e\tau)\,I - (A-D)$, i.e. the marginal source of finance is external debt, and the constraint (6): $V^E = \max_{I,D}$

$$(1-t_D)\left[D + \frac{D_1}{1+r}\right] + \lambda \cdot \frac{(1-\tau)\,\theta f(I) + (1-e\tau)\,I - (1+(1-\tau)\,r)\,B - \phi I}{1+r}. \quad \text{(A.1)}$$

Optimality with respect to I and $D \geqslant \bar{D}/(1-t_D)$ requires

$$\begin{aligned} \frac{dV^E}{dI} &= \frac{(1-t_D+\lambda)(1-\tau)\,[\theta f' - (1-e\tau)\,r] - \lambda\phi}{1+r} = 0, \quad \text{(A.2)} \\ \frac{dV^E}{dD} &= \frac{(1-t_D)\,\tau r - \lambda\,[1+(1-\tau)\,r]}{1+r} \leq 0. \end{aligned}$$

Firms differ by own assets, generating first period earnings A. There are two regimes.

First, if $dV^E/dD\big|_{D=\bar{D}/(1-t_D)} < 0$, the firm sets the lowest level of dividends to maximize internal financing. The shadow price is large, indicating a tight constraint. For cash-poor firms, the financing constraint binds even if dividends are cut to a minimum. Substituting $B = (1-e\tau)\,I - A + D$ and $D = \bar{D}/(1-t_D)$, the constraint implicitly determines investment. Given I, condition (i) above yields λ.

The second regime applies when firms are cash-rich and pay debt financed dividends $D > \bar{D}/(1-t_D)$ to exploit the tax advantage of debt. The second condition above gives λ, which is used in condition (i) to yield

$$\lambda = \frac{\tau r \cdot (1-t_D)}{1+(1-\tau)\,r} > 0, \quad \theta f'(I_n) - (1-e\tau)\,r = \frac{\tau}{1-\tau}\frac{r\phi}{1+r} > 0. \quad \text{(A.3)}$$

Investment is independent of own funds. Given I_n, the constraint implies a level of debt B which, in turn, yields dividends $D = A + B - (1-e\tau)\,I$. In the absence of tax, the firm invests at the first best level noted in (5). There is no preference for external debt over retained earnings so that dividends are not determined.

Due to the tax preference of external debt, the firm ends up always constrained, $\lambda > 0$, and earns an excess return on investment, $\theta f'(I) > (1 - e\tau) r$. To exploit the tax advantage in the first best, where I^* is given by $\theta f'(I^*) = (1 - e\tau) r$, the firm pays out all earnings as dividends, $D = A$, and finances investment entirely with external debt, $B = (1 - e\tau) I^*$. With zero retained earnings, the financing constraint is violated, see Assumption 1, yielding the constrained solution in (A.3). The constraint in (6) introduces a trade-off between investment and dividends, $\partial I / \partial D = -R/k$, see (7).[23] Noting the partial effects on firm value in (4), the firm raises dividends and reduces investment until firm value is maximized, $\frac{dV^E}{dD} = \frac{\partial V^E}{\partial D} + \frac{\partial V^E}{\partial I} \frac{\partial I}{\partial D} = 0$. It becomes optimal to cut investment below the first best level I^* and, instead, use external debt to pay out more dividends. We call this a 'tax constrained' as opposed to the 'cash-constrained' regime. Substituting partial derivatives and using k yields (A.3) again.

Due to the tax preference for debt, entrepreneurial firms are always constrained. Cash constrained firms do not pay dividends while firms with more own funds are able to raise more external debt and pay dividends to exploit the tax advantage of debt. To separate cash-constrained and tax-constrained firms, set $D = \bar{D} / (1 - t_D)$ and investment I_n as in (A.3) to obtain the threshold value A_c from (6).

References

[1] Aghion, Philippe, Thibault Fally, and Stefano Scarpetta (2007), Credit Constraints as a Barrier to the Entry and Post-entry Growth of Firms, *Economic Policy 20* October 2007, 731-779.

[2] Alstadsaeter, Annette and Martin Jacob (2015), Dividend Taxes and Income Shifting, *Scandinavian Journal of Economics*, forthcoming.

[23] An increase in dividends reduces retained earnings and has the same effect as a reduction in earnings.

[3] Auerbach, Alan J. (1983), Taxation, Corporate Financial Policy and the Cost of Capital, *Journal of Economic Literature 21(3)*, 905-940.

[4] Auerbach, Alan J. (2002), Taxation and Corporate Financial Policy, in: Auerbach, A.J., and M. Feldstein (eds.). *Handbook of Public Economics, Vol.3(19)*, Amsterdam: Elsevier Science, 1251-1292.

[5] Auerbach, Alan J., and Kevin Hassett (2003), On the Marginal Source of Investment Funds, *Journal of Public Economics 87(1)*, 205-232.

[6] Beck, Thorsten and Asli Demirgüc-Kunt (2006), Small and Medium-size Enterprises: Access to Finance as a Growth Constraint, *Journal of Banking and Finance 30(11)*, 2931-2943.

[7] Beck, Thorsten, Asli Demirgüc-Kunt, and Vojislav Maksimovic (2005), Financial and Legal Constraints to Growth: Does Firm Size Matter?, *Journal of Finance 60(1)*, 137-177.

[8] Beck, Thorsten, Asli Demirgüç-Kunt and Vojislav Maksimovic (2008), Financing Patterns around the World: Are Small Firms Different?, *Journal of Financial Economics 89(3)*, 467-487.

[9] Beran, Rudolf (1987), Prepivoting to Reduce Level Error of Confidence Sets, *Biometrika 74(3)*, 457-468.

[10] Beran, Rudolf (1988), Prepivoting Test Statistics: A Bootstrap View of Asymptotic Refinements, *Journal of the American Statistical Society 83(403)*, 687-697.

[11] Bösenberg, Simon, Peter Egger and Katharina Erhardt (2015), An Analysis of Ex-post and Ex-ante Effective Tax Rates at the Firm Level, mimeo.

[12] Bösenberg, Simon, Peter Egger and Benedikt Rydzek (2014), *Capital Taxation, Investment, Growth, and Welfare*, mimeo.

[13] Calomiris, Charles W. and R. Glenn Hubbard (1995), Internal Finance and Investment: Evidence from the Undistributed Profits Tax of 1936-37, *Journal of Business 68(4)*, 443-482.

[14] Carpenter, Robert E. and Bruce C. Petersen (2002), Is the Growth of Small Firms Constrained by Internal Finance?, *Review of Economics and Statistics 84(2)*, 298-309.

[15] Chaney, Thomas, David Sraer and David Thesmar (2012), The Collateral Channel: How Real Estate Shocks Affect Corporate Investment, *American Economic Review 102(6)*, 2381-2409.

[16] Chetty, Raj and Emmanuel Saez (2010), Dividend and Corporate Taxation in an Agency Model of the Firm, *American Economic Journal: Economic Policy 2(3)*, 1-31.

[17] Chetty, Raj and Emmanuel Saez (2006), The Effects of the 2003 Dividend Tax Cut on Corporate Behavior: Interpreting the Evidence, *American Economic Review 96(2)* P&P, 124-129.

[18] Chetty, Raj and Emmanuel Saez (2005), Dividend Taxes and Corporate Behavior: Evidence from the 2003 Dividend Tax Cut, *Quarterly Journal of Economics 120(3)*, 791-833.

[19] Chirinko, Robert S. and Huntley Schaller (1995), Why Does Liquidity Matter in Investment Equations?, *Journal of Money, Credit and Banking 27(2)*, 527-548.

[20] Desai, Mihir A., Alexander Dyck, and Luigi Zingales (2007), Theft and Taxes, *Journal of Financial Economics 84(3)*, 591-623.

[21] Egger, Peter and Katharina Erhardt (2015), A Threshold Regression in the Presence of Sample Selection, mimeo.

[22] Egger, Peter and Simon Loretz (2010), Homogeneous Profit Tax Effects for Heterogeneous Firms?, *The World Economy, 33(8)*, 1023-1041.

[23] Egger, Peter, Doina Radulescu and Nora Strecker (2013), Effective Labor Taxation and the International Location of Headquarters, *International Tax and Public Finance 20(4)*, 631-652.

[24] Ellul, Andrew, Tullio Jappelli, Marco Pagano and Fausto Panunzi (2015), Transparency, Tax Pressure and Access to Finance, *Review of Finance*, forthcoming.

[25] Ellul, Andrew, Marco Pagano and Fausto Panunzi (2010), Inheritance Law and Investment in Family Firms, *American Economic Review 100(5)*, 2414-50.

[26] Fazzari, Steven M. and Bruce C. Petersen (1993), Working Capital and Fixed Investment: New Evidence on Financing Constraints, *Rand Journal of Economics 24(3)*, 328-342.

[27] Gordon, Roger H. and Martin D. Dietz (2008), Dividends and Taxes, in Alan Auerbach and Daniel Shaviro (eds.), *Institutional Foundations of Public Finance: Economic and Legal Perspectives*, 204-224.

[28] Greene, William (2003), *Econometric Analysis*, Prentice Hall, edition 5.

[29] Guiso, Luigi (1998), High-tech Firms and Credit Rationing, *Journal of Economic Behavior & Organization 35(1)*, 39-59.

[30] Hall, Bronwyn H. and Josh Lerner (2010), The Financing of R&D and Innovation, in: B. H. Hall and N. Rosenberg, eds., *Handbook of the Economics of Innovation*. Amsterdam: North-Holland, 609-639.

[31] Hansen, Bruce (2000), Sample Splitting and Threshold Estimation, *Econometrica 68(3)*, 575-604.

[32] Hassett, Kevin E. and R. Glenn Hubbard (2002), Tax Policy and Business Investment, in: A.J. Auerbach and M. Feldstein (eds.), *Handbook of Public Economics*, Vol. 3. Amsterdam: North-Holland, 1293-1343.

[33] Heckman, James (1979), Sample Selection Bias as a Specification Error. *Econometrica 47(1)*,153-162.

[34] Himmelberg, Charles P. and Bruce C. Petersen (1994), R&D and Internal Finance: A Panel Study of Small Firms in High-Tech Industries, *Review of Economics and Statistics 76(1)*, 38-51.

[35] Horowitz, Joel (2001), The Bootstrap, in J.J. Heckman and E.E. Leamer (eds.), *Handbook of Econometrics*, Vol. 5. Elsevier, 3159-3228.

[36] Hoshi, Takeo, Anil Kashyap, and David Scharfstein (1991), Corporate Structure, Liquidity, and Investment: Evidence from Japanese Industrial Groups, *Quarterly Journal of Economics 106(1)*, 33-60.

[37] Hubbard, Glenn (1998), Capital Market Imperfections and Investment, *Journal of Economic Literature 36(1)*, 193-225.

[38] Jimenez, Emmanuel and Bernardo Kugler (1987), The Earnings Impact of Training Duration in a Developing Country: An Ordered Probit Selection Model of Colombia's Servicio Nacional de Aprendizaje (SENA), *The Journal of Human Resources 22(2)*, 228-247.

[39] La Porta, Rafael, Florencio Lopez-de-Silanes, Andrei Shleifer and Robert W. Vishny (1998), Law and Finance, *Journal of Political Economy 106(6)*, 1113-1155.

[40] Levinsohn, James and Amil Petrin (2003), Estimating Production Functions Using Inputs to Control for Unobservables, *Review of Economic Studies 70(2)*, 317-341.

[41] Melitz, Marc (2003), The Impact of Trade on Intra-Industry Reallocations and Aggregate Industry Productivity, *Econometrica 71(6)* , 1695-1725.

[42] Michelacci, Claudio and Javier Suarez (2004), Business Creation and the Stock Market, *Review of Economic Studies 71(2)*, 459-481.

[43] Rajan, Raghuram G. and Luigi G. Zingales (1998), Financial Dependence and Growth, *American Economic Review 88(3)*, 559-586.

[44] Seo, Myung Hwan and Oliver Linton (2007), A Smoothed Least Squares Estimator for Threshold Regression Models, *Journal of Econometrics 141(2),* 704-735.

[45] Sivadasan, Jagadeesh and Joel Slemrod (2008), Tax Law Changes, Income-Shifting and Measured Wage Inequality: Evidence from India, *Journal of Public Economics 92(10-11)*, 2199-2224.

[46] Terza, Joseph (1987), Estimating Linear Models with Ordinal Qualitative Regressors, *Journal of Econometrics 34(3)*, 275-291.

[47] Wooldridge, Jeffrey (2001), *Econometric Analysis of Cross Section and Panel Data*, MIT Press Books, edition 1.

[48] World Bank (2012), *Doing Business 2012: Doing Business in a More Transparent World*, Washington, DC: World Bank Group.

Figure 1: Entrepreneurial investment.

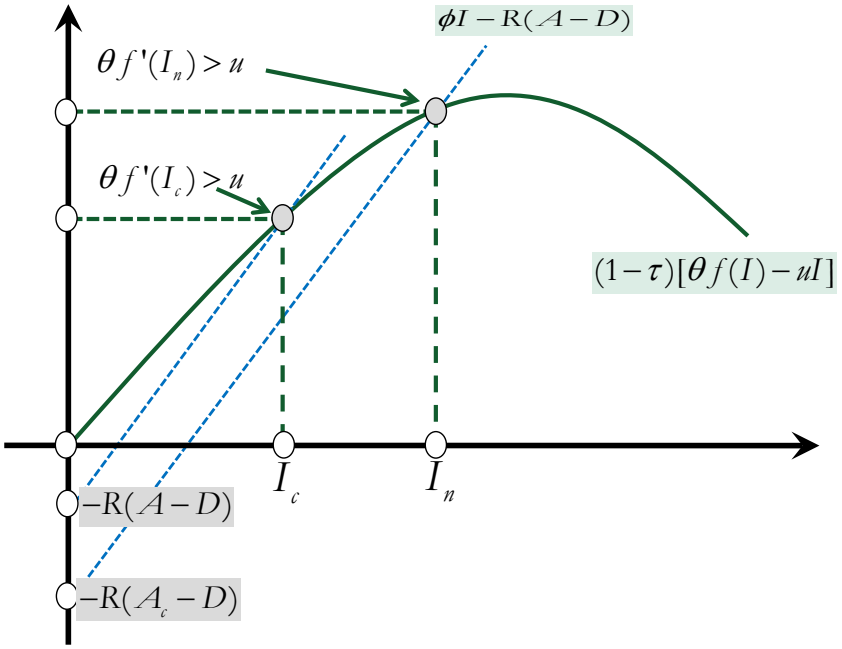

Figure 2: Firm investment in the cross-section.

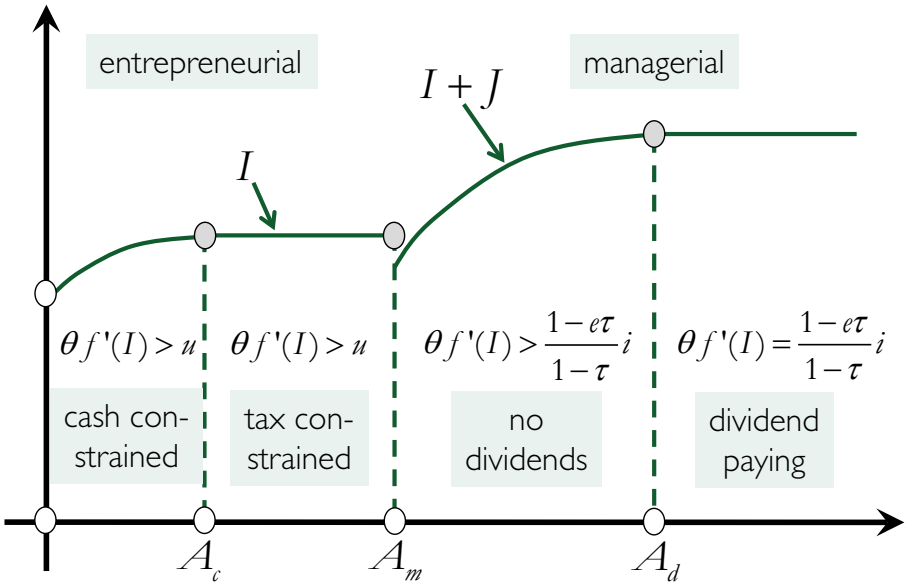

Figure 3: Firm values in the cross-section.

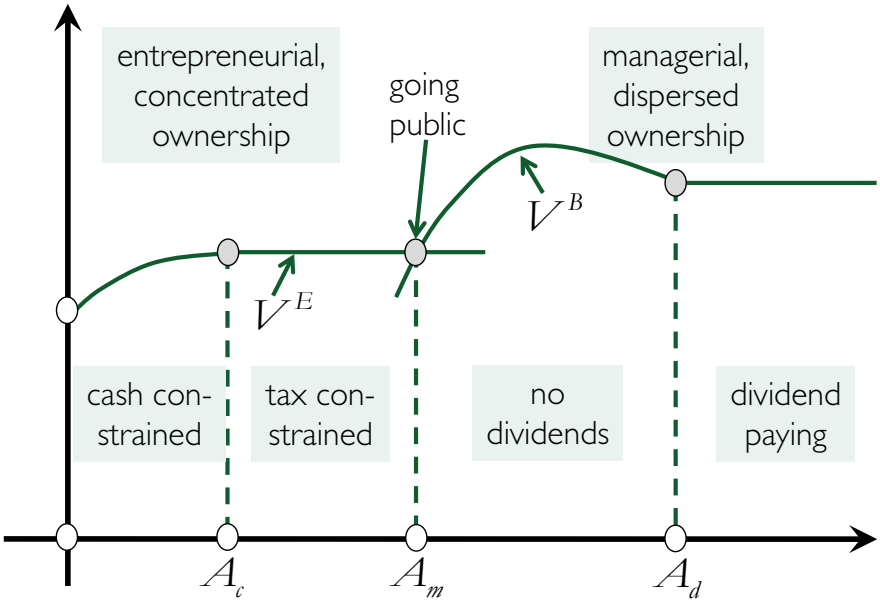

Table 1: Comparative-static effects of drivers of intensive investment

		Entrepreneurial firms		Managerial firms			
		Cash con.	Tax con.	No div.		Div.	
Independent variables		(7)	(8)	I: (18)	I+J	I: (20)	I+J
Tax credit	e	+	+	+	+	+	+
Corp. tax rate *)	τ	–	–	–	+	–	–
Div. tax rate	t_D	–	0	–	0	0	+
Interest entr. firms	r	–	–				
Interest man. firms	i			0	0	–	–
Firm productivity	θ	+	+	+	0	+	+
Own funds	A	+	0	+	+	0	0
Accounting standards	$1/\phi$	+	+				
Investor protection	q			+	0	0	–
Management share	α			+	0	0	–

*) The effects of τ hold at least for small e.

Table 2: Summary statistics of firm-level variables

Variable	**Mean**	**Std. dev.**	**Min.**	**Max.**
Investment	0.229	0.219	0	1
Cash ratio	0.091	0.118	0	1
Corporate tax	0.224	0.069	-0.013	0.355
Interest rate	0.022	0.023	0	0.678
log(Productivity)	7.432	0.688	2.864	13.978
Concentrated ownership	0.633	0.482	0	1
Observations (N)	44863			

Table 3: Summary statistics of country-level variables

Country	**Obs. (N)**	**Income tax**	**Div tax**	**Legal rights**	**Inv. protection**
AUT	203	0.39	0.25	7.00	5.00
BEL	405	0.42	0.05	6.00	7.00
BGR	513	0.09	0.00	9.00	6.00
CHE	15	0.36	0.35	8.00	3.00
CZE	1577	0.15	0.15	6.00	5.00
DEU	4150	0.47	0.05	7.00	5.00
DNK	4	0.59	0.28	9.00	6.30
ESP	7140	0.43	0.00	6.00	5.00
FIN	472	0.40	0.00	8.00	5.70
FRA	3531	0.39	0.05	7.00	5.30
GBR	1585	0.35	0.00	10.00	8.00
GRC	14	0.40	0.17	4.00	4.70
HRV	3	0.45	0.00	7.00	3.30
HUN	82	0.30	0.00	7.00	4.30
IRL	65	0.42	0.00	9.00	8.30
ITA	18149	0.45	0.05	3.00	6.00
LUX	13	0.39	0.15	4.00	4.30
LVA	11	0.19	0.00	10.00	5.70
NLD	11	0.52	0.00	6.00	4.70
POL	785	0.38	0.19	9.00	6.00
ROM	3539	0.13	0.10	9.00	6.00
SRB	533	0.10	0.00	7.00	5.30
SVN	1154	0.35	0.00	4.00	7.30
SWE	897	0.43	0.00	8.00	6.30
TUR	12	0.35	0.00	4.00	5.70
Total	44863	0.39	0.05	5.45	5.76

Table 4: First stage: Probit model for manufacturing firms only

Dependent variable: Concentrated ownership = 1		
Cash ratio	-0.3958***	(0.0543)
Income tax	-0.1167	(0.1639)
Corporate tax	-1.1952***	(0.2125)
Dividend tax	-1.7282***	(0.2997)
Interest rate	-1.1410***	(0.2837)
log(Productivity)	0.0655***	(0.0163)
Legal rights	0.0567***	(0.0073)
Investor protection	-0.0028	(0.0114)
Age	-0.0071***	(0.0006)
Age^2	0.0000***	(0.0000)
log(Employees)	-0.0369***	(0.0082)
log(Total Assets)	0.0613***	(0.0068)
Constant	-0.4115**	(0.1667)
Country controls	yes	
Observations (N)	44863	

Notes: Standard errors in parentheses. ***, ** and * indicate statistical significance at the 1%, 5% and 10% test levels, respectively.

Table 5: Threshold-regression results for manufacturing firms only

	Entrepreneurial firms		Managerial firms	
Investment	Cash-constr.	Tax-constr.	No dividends	Dividends
Variable	Coeff.	Coeff.	Coeff.	Coeff.
Cash ratio	1.6769***	0.1722***	2.2990***	0.2392***
	(0.2249)	(0.0145)	(0.5691)	(0.0175)
Income tax	-0.1714***	-0.1357***	-0.1374	-0.1666***
	(0.0505)	(0.0382)	(0.0933)	(0.0536)
Corporate tax	-0.8818***	-0.8238***	-1.2513***	-0.9349***
	(0.0693)	(0.0556)	(0.1061)	(0.0724)
Dividend tax	-0.4010***	-0.2074***	-0.6069***	-0.2041**
	(0.0855)	(0.0678)	(0.1695)	(0.0955)
Interest rate	-0.5508***	-0.2628***	-0.7062***	-0.2541***
	(0.1077)	(0.0704)	(0.1818)	(0.0927)
log(Productivity)	0.0184***	0.0210***	0.0276***	0.0174***
	(0.0039)	(0.0035)	(0.0063)	(0.0044)
Legal environment	0.0023	0.0009		
	(0.0019)	(0.0017)		
Investor protection			-0.0057	-0.0083**
			(0.0068)	(0.0041)
Constant	0.1965***		0.1513***	
	(0.0339)		(0.0467)	
Mills ratio	-0.0281		0.1042***	
	(0.0244)		(0.0250)	
Country controls	yes	yes	yes	yes
Threshold	0.0300		0.0181	
	[0.0284,0.0402]		[0.0022,0.4894]	
Observations (N)	44863			

Notes: Standard errors in parentheses. ***, ** and * indicate statistical significance at the 1%, 5% and 10% test levels, respectively. Confidence bounds for the threshold at the 10% level in squared brackets.

Table 6: Threshold regression results for all firms

	Entrepreneurial firms		Managerial firms	
Investment	Cash-constr.	Tax-constr.	No dividends	Dividends
Variable	Coeff.	Coeff.	Coeff.	Coeff.
Cash ratio	0.9912***	0.1237***	0.7137***	0.1435***
	(0.0368)	(0.0075)	(0.0352)	(0.0122)
Income tax	-0.1261***	-0.2074***	-0.0467	-0.2393***
	(0.0255)	(0.0271)	(0.0376)	(0.0454)
Corporate tax	-0.5156***	-0.4545***	-0.6466***	-0.3192***
	(0.0264)	(0.0304)	(0.0366)	(0.0468)
Dividend tax	-0.1037**	0.0220	-0.2038***	-0.0815
	(0.0428)	(0.0467)	(0.0715)	(0.0826)
Interest rate	-0.3048***	-0.1403***	-0.4897***	-0.2436***
	(0.0397)	(0.0363)	(0.0631)	(0.0661)
log(Productivity)	0.0131***	0.0217***	0.0202***	0.0277***
	(0.0016)	(0.0019)	(0.0025)	(0.0030)
Legal environment	-0.0013	-0.0020*		
	(0.0010)	(0.0012)		
Investor protection			-0.0053**	-0.0054*
			(0.0027)	(0.0033)
Constant	0.2633***		0.0154	
	(0.0197)		(0.0280)	
Mills ratio	-0.2005***		0.2471***	
	(0.0201)		(0.0128)	
Country controls	yes	yes	yes	yes
Threshold	0.0831		0.1140	
	[0.0000,1.0000]		[0.0000,1.0000]	
Observations (N)	184940			

Notes: Standard errors in parentheses. ***, ** and * indicate statistical significance at the 1%, 5% and 10% test levels, respectively. Confidence bounds for the threshold at the 10% level in squared brackets.

Table 7: Baseline regression with bootstrapped standard errors for manufacturing firms only

	Entrepreneurial firms		Managerial firms	
Investment	Cash-constr.	Tax-constr.	No dividends	Dividends
Variable	Coeff.	Coeff.	Coeff.	Coeff.
Cash ratio	1.6769***	0.1722***	2.2990***	0.2392***
	(0.2850)	(0.0203)	(0.7947)	(0.0549)
Income tax	-0.1714***	-0.1357***	-0.1374	-0.1666*
	(0.0485)	(0.0452)	(0.0883)	(0.0873)
Corporate tax	-0.8818***	-0.8238***	-1.2513***	-0.9349***
	(0.0814)	(0.0656)	(0.1653)	(0.1665)
Dividend tax	-0.4010***	-0.2074***	-0.6069**	-0.2041*
	(0.0664)	(0.0743)	(0.2740)	(0.1171)
Interest rate	-0.5508***	-0.2628***	-0.7062***	-0.2541
	(0.1416)	(0.1015)	(0.2007)	(0.1998)
log(Productivity)	0.0184***	0.0210***	0.0276***	0.0174**
	(0.0044)	(0.0034)	(0.0087)	(0.0071)
Legal environment	0.0023	0.0009		
	(0.0021)	(0.0018)		
Investor protection			-0.0057	-0.0083
			(0.0070)	(0.0082)
Constant	0.1965***		0.1513**	
	(0.0424)		(0.0661)	
Mills ratio	-0.0281		0.1042**	
	(0.0450)		(0.0410)	
Country controls	yes	yes	yes	yes
Threshold	0.0300		0.0181	
	[0.0284,0.0402]		[0.0022,0.4894]	
Observations (N)	44863			

Notes: Jointly bootstrapped standard errors in parentheses (based on 50 bootstrap samples). ***, ** and * indicate statistical significance at the 1%, 5% and 10% test levels, respectively. Confidence bounds for the threshold at the 10% level in squared brackets.

Table 8: Threshold-regression results with three regimes for manufacturing firms only

	Entrepreneurial firms		Managerial firms
Investment	Cash-constr.	Tax-constr.	
Variable	Coeff.	Coeff.	Coeff.
Cash ratio	1.6769***	0.1722***	0.3340***
	(0.2249)	(0.0145)	(0.0167)
Income tax	-0.1714***	-0.1357***	-0.1512***
	(0.0505)	(0.0382)	(0.0470)
Corporate tax	-0.8818***	-0.8238***	-0.9594***
	(0.0693)	(0.0556)	(0.0635)
Dividend tax	-0.4010***	-0.2074***	-0.1598*
	(0.0855)	(0.0678)	(0.0915)
Interest rate	-0.5508***	-0.2628***	-0.3504***
	(0.1077)	(0.0704)	(0.0841)
log(Productivity)	0.0184***	0.0210***	0.0184***
	(0.0039)	(0.0035)	(0.0040)
Legal environment	0.0023	0.0009	
	(0.0019)	(0.0017)	
Investor protection			-0.0091***
			(0.0036)
Constant	0.1965***		0.0917*
	(0.0339)		(0.0479)
Mills ratio	-0.0281		0.1351***
	(0.0244)		(0.0246)
Country controls	yes	yes	yes
Threshold	0.0300		
	[0.0284,0.0402]		
Observations (N)	44863		

Notes: Standard errors in parentheses. ***, ** and * indicate statistical significance at the 1%, 5% and 10% test levels, respectively. Confidence bounds for the threshold at the 10% level in squared brackets.

Table 9: Threshold-regression results for ownership cutoff of managerial manufacturing firms at 25%

	Entrepreneurial firms		Managerial firms	
Investment	Cash-constr.	Tax-constr.	No dividends	Dividends
Variable	Coeff.	Coeff.	Coeff.	Coeff.
Cash ratio	1.6481***	0.2159***	0.3611***	-0.0165
	(0.1826)	(0.0194)	(0.0505)	(0.4391)
Income tax	-0.2087***	-0.2054***	-0.3302**	-4.2828***
	(0.0667)	(0.0584)	(0.1371)	(3.7638)
Corporate tax	-0.6325***	-0.5734***	-0.7625***	-4.4102***
	(0.0913)	(0.0820)	(0.1976)	(1.4060)
Dividend tax	-0.1425	0.0501	-0.1352	0.3908
	(0.1116)	(0.1036)	(0.2134)	(2.3375)
Interest rate	-0.6044***	-0.2505**	-0.6479**	-17.0780***
	(0.1221)	(0.1005)	(0.2603)	(3.5165)
log(Productivity)	0.0464***	0.0471***	0.0503***	0.0711
	(0.0054)	(0.0052)	(0.0125)	(0.0612)
Legal environment	0.0020	0.0008		
	(0.0026)	(0.0024)		
Investor protection			-0.0119	-0.2584
			(0.0091)	(0.2489)
Constant	0.0011		-0.3576**	
	(0.0504)		(0.1773)	
Mills ratio	-0.8760***		0.1971***	
	(0.0689)		(0.0374)	
Country controls	yes	yes	yes	yes
Threshold	0.0300		0.4994	
	[0.0240,0.0416]		[0.4345,0.5356]	
Observations (N)	46268			

Notes: Standard errors in parentheses. ***, ** and * indicate statistical significance at the 1%, 5% and 10% test levels, respectively. Confidence bounds for the threshold at the 10% level in squared brackets.

Table 10: Threshold-regression results with country-level instead of firm-level corporate tax rates for manufacturing firms only

	Entrepreneurial firms		Managerial firms	
Investment	Cash-constr.	Tax-constr.	No Dividends	Dividends
Variable	Coeff.	Coeff.	Coeff.	Coeff.
Cash ratio	1.7295***	0.1787***	2.4285***	0.2609***
	(0.2262)	(0.0146)	(0.3517)	(0.0204)
Income tax	-0.0596	-0.0412	0.0998	-0.0709
	(0.0510)	(0.0381)	(0.0854)	(0.0593)
Corporate tax	-0.4747***	-0.3268***	-1.2462***	-0.1325
	(0.1147)	(0.0872)	(0.3004)	(0.2259)
Dividend tax	-0.3566***	-0.1322*	-0.0943	-0.0586
	(0.0872)	(0.0699)	(0.1590)	(0.1242)
Interest rate	-0.4850***	-0.2454***	-0.4645***	-0.1742*
	(0.1082)	(0.0709)	(0.1626)	(0.1052)
log(Productivity)	0.0133***	0.0150***	0.0186***	0.0033
	(0.0040)	(0.0035)	(0.0062)	(0.0050)
Legal environment	0.0027	0.0000		
	(0.0020)	(0.0018)		
Investor protection			-0.0361***	-0.0092
			(0.0081)	(0.0065)
Constant	0.1911***		0.1085	
	(0.0380)		(0.0780)	
Mills ratio	-0.0327		0.1529***	
	(0.0247)		(0.0277)	
Country controls	yes	yes	yes	yes
Threshold	0.0300		0.0268	
	[0.0295,0.0300]		[0.0079,0.1144]	
Observations (N)	44960			

Notes: Standard errors in parentheses. ***, ** and * indicate statistical significance at the 1%, 5% and 10% test levels, respectively. Confidence bounds for the threshold at the 10% level in squared brackets.