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Abstract

This paper introduces a stylized theoretical framework to identify five different firm types depending on their financial situation and their ownership structure. Based on these firm types, the model explains the heterogeneous tax sensitivity of firm-level investments. Guided by the theoretical model, we empirically identify these partly latent firm types using a threshold estimation approach. The empirical analysis uses a large firm database for 17 countries allowing for a quantification of the regime-specific investment responses to taxation. We find important differences in the tax sensitivity of investment across firm-types for dividend as well as for corporate taxation. The impact of corporate taxation is up to 70% higher for entrepreneurial firms than for managerial firms. In contrast, dividend taxation has a comparable negative effect for cash-constrained managerial firms and entrepreneurial firms but no significant impact on their unconstrained counterparts.

JEL Classification: D22, G32, H25, L21

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1 Introduction

Recent decades have seen a dramatic increase in empirical studies based on micro-level data of individual producers (Bartelsman and Doms, 2000; Bernard et al., 2003). A salient feature of firm distributions documented by these studies is their heterogeneity along several dimensions. Owing to these empirical facts, economic modeling has increasingly incorporated firm-level heterogeneity, predominantly focusing on differences in firm-level productivity (Melitz, 2003; Chaney 2008; Restuccia and Rogerson, 2008; Gourio and Miao, 2010; Davies and Eckel, 2010). However, beyond differences in productivity, these micro-level data reveal that firms differ also in many other dimensions, such as their age, asset and ownership structure, their governance, to name only a few. Some of these characteristics are typically related to the stage within a firm's life cycle. Young innovative firms tend to be entrepreneur-centered with concentrated ownership, might have large growth potential but little own assets and are, thus, more likely to be subject to credit constraints. Medium sized companies with still relatively concentrated ownership might have more own funds and larger earnings which reduces financing problems. Large firms, in contrast, are typically run by a professional manager and have better access to external credit but might be subject to manager-shareholder conflicts. It should not come as a surprise that firms being subject to such heterogeneous environments, react differently to their institutional environment. Understanding these heterogeneous responses and assessing their effects is invaluable for designing effective policies.

In this paper, we focus on the heterogeneous investment responses to taxes on firm profits (corporate taxes) and taxes levied on profit distributions to the owners (dividend taxes). To this end, we develop a theoretical model of firm-level investment that allows for heterogeneous firms in various dimensions. Specifically, we characterize five different

firm types that vary in their asset and ownership structure as well as their differential access to finance and model their heterogeneous investment behavior with respect to the aforementioned tax changes. The theoretical model provides guidelines for an empirical analysis that is aimed at identifying these different firm types and estimating their heterogeneous tax sensitivities. The empirical exercise serves not only as a qualitative test of the theoretical model but also allows for an empirical quantification of these elasticities across firm types. We find important differences in the tax sensitivity of investment across firm types for dividend as well as for corporate taxation. Specifically, the effect of corporate taxation is up to 70% higher for entrepreneurial firms than for managerial firms. In contrast, dividend taxation has a comparable negative effect for cash-constrained managerial and entrepreneurial firms but no significant impact on their cash-unconstrained counterparts.

Former 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. The review by Hassett and Hubbard (2002) reports estimates of the user-cost-elasticity of investment ranging from -0.5 to -1.0. Auerbach and Hassett (2003) document that 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 (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).

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

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 to 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 considers a manager-shareholder conflict in large firms with dispersed ownership and investigates the implications of taxes and other determinants for investment and dividend payout behavior. 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.

Apart from the aforementioned work, our empirical analysis is related to two recent investigations of heterogeneous investment behavior by Zwick and Mahon (2017) and Yagan (2015). Zwick and Mahon investigate the effects of bonus depreciation in the U.S. and find that small firms respond much stronger than big firms. Firms respond strongly to policies that generate immediate rather than delayed cash-flow. They argue that their results support models with financial frictions but their empirical analysis is not tightly linked to a unified theoretical framework encompassing different regimes. Yagan (2015) investigates the response of C- versus S-corporations in the U.S. to the 2003 dividend-

tax cut where C-corporations are subject to dividend taxation and S-corporations are not. He finds no effect of the dividend-tax cut on C-corporations relative to unaffected S-corporations. His analysis, however, does not separately estimate the effects of financially constrained and unconstrained firms.

We contribute to this literature by outlining a unified theoretical framework featuring small entrepreneur-centered firms and large managerial firms with dispersed ownership and manager-shareholder tension. Within each class, we distinguish cash-constrained firms, which pay only minimal dividends and are left with unrealized investments, from cash-rich firms which pay large dividends and are able to exploit the tax bias towards debt. The novel feature is that the model gives rise to endogenously determined threshold levels of own assets that separate five types of firms operating in different financial regimes. The transmission channel for taxes is entirely different between these groups. Depending on their level of own assets and ownership structure, firms respond in different ways to corporate and dividend taxes which leads to a heterogeneity of tax elasticities. The analysis of managerial firms follows the work of Chetty and Saez (2010) with two important extensions. We connect managerial and entrepreneurial firms by a going-public decision, and we extend their model of managerial firms by allowing for external debt-financing on top of retained earnings.

Based on the predictions of the theoretical model, the paper sheds light on the heterogeneity of investment responses to corporate and dividend taxation empirically. We make use of accounting information from a large panel-data set on individual firms. The data set provides information on profits, sales, financial assets and ownership structure of 35,092 firms for the years 2004-2012 in a set of 17 European countries. In order to obtain firm-type-specific tax elasticities of investment, we propose an econometric strategy

that involves estimating unobservable thresholds within an observable (entrepreneurial- vs. managerial-firm) regime by using Hansen's (1999, 2000) sample-splitting approach for panel data. Overall, the estimation results are well aligned with the theoretical model and allow for a quantification of the heterogeneous investment responses to taxation: The empirical results point to a statistically significant and economically large effect of corporate taxation that varies between a 0.49 and 0.84 percentage point decrease in investment following a one percentage point increase in corporate taxation. The effect of dividend taxation amounts to a 0.11-0.17 percentage-point decline in investment after a one-percentage-point increase in dividend taxes for constrained entrepreneurial and managerial firms with no significant effect being established for unconstrained firms.

The paper is organized as follows. Section 2 sets out a theoretical model to explain heterogeneous tax sensitivities of investment to dividend and corporate taxes. Section 3 describes the data set and introduces econometric methodology. Section 4 presents empirical findings and Section 5 reports robustness checks. Finally, Section 6 concludes.

2 The Model

We aim at modeling firm-level investment decisions for different types of firms, all being subject to corporate and dividend taxation. To do so, we consider entrepreneurial firms and managerial ones, with both types of firms being subject to a different agency problem.

Small entrepreneurial firms are run by managing owners and have no independent board that protects shareholder interests. As a consequence, these firms are rather dependent on bank credit and may be financially constrained. For a firm to be large, the entrepreneur has to rely on external equity financing through 'going public' and raising

funds on the stock market or selling out a substantial share to other investors. Such firms are typically run by professional managers, and we refer to them as managerial firms. A manager-shareholder conflict could potentially lead to inefficient investment at the expense of shareholders in managerial firms.

To obtain a well-determined cross section of firms, we assume that entrepreneurial firms face a higher discount rate, $r > i$, than (investor-owned) managerial ones, i (see Michelacci and Suarez, 2004). This is motivated by the fact that the illiquidity and risk of a concentrated share in an entrepreneurial firm must be compensated with a premium, while investors in large firms are better diversified. Managerial firms are thus more valuable, which compensates for the extra cost of setting up a board and hiring a manager. This trade-off is the reason why smaller firms with limited own assets remain entrepreneurial and larger ones choose a managerial structure with more diversified ownership.

2.1 Entrepreneurial Firms

We introduce a simple, two-period model ($t = 0, 1$) of a manager-owned entrepreneurial firm that starts out with internal funds A and faces investment possibilities that generate net earnings of $\theta f(I)$. The latter are increasing in productivity θ, and they obey $f' > 0 > f''$. To finance investment I, firms can use internal funds A and external debt B with the latter potentially being constrained. Funds that are not invested are paid out as dividends D_0 in period 0,

$$D_0 = A + B - I. \tag{1}$$

Note that I measures the value of total assets. Accordingly, gross earnings from investment amount to $\theta f(I)+I$. Invested funds create opportunity costs of $(1+r)A$ in the case of internal funds and borrowing costs for external funds of $(1+r)B$. Furthermore, firm profits are taxed at a corporate tax rate of τ with the cost of borrowing being deductible, giving a tax base of $T \equiv \theta f(I) - rB$.[2] Dividends in period 1 are

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

Entrepreneurs maximize firm value $V^E = (1+r)(1-t)\,D_0 + (1-t)\,D_1$, measured at the end of period 1. Taking into account the dividend tax at a rate of t gives the problem

$$V^E = \max_{I,D} \;\; (1-t)\left[(1-\tau)\left(\theta f(I) - rI\right) - \tau r\left(A - D_0\right)\right]. \tag{3}$$

We follow Ellul et al. (2010, 2015) for a simple way of modeling credit constraints. Investment and financing (I, B and D_0) is decided in period 0. Suppose insiders can divert some earnings which outside investors are unable to claim. Depending on the legal environment (investor protection, antidirector rights, etc.), diverting funds is limited to $[0, \phi]$. For simplicity, we assume diverted earnings to be proportional to total assets I. Then, if investment diversion is costless, insiders divert either a maximum ϕI or nothing.

Without diversion, profits in period 1 amount to $\pi_1 \equiv \theta f + I - \tau T - (1+r)\,B$. The incentive to divert emerges when debt is too high, $\phi I > \pi_1$. Instead of repaying debt, the entrepreneur is better off in diverting ϕI, reporting negative earnings and declaring bankruptcy. Limited liability leaves her with zero profit, but she keeps diverted income. Since reported earnings are negative, banks could recover only part of their

[2] A tax deduction of a share e of investment would reduce the private cost to $(1-e\tau)\,I$. Tax effects would be less damaging but qualitatively the same.

claims, $\theta f + I - \tau T - \phi I < (1+r) B$. To avoid this, they stop lending as soon as the no-diversion constraint becomes binding, $\pi_1 = (1-\tau)\theta f(I) + I - (1+(1-\tau) r) B \geq \phi I$.

A constrained firm is forced to cut dividends in period 0 and rely more on retained earnings to replace external funds, $B = I - (A - D_0)$. Assuming that the entrepreneur needs at least an amount $\bar{D}$ of current, after-tax dividends for private needs, leaves the financing constraint to be

$$(1-\tau)(\theta f(I) - rI) \geq \phi I - R(A - D_0), \quad (1-t) D_0 \geq \bar{D}, \quad R \equiv 1 + (1-\tau) r. \tag{4}$$

In the absence of a financing constraint ($\phi = 0$), value maximization results in a first-best, unconstrained level of investment I^*, obeying

$$\theta f'(I^*) = r. \tag{5}$$

Since the marginal source of finance is debt, the tax has no effect on the user cost since interest is fully tax-deductible. If the firm pays more dividends, it must raise more external debt, leading to a larger repayment. Raising dividends today thus reduces dividends tomorrow. Without tax, the net effect on firm value is zero. With taxes, debt repayment is subsidized since interest is tax-deductible while the opportunity cost of equity is not. The firm saves tax by shifting from retained earnings to external debt, $I^* = (A - D_0) + B$. As a consequence, the firm raises dividends as much as possible by incurring more debt until it hits the corner solution where retained earnings are exhausted. Profits are paid out, $D_0 \leq A$, and investment is fully debt-financed, $B \leq I^*$.

Assumption 1 *With unconstrained investment, $\theta f'(I^*) = r$, the financing constraint*

is violated when retained earnings are zero, $(1-\tau)(\theta f(I^*) - rI^*) < \phi I^*$.

This assumption excludes the first-best solution and makes the financing constraint bind in a way which depends on the state (regime) entrepreneurial firms are in. Appendix A provides a formal solution to maximizing (3) subject to (4). Specifically, entrepreneurial firms may be in two alternative regimes.

(i) Cash-constrained Firms Cash-poor firms face a tight financing constraint which binds even if they pledge the maximum retained earnings by cutting dividends to a minimum. Investment is implicitly fixed by (4) with dividends in period 0 being reduced to $D_0 = \bar{D}/(1-t)$. Investment in the cash-constrained state, I_c, depends on own funds and other determinants of pledgeable earnings such as the quality of the legal environment (measured by ϕ), tax liability and minimum dividend requirements,[3]

$$dI_c = -\frac{D_0}{1-t}\frac{R}{k}\cdot dt - \frac{T}{k}\cdot d\tau + \frac{R}{k}\cdot dA - \frac{I}{k}\cdot d\phi + \frac{(1-\tau)f}{k}\cdot d\theta - \frac{(1-\tau)B}{k}\cdot dr, \quad (6)$$

where $k \equiv \phi - (1-\tau)(\theta f' - r) > 0$ and $D_0 = \bar{D}/(1-t)$.

Figure 1 illustrates how the financing constraint determines investment. It plots the left- and right-hand side of (4). At the intersection point, the slopes of the two lines reflect $k > 0$. Investment rises with more own funds $A - D_0$ and declines with a higher cost of capital, with a deteriorating institutional quality (higher ϕ), and with a higher dividend tax (t). Cash-poor firms with little own funds are heavily constrained and cut dividends to preserve retained earnings for self-financing. A higher dividend tax thus requires larger gross dividends, which drains retained earnings $A - D_0$ and reduces investment. Being

[3] Write $[\theta f - rI + r(A - D_0)]\cdot d\tau = T\cdot d\tau$ by using the definition of the tax base and $B = I - A + D_0$.

cash-constrained, firms are left with unrealized investments and earn an excess return ($\theta f'(I) > r$ at the intersection point of Figure 1).

Insert Figure 1 here

(ii) Tax-constrained Firms If an entrepreneurial firm is endowed with higher own funds, it starts paying larger dividends in period 0. It could invest at the unrestricted level, pay dividends and raise external debt such that the financing constraint (4) 'just binds'. At that point, pushing for higher dividends in period 0 would reduce retained earnings even further and restrict investment. Given the tax bias for debt, this strategy adds value since a small cut in investment at $I = I^*$ does not affect firm value while a small increase in debt-financed dividends is strictly value-increasing due to tax savings. Investment is thus cut below the unconstrained level and still earns an excess return, see the discussion of (A.2) in the Appendix and the illustration in Figure 1,

$$\theta f'(I_n) - r = \frac{\tau}{1-\tau}\frac{r\phi}{1+r} > 0. \tag{7}$$

We call this regime 'tax-constrained' in contrast to 'cash-constrained', since the financing constraint binds for tax reasons only. The firm would be unconstrained in the absence of tax. Investment of a tax-constrained entrepreneurial firm, I_n changes according to

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

A constant dividend-tax rate has no impact in this case since it does not affect the firm's choice between present and future dividends. A higher corporate tax rate reduces investment. It makes firms pay out more dividends today to exploit the larger tax advantage of debt, accepting a somewhat smaller level of investment due to diminishing internal funds. A worse institutional environment (higher ϕ) and a negative productivity shock (lower θ) both reduce pledgeable income, make banks more restrictive in lending, and thereby reduce investment. Obviously, a higher cost of capital r reduces the amount of credit that can be repaid out of a given pledgeable income and restricts investment. Figure 2 illustrates how investment rises with more own funds A when the firm is cash-constrained while the effect disappears in the tax-constrained regime.

Insert Figure 2 here

Firm Value: Given little own funds, the *financing constraint binds* even if dividends are cut to the minimum in order to strengthen retained earnings, yielding $D_0 = \bar{D}/(1-t)$ and implying a debt of $B = I + D_0 - A$. Firms with larger own funds A invest more. Noting (3), firm value rises with own funds, at least for small taxes ($\tau \to 0$),

$$\frac{dV_c^E}{dA} = (1-t)\left[(1-\tau)(\theta f' - r)\frac{dI}{dA} - \tau r\right], \quad \frac{dV_n^E}{dA} = 0. \tag{9}$$

When own funds are larger, the firm switches to the *tax-constrained* regime. Investment I_n is fixed in (7) and independent of A. Given the tax bias for debt, the firm wants to raise more debt and pay dividends. Given I_n, the financing constraint yields the minimum level of retained earnings, $R(A - D_0) = \phi I_n - (1-\tau)(\theta f(I_n) - rI_n)$, and thereby the maximum feasible level of debt, $B = I_n - (A - D_0)$. Hence, both investment and debt,

I_n and B, are independent of A so that dividends in period 0, $D_0 = A + B - I_n$, rise one for one with own funds, while dividends in period 1 decline in proportion to $1 + r$. The net discounted effect is zero. The firm's surplus is not affected by larger own funds.

Clearly, *cash-constrained* firms with more own funds can finance more investment which adds 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; see Figures 2 and 3. There is a cutoff value A_c such that firms with $A < A_c$ are cash-constrained and pay minimum dividends $\bar{D}$ while richer firms with $A > A_c$ are tax-constrained and pay more generous dividends.[4]

Insert Figure 3 here

2.2 Managerial Firms

In large firms (high A), entrepreneurs divest and sell out to external investors who require a lower return on their diversified portfolio, $i < r$. Shareholders must hire a manager (possibly the founding entrepreneur) and set up a board to exercise oversight and control. As in Chetty and Saez (2010), a manager-shareholder conflict arises. We extend their framework by additionally allowing for external debt financing.

Instead of productively investing, managers can divert funds J to finance projects yielding private benefits $g(J)$ rather than adding to the firm's earnings. In paying dividends, managers cut retained earnings $A - D_0$ and must raise more external debt B.

[4]To separate cash- and tax-constrained firms analytically, set I_n as in (7) and $D_0 = \bar{D}/(1-t)$ to obtain the threshold A_c from (4).

Then, dividends paid out in period 0 are

$$D_0 = B + A - I - J. \tag{10}$$

In period 1, debt is to be repaid with interest i and own funds must earn at least the opportunity cost $(1+i)\,A$. Given the tax base $T \equiv \theta f(I) - iB$, dividends are

$$D_1 = (1-\tau)\,\theta f(I) + I + J - (1 + (1-\tau)\,i)\,B - (1+i)\,A. \tag{11}$$

Managers choose investments I and J, set dividends D, and raise external debt B. The value of the firm in period 1 is $V^M = (1-t)\,[(1+i)\,D_0 + D_1]$, yielding

$$V^M = (1-t)\,[(1-\tau)\,(\theta f(I) - i\,(I+J)) - \tau i\,(A - D_0)]\,. \tag{12}$$

The manager's choices are restricted by two constraints in period 0, $(1-t)\,D_0 \geq \bar{D}$ and $J \geq 0$, which might lead to corner solutions. Furthermore, regarding access to external credit, managers face a debt-capacity constraint in period 1 through

$$(1-\tau)\,\theta f(I) + I + J - \phi I \geq (1 + (1-\tau)\,i)\,B, \quad B = I + J - (A - D_0)\,. \tag{13}$$

As before, banks are willing to lend only if pledgeable earnings exceed the required repayment. Yet, external lenders cannot fully access earnings if owners and managers are able to hide a part ϕI of earnings.

Unproductive investments J yield private benefits of $g(J)$ for the manager only. These private benefits are reduced by tighter monitoring and higher institutional quality relating

to antidirector rights, voting rights and reporting requirements for shareholder protection which are summarized in the parameter γ. Hence, net private benefits amount to $\gamma g(J)$. To align shareholder and manager interests, managers receive a share α of the firm value, possibly against a lump-sum payment of B^M. Firm value is split between shareholders (board, $V^{M,B}$) and managers ($V^{M,M}$),

$$V^{M,M} = \alpha \cdot V^M + \gamma g(J) - B^M, \quad V^{M,B} = (1-\alpha) \cdot V^M + B^M. \tag{14}$$

Owners cannot extract rents when managers are wealth-constrained, $B^M = 0$. In this case, rents of managers consist of income plus private benefits, $V^{M,M} = \alpha V^M + \gamma g(J)$. Given a contract α, the manager maximizes her rent by setting investment, unproductive spending and dividends subject to the financing constraint in (13),

$$\begin{aligned} V^{M,M} = \max_{I,J,D_0} \quad & \alpha \cdot (1-t)\left[(1-\tau)(\theta f(I) - i(I+J)) - \tau i(A-D_0)\right] + \gamma g(J) \\ + \quad & \lambda \cdot \left[(1-\tau)(\theta f(I) - i(I+J)) + (1+(1-\tau)i)(A-D_0) - \phi I\right]. \end{aligned} \tag{15}$$

Given internal funds A, external debt must cover total investment minus retained earnings, $B = I + J - (A - D_0)$. Optimality requires

$$\begin{aligned} (a) \quad &: \quad \frac{dV^{M,M}}{dI} = \left[(1-t)\alpha + \lambda\right](1-\tau)(\theta f'(I) - i) - \lambda\phi = 0, \\ (b) \quad &: \quad \frac{dV^{M,M}}{dJ} = \gamma g'(J) - \left[(1-t)\alpha + \lambda\right](1-\tau) i \leq 0, \quad J \geq 0, \\ (c) \quad &: \quad \frac{dV^{M,M}}{dD_0} = (1-t)\alpha\tau i - (1+(1-\tau)i)\lambda \leq 0, \quad (1-t)D_0 \geq \bar{D}. \end{aligned} \tag{16}$$

The first-best solution is obtained if (i) $\phi \to 0$ and own funds A are large, such that the external-debt constraint is slack ($\lambda = 0$), and (ii) unproductive spending yields no private

benefits, $\gamma \to 0$, such that $J = 0$. In this case, the firm invests at the unconstrained level, $\theta f'(I^*) = i$. It also raises dividend payouts (by replacing retained earnings with debt), $\frac{dV^M}{dD_0} = (1-t)\,\alpha\tau i > 0$, until it hits the corner solution at $B \leq I^*$ and $D_0 \leq A$. With all frictions in place, however, we must distinguish three regimes.

(i) Tax-constrained, Cash-rich Firms When firms are cash-rich, they pay dividends. Firms raise dividends and accordingly take on more debt until they hit the financing constraint. The shadow price is determined by (16.c), which holds with equality when the dividend constraint is slack. Substituting into (16.a) and (16.b) yields the levels of productive (I) and unproductive (J) investment, respectively, from

$$\frac{(1-t)\,\alpha\tau i}{1+(1-\tau)\,i} = \lambda, \quad \theta f'(I) - i = \frac{\tau}{1-\tau}\frac{i\phi}{1+i}, \quad \gamma g'(J) = \frac{(1+i)\,(1-t)\,(1-\tau)\,i\alpha}{1+(1-\tau)\,i}. \tag{17}$$

If private benefits are valuable, the manager diverts some resources. Knowing investments, the level of dividends in period 0 follows from the financing constraint which requires a minimum of own funds of $A - D_0$. External debt follows from the financial identity $B = I + J - (A - D_0)$.

Appendix B shows analytically how tax and institutional reform affect the composition and volume of investment. By (17), the manager compares the value of the tax shield with the excess return earned on constrained investment. When the corporate tax rate rises, the debt bias becomes stronger. The manager raises more debt and pays higher dividends in period 0, thereby accepting a drop in investment, until the higher excess return matches the value of the tax shield. A higher interest rate works similarly. A higher factor productivity boosts the return and raises productive investment. A deteriorating institutional environment (higher ϕ) tightens the financing constraint and squeezes

investment. Because the manager can adjust dividends, there is no interaction between productive and unproductive investment.

Clearly, better managerial control and oversight (lower γ) reduce inefficient investment. The same holds for stronger monetary incentives in terms of a higher managerial profit share α. A higher interest rate raises the opportunity costs of inefficient projects and thereby reduces self-serving investment. Dividend and corporate taxes only tax the return on productive investment whereas private benefits go untaxed. Taxes thus lead to more inefficient investment spending.

Only the corporate tax rate and the interest rate affect spending for both purposes, investment and private benefits. A higher interest rate discourages both and, thus, unambiguously reduces total investment volume $(I + J)$. A higher corporate tax rate leads to offsetting investment responses. In Appendix B, we argue that inefficient investment is unlikely to be that large that its response could dominate the adjustment of total investment. A higher corporate tax rate thus reduces not only productive investment spending but most likely also total investment $(I + J)$.

(ii) Weakly Finance-constrained Firms For firms with smaller own funds A, the finance constraint tightens relative to cash-rich firms. The shadow price eventually rises to the extent that condition (16.c) becomes an inequality. Dividends in period 0 are set to the lowest possible value $D_0 = \bar{D}/(1-t)$, since paying out more than the minimum dividend is unambiguously value reducing. As a constrained firm earns an excess return $\theta f'(I) > i$, see (16.a), retained earnings are more profitable than funds being paid out and reinvested in the capital market. With λ being moderately large, the manager still channels funds $J > 0$ to investments with private benefits, see (16.b). The tighter the

financing constraint is, and the larger its shadow price is, the lower is unproductive spending. This regime is characterized by three equations (binding debt constraint and conditions 16.a-b) which solve for the three unknowns, λ, I and J.

As dividends are fixed at the minimum, retained earnings $A - D_0$ cannot adjust. The interaction of productive and unproductive investment is more involved in this scenario and illustrated in Figure 4. When managers use up internal funds for projects serving private benefits, they cut self-financing of productive investment. As a consequence, the financing constraint tightens and investment I declines. The financing constraint thus gives a negatively-sloped relationship $I(J)$. Given J, other parameters shift the financing constraint towards higher or lower investment I. Paying a higher corporate tax rate, for example, diminishes pleadgeable earnings which tightens the financing constraint and reduces productive investment. Given J, the tax increase shifts down the productive investment schedule. Equation (B.4) in the Appendix outlines all partial effects on investment analytically.

Conditions (16.a-b) establish a positive relationship between unproductive spending J and productive investment I in $J(I)$. More productive investment I reduces the excess return $\theta f'(I) - i$. This can happen only if the financing constraint becomes less tight which diminishes the shadow price. A lower shadow price reduces the opportunity cost and thereby favors unproductive spending J. Equation (B.6) in the Appendix shows how the positively-sloped schedule $J(I)$ is affected by different parameters of the model. For instance, a higher corporate tax rate shifts the private-benefits schedule $J(I)$ to the right. Hence, for a given level of productive investment, an increase in the corporate tax rate discriminates against productive investment and thereby shifts spending towards unproductive uses. More unproductive spending absorbs scarce funds, which magnifies the

decline in productive investment. Figure 4 illustrates how an increase in the corporate tax rate causes a large reduction of productive investment spending but might or might not lead to an increase in unproductive projects. Whatever the qualitative effect on unproductive investment, it is likely to be relatively small due to offsetting forces. Therefore, an increase in corporate taxes almost surely reduces total investment, especially if the share of unproductive spending in total investment is not too large.

Insert Figure 4 here

With a larger dividend tax, shareholders ask for a rise in gross dividends in period 0, D_0, to compensate the tax which drains the company of valuable funds and causes productive investment to fall. On the other hand, the dividend tax reduces the opportunity cost of pet projects and thereby shifts spending towards unproductive uses. The net effect leads to a reduction in total investment spending. Better managerial incentives (a higher profit share α for managers and a tighter institutional environment with lower γ) shift spending from unproductive to productive uses but may increase or reduce total spending. Better creditor protection (lower ϕ) boosts total investment (see Appendix B.9 for analytical results).

(iii) Strongly Finance-constrained Firms When the firm is endowed with very little own funds, the shadow price λ is so large that $\gamma g'(0) < [(1-t)\alpha + \lambda](1-\tau)i$. As external debt is very scarce and productive investment I earns a high excess return, the opportunity cost of unproductive spending is high. The manager cuts dividends to the minimum (see 16.c) and entirely gives up private benefits to strengthen the firm's debt capacity. With minimum dividends and no unproductive projects whatsoever, the

financing constraint implicitly determines productive investment spending I by

$$(1-\tau)(\theta f(I)-iI)+(1+(1-\tau)i)\left(A-\bar{D}/(1-t)\right)=\phi I. \tag{18}$$

Given I, condition (16.a) fixes the shadow price λ, which is high when investment is very constrained and the excess return is very high. Equation (B.10) in the Appendix shows that partial effects on investment decisions are identical to those of cash-constrained entrepreneurial firms as discussed around equation (6).

Firm Value: An entrepreneur benefits from selling out to diversified shareholders if the firm is more valuable with a managerial organization than without it. Shareholders must cede a share α to managers, leading to a trade-off governing organizational choice, $V^E \gtrless V^{M,B}=(1-\alpha)V^M$. For both types to exist, one must have $V^E<V^{M,B}$ at least for high levels of wealth, which is supported by $i<r$.[5] A well determined cut-off A_m exists, establishing $V^E=V^{M,B}$ as in Figure 4, if the value V^M in the managerial mode rises in own funds, starting from very low levels, and eventually approaches a constant value larger than the maximum value under entrepreneurial ownership. Taking the differential of (12) gives

$$\frac{1}{1-t}\frac{dV^M}{dA}=(1-\tau)\left[(\theta f'-i)\frac{dI}{dA}-i\frac{dJ}{dA}\right]-\tau i\frac{d(A-D_0)}{dA}. \tag{19}$$

[5]In a 'first-best', shareholders could sell a share α to a manager at a price that extracts managerial rents, $B^M=\alpha V^M+\gamma g(J)$, giving a value $V^{M,B}=V^M+\gamma g(J)$. If in addition $\gamma\to 0$, manager and shareholder interests become congruent. Maximizing αV^M yields the same result as maximizing V^M. Managers do not value private benefits and prefer dividends, leading to $J=0$. Shareholders get the entire surplus, $V^{M,B}=V^M=(1-t)[(1-\tau)\theta f(I)-iI]-\tau i(A-D_0)$ as in (12) with $J=0$ and investment I given by $\theta f(I^*)=i$ as noted after equation (16). Comparing $V^{M,B}=V^M$ with V^E in (3) shows that a firm with any given level of assets A – in the absence of any tax or market distortions – has always greater value with shareholders rather than with entrepreneurial ownership since $i<r$ implies $V^E<V^M$.

The extent to which firm value depends on own funds, varies across regimes. Using the results of Appendix B, with specific coefficients $\{\varepsilon_I^i, \eta_J^i, m^i, \nabla\}$ relating to regime i, all defined positive, yields

$$\begin{aligned}
\text{cash rich} \quad &: \quad \frac{dV^M}{dA} = 0, \\
\text{medium cash} \quad &: \quad \frac{dV^M}{dA} = (1-t)\left[(1-\tau)\left[(\theta f' - i) - i\varepsilon_I^2\right]\frac{\eta_A^2}{\nabla} - \tau i\right] \gtrless 0, \qquad (20) \\
\text{cash poor} \quad &: \quad \frac{dV^M}{dA} = (1-t)\left[(1-\tau)(\theta f' - i)\,\eta_A^3 - \tau i\right] > 0.
\end{aligned}$$

In the tax-constrained regime of cash-rich firms, I and J are independent of A, see (17). The financing constraint (15) yields feasible dividends in excess of the minimum. Dividends rise one for one with higher internal funds A so that retained earnings $A - D_0$ remain constant. The financial identity $B = I + J - (A - D_0)$ yields a fixed amount of debt. Hence, firm value is independent of own funds for cash-rich firms, $dV^M/dA = 0$.

Firms with less own resources end up moderately finance-constrained. Given an excess return on investment within the firm, it is optimal to reduce dividends to a fixed minimum $D_0 = \bar{D}/(1-t)$. The manager still invests $J > 0$ for private benefits instead of adding shareholder value. Substituting (B.7)-(B.8) in (19) yields (20). The more constrained a firm is, the higher is the excess return, and the more likely firm value rises with own funds, at least for small tax rates.

Cash-poor firms pay minimal dividends and do not divert earnings. With D_0 fixed at the minimum and $J = 0$, more funds relax the financing constraint and boost productive investment, $dI/dA = \eta_A$, see (B.10). Own funds get leveraged with debt, $dB/dA = \eta_A - 1 > 0$. Productive investment expands more than proportionately. When firms are severely constrained, the excess return is large and firm value rises with own funds.

When an entrepreneur goes public, shareholders pay the price $V^{M,B}$. The value of a small managerial firm rises with more own funds before it could grow out from the financially constrained regime. The values of V^E of entrepreneurial firms in the tax-constrained regime which are sufficiently similar to small managerial firms are independent of own funds. In Figure 3, the valuation of a managerial firm must thus cut the valuation of the same firm in entrepreneurial mode from below. When assets grow larger than the cut-off value A_m at the intersection point in Figure 3, the entrepreneur sells out and the firm goes public.[6] At that point, it is not determined whether the managerial firm is strongly or weakly constrained. Theoretically, the cash-poor managerial regime in (20) may or may not exist.

2.3 Cross Section

A cross section of firms includes entrepreneurial and managerial firms with heterogeneity within each class. In a life-cycle interpretation, firms start out entrepreneurial with concentrated ownership. (i) Those with low own assets are smallest and pay only minimal dividends to maximize internal funds. Investment is restricted by pledgeable earnings and is *cash-constrained.* (ii) Firms with larger funds could invest at a first-best level and pay higher dividends. Given the tax bias for debt, they prefer external credit over retained earnings. They end up constrained for tax reasons only, i.e., they are *tax-constrained.*

Yet, larger firms with more own funds go public. With dispersed ownership, a manager is hired and a board is installed to exercise oversight and control. Conditional on the level of own funds, managerial firms fall into three subgroups. (iii) If own funds are very scarce, firms must retain as much profit as possible to improve access to external capital.

[6]Investment is discontinuous when the firm goes public, see Figure 2. The managerial organization requires a manager salary and other organizational costs, while shareholders require a lower return.

Being *severely cash-constrained,* managers do not divert any funds, and pay out the minimum level of dividends.[7] (iv) With somewhat more own funds available (*moderately cash-constrained*), managers start to divert part of internal funds to advance private benefits, but still deny any more generous dividend payments to augment own funds via retained earnings and relax the external credit constraint. (v) Cash-rich firms with large internal funds pay dividends and could invest at an unrestricted level. However, the tax preference for debt leads them to shift from retained earnings to external debt financing which makes them *tax-constrained.* The presence of private benefits merely shifts the balance between shareholder dividends and managerial private benefits of managers. We denote the cut-off values of assets by $A_c < A_m < A_j < A_d$ as shown in Figures 2 and 3.

The theory illustrates investment behavior of firms operating in distinct financial regimes. It points to institutional and firm-level determinants of investment and to entirely different transmission channels of tax policy specific to a firm's financial regime. For that reason, the theory clearly points to heterogeneous tax sensitivities of firm-level investments across firm types. We summarize the main theoretical predictions as follows:

- corporate taxation negatively affects investment in all regimes;
- dividend taxation reduces investment of cash-constrained entrepreneurial and managerial firms but has little or no effect on their tax constrained counterparts;
- an increase in own funds boosts investment of cash-constrained entrepreneurial and managerial firms, with little or no effect on the other two groups;
- higher firm-level productivity and lower interest rates boost investment of all firms.

[7] Introducing external credit adds this new regime to the Chetty and Saez (2010) framework.

3 Empirical Framework

The subsequent empirical setup allows for an identification of all firm types characterized in the theoretical model and for an estimation of the above stated elasticities across these firm types. The empirical analysis will entail two main goals. First, we will use the empirical model to assess the qualitative predictions of the theoretical model by comparing the sign and ranking of estimated coefficients. Second, we will estimate the quantitative differences in the tax sensitivities across firm types.

3.1 Data Description

We employ 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 European companies between the years 2004 and 2012. Additional country-level variables are taken from the World Bank's World Development Indicators. Moreover, the paper utilises data from Egger and Loretz (2010) and Bösenberg, Egger and Erhardt (2014) on the taxation of corporate profits and from Bösenberg, Rydzek, and Egger (2014) on the taxation of dividends across countries and time.

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

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). In the following, let us refer to a specific firm by subscript ℓ and denote time by subscript t, $0 \leq t \leq T$.

Investment: The dependent variable – investment of firm ℓ at time t, $I_{\ell t}$ – is constructed from the balance-sheet data as the relative change in fixed assets between the beginning and end of the accounting year, abstracting from depreciation. For instance, a value of 0.1 of the dependent variable indicates an annual growth rate of fixed assets of 10%. In order to capture regular investment projects rather than mergers and acquisitions, we exclude firms where the absolute value of $I_{\ell t}$ exceeds unity.

Determinants of Firm Regimes: In the proposed theoretical framework, the level of own liquid funds determines the selection of firms into the different regimes (cash-constrained and tax-constrained entrepreneurial firms; dividend-paying as well as severely and moderately cash-constrained, non-dividend-paying managerial firms). These five firm regimes emerge from two different kinds of agency problems: a manager-shareholder-external investor conflict as opposed to an entrepreneur-external-investor conflict. In the data, we can distinguish between entrepreneurial and managerial firms and, hence, differentiate between firms that are subject to these different agency problems.

Legally, a manager-shareholder conflict becomes relevant as soon as none of the individual shareholders has 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. We construct a concentration indicator q_ℓ that equals zero for com-

panies with none of the recorded shareholders holding more than 50% of direct or total ownership and one for companies with a recorded shareholder that holds at least 50% of direct or total ownership. Data on the required concentration indices are available only for the years 2007-2012. In order to be able to utilize information from as many years as possible, we code all firms that are subject to dispersed (concentrated) ownership from 2007-2012 as being dispersed (concentrated) for the whole sample period.[8] Hence, the regime status of a firm ℓ is held time-invariant for the whole sample period and we can control for potential selection into an entrepreneurial versus a managerial regime by firm-fixed effects in the subsequent analysis.

Within either a concentrated or a dispersed ownership structure regime, however, it is unobserved whether firms are relatively abundant in own liquid funds or not. We choose the cash ratio at the beginning of the accounting period defined as cash and cash-equivalent holdings over total assets as a measure of size-normalized own liquid funds, $A_{\ell t}$. The cash ratio is a standard measure of liquidity in the literature and suits the idea of the theoretical model that firms can resort to own funds rather than raising external debt or paying dividends. Scaling own funds by total assets allows us to compare firms of different age and industry type, as scaled own liquid funds, $A_{\ell t}$, do not reflect firm size.

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 proxy the relevant interest rate by using the average cost of a loan for any firm ℓ at time t. The latter is defined as the firm-specific ratio of total interest expenses to total liabilities. In order to obtain a measure of productivity, $\theta_{\ell t}$, we use real

[8] Only very few firms actually switch the status between 2007 and 2012 so that this assumption appears justifiable. These switchers are excluded from the sample in order to guarantee a balanced sample which is required for the estimation strategy.

operating revenues per worker in the previous period.[9] Finally, in order to account for the life cycle of the firm, we control for a second-order polynomial of firm age.

3.1.2 Data on the Investment Climate

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 percent of GDP), the percentage of bank non-performing loans in total gross loans, domestic credit to the private sector provided by banks (in percent of GDP), gross fixed capital formation (in percent of GDP), and gross savings (in percent 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. Specifically, we use data on effective marginal corporate tax rates which are computed for a country-time-specific model firm. Details on these effective marginal tax rates on profits are available from Bösenberg, Egger, and Erhardt (2014).[10] Regarding dividend tax rates, we use country-time-specific statutory rates which, due to the flat nature of dividend tax codes in most countries, correspond to effective marginal rates as well. The data on the latter are taken from Bösenberg, Egger, and Rydzek (2014).

[9] Operating revenues are deflated using country-time-sector-specific deflators for output from the World Input-Output Database (WIOD) with 1995 as the base year.

[10] In our data, entrepreneurial firms refer to small, entrepreneur-centered corporations with only an informal board, and an identity of the owner and manager.

3.1.4 Descriptive Statistics

Combining the aforementioned data, we construct a balanced panel of 35,092 firms for the years 2004-2012 covering firms from 17 different European countries.[11] Summary statistics of all firm-specific variables are presented in Table 1 for entrepreneurial and managerial firms, respectively. A list of countries is provided along with details of country-specific taxation data in Table 2.

Insert Tables 1 And 2 About Here

On average, investment $I_{\ell t}$ amounts to around 0.17 (17%) for entrepreneurial firms and to 0.15 (15%) for managerial firms. The average entrepreneurial firm has scaled own liquid funds (cash holdings relative to total assets) of around 8.8% and is subject to an interest rate of 2.4%, with these numbers being slightly higher for managerial firms. While average productivity and age are similar for managerial and entrepreneurial firms, both variables are more dispersed in the entrepreneurial-firm subsample. The majority of firms in the sample (61%) is entrepreneurial. Clearly, a mere comparison of descriptive statistics does not account, e.g., for the different sector or country composition across managerial and entrepreneurial firms. By taking into account firm-level fixed effects, the empirical analysis will be able to identify any differences across these firms conditional on their time-invariant characteristics, e.g., their country or sector affiliation.

The effective marginal corporate tax rate (average over the sample period) varies between 8% in Bulgaria and Romania and 31% in Germany. Slightly more than half

[11] 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. In the outline of his econometric model, Hansen (1999) focuses on the analysis in a balanced panel data-set.

of the countries impose dividend taxes with Danish firms being subject to the highest average dividend-tax rate of 28%. We will use the variation in taxes over time to identify firm-level investment responses to taxation. Using a panel over nine years from 2004-2012, we observe important variations in both corporate and dividend taxation. All but two countries in the data experience at least one such policy change over this time period.

3.2 Econometric Strategy

Figure 2 suggests that investment responses depend on the respective firm type in the theoretical model. The econometric strategy is aimed at identifying these firm types and test the theoretical implications regarding firm-level investment responses to taxation.

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. 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 cash-constrained and tax-constrained entrepreneurial firms on the one hand and severely-constrained, cash-constrained and tax-constrained managerial firms on the other hand emerge, so that these thresholds need to be estimated.[12] We thus propose an econometric strategy which involves estimating an unobservable threshold within an observable (entrepreneurial- vs. managerial-firm) regime by using Hansen's (1999, 2000) sample-

[12]One might identify the second threshold within managerial firms by using observed dividend payments. In reality, however, observed zero versus non-zero dividend payments might not be informative about the threshold, 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 estimate it.

splitting approach for panel data.

3.2.1 Estimation Strategy

Following the notation of Section 2.3, we use subscripts $\{c, x\}$ to denote cash-constrained and tax-constrained entrepreneurial firms, and subscripts $\{m, j, d\}$ to denote severely constrained managerial firms, constrained managerial firms with non-zero unproductive spending j, and dividend-paying managerial firms. These regimes are separated by four threshold values of $A_{\ell t}$, $\{A_c, A_m, A_j, A_d\}$.

Guided by the theoretical model, we propose the dependent investment variable, $I_{\ell t}$, to be determined by a piecewise-linear function of a vector of independent variables, $x_{\ell t}$. Moreover, we will allow for regime-independent control variables $z_{\ell t}$ and a firm-specific fixed effect μ_ℓ. The coefficients on the variables of the model are allowed to depend on the observed and unobserved regimes according to:

$$I_{\ell t} = \begin{cases} \mu_\ell + z'_{\ell t}\gamma + x'_{\ell t}\beta_c + e_{\ell t,1} & \text{if } A_{\ell t} \leq A_c, \\ \mu_\ell + z'_{\ell t}\gamma + x'_{\ell t}\beta_x + e_{\ell t,1} & \text{if } A_c < A_{\ell t} \leq A_m, \\ \mu_\ell + z'_{\ell t}\gamma + x'_{\ell t}\beta_m + e_{\ell t,0} & \text{if } A_m < A_{\ell t} \leq A_j, \\ \mu_\ell + z'_{\ell t}\gamma + x'_{\ell t}\beta_j + e_{\ell t,0} & \text{if } A_j < A_{\ell t} \leq A_d, \\ \mu_\ell + z'_{\ell t}\gamma + x'_{\ell t}\beta_d + e_{\ell t,0} & \text{if } A_d < A_{\ell t}, \end{cases} \tag{21}$$

where A_c, A_j and A_d are unobserved, whereas A_m is indirectly observed through q_ℓ which identifies firms with dispersed ($q_\ell = 0$) and concentrated ownership ($q_\ell = 1$), respectively.

Conditional on q_ℓ, the econometric model in (21) can be rewritten as:

$$E[I_{\ell t}|q_\ell = 0, x_{\ell t}] = \mu_\ell + z'_{\ell t}\gamma + x'_{\ell t}\beta_x + \mathbf{1}\{A_{\ell t} \leq A_c\}x'_{\ell t}(\beta_c - \beta_x), \tag{22}$$

$$E[I_{\ell t}|q_\ell = 1, x_{\ell t}] = \mu_\ell + z'_{\ell t}\gamma + x'_{\ell t}\beta_d$$
$$+\mathbf{1}\{A_j < A_{\ell t} \leq A_d\}x'_{\ell t}(\beta_j - \beta_d) + \mathbf{1}\{A_{\ell t} \leq A_j\}x'_{\ell t}(\beta_m - \beta_d). \tag{23}$$

The regime-specific independent variables $x_{\ell t}$ comprise the cash ratio, the country-time-specific corporate profits and dividend tax rate, respectively, a firm's average cost of loans, the log of productivity and a firm's age. A firm's cash ratio additionally defines the regime a firm belongs to. Furthermore, we allow for year fixed effects and controls at the country-year level which are further detailed in section 3.1.2. Note that we allow for a firm-specific fixed effect in all specifications which enables us to control for the sample selection into managerial and entrepreneurial regimes, as well as for other unobserved time-invariant determinants at the firm- and country-level. Following Hansen (1999), we estimate (22) and (23) separately using a least-squares estimator. All reported standard errors are robust to heteroskedasticity.

4 Main Results

Estimating the threshold regression model (22) and (23) yields a critical cash ratio of $\hat{A}_c = 0.335$ which separates cash- and tax-constrained entrepreneurial firms, and $\hat{A}_d = 0.188$ which separates dividend-paying and non-dividend-paying managerial firms. We further distinguish severely constrained non-dividend-paying managerial firms with a cash ratio below $\hat{A}_j = 0.015$. Recall at this point that the empirical measure of liquid funds is defined as cash holdings over total assets and through this normalization does not capture

size effects. For that reason, we do not have a prediction about the ordering or relative location of $\hat{A}_c$ relative to $\hat{A}_d$ or $\hat{A}_j$ in normalized cash-ratio space. However, what the results indicate is that, conditional on firm size, the critical level of liquid funds where the respective agency problem is relaxed due to a relative abundance of liquid funds is higher for entrepreneurial firms than for managerial ones. The confidence bounds for the thresholds are based on the likelihood-ratio statistic proposed by Hansen (2000) and indicate a very precise measurement of the thresholds.

In line with theoretical predictions, liquid funds are more important for the investment of cash-constrained entrepreneurial firms and non-dividend-paying managerial firms than for the respective counterparts, namely tax-constrained entrepreneurial and dividend-paying managerial firms. However, even for the latter firm types investment is affected positively (albeit substantially less so) by an increase in 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 in this paper.

Insert Table 3 About Here

Corporate taxes affect investment negatively across all firm-types, with the effect being generally more pronounced for entrepreneurial firms where the estimated coefficients are between 40 and 70 percent higher than for managerial firms. Even within the set of entrepreneurial firms, the differences across firm types are substantial: an increase in effective marginal corporate taxes of one percentage point leads to a decline in investment by 0.84 percentage points for cash-constrained entrepreneurial firms and by 0.68 percentage points for tax-constrained entrepreneurial firms. The investment of managerial

firms, by contrast, is predicted to decrease by roughly 0.5 percentage points assuming the same policy shock. Given an average size of investment of 15-17%, these effects are economically large: an increase in corporate taxation by 10 percentage points would cut investment of cash-constrained entrepreneurial firms in half.

While corporate taxation negatively affects investment across all firm types, albeit to a varying extent across regimes, dividend taxation has a significant negative effect on investment only for cash-constrained entrepreneurial firms and non-dividend paying managerial firms. This result is perfectly aligned with the theoretical prediction: cash-constrained firms have to reduce dividends to a minimum level to relax the financing constraint and scale up investment, financed with more internal resources and leveraged by improved access to external capital. When owners demand a given minimum level of dividends net of tax, firms must compensate for the tax which drains internal funds and restricts investment. Our econometric estimates suggest that a one-percentage-point increase in dividend taxation decreases investment by around 0.11-0.17 percentage points for cash-constrained entrepreneurial and managerial firms, respectively.

All other controls bear the expected signs and enter the regression significantly: interest rates affect investment negatively for all firms albeit substantially more so for firms that face a binding finance constraint. Generally, more productive firms and younger firms tend to invest more with the elasticities being very similar across firm types.

Overall, the estimation results in Table 3 are well aligned with the theory outlined in Section 2. Beyond testing the theory, the empirical setting allows for a classification of firms into the theoretically-motivated firm types and their respective latent agency problems. Thus, we can quantify the heterogeneous investment responses to taxation: the empirical results point to a statistically significant and economically large effect of

corporate taxation that varies between a 0.49 and 0.84 percentage-point decrease in investment following a one percentage point increase in corporate taxation. The impact on constrained entrepreneurial firms is about 70% higher than the effect on constrained managerial firms. Dividend taxation reduces investment by 0.11-0.17 percentage points after a one-percentage-point tax increase for constrained entrepreneurial and managerial firms, with no significant effect being established for unconstrained (or rather tax-constrained) firms.

In order to further validate the theoretical model, we use the threshold estimates from Table 3 to compare two equilibrium outcomes of the model across firm types. First, we consider the distribution of dividend payments scaled by the operating revenues across firm types.[13] A histogram of these scaled dividends is depicted in the upper panels of Figure 5 for entrepreneurial and managerial firms, respectively.[14] Consistent with the theoretical model, the distribution of scaled dividend payments for tax-constrained entrepreneurial firms and dividend-paying managerial firms is clearly to the right of the distribution of the respective counterpart. Generally, average dividends being paid out by tax-constrained entrepreneurial and managerial firms are 50-60% higher than those of their cash-constrained and severely constrained counterparts.

Insert Figure 5 About Here

Considering the distribution of investment we find a qualitatively similar result that is

[13]While we do not directly observe dividend payments in the data, we approximate them as follows: we calculate retained earnings from the difference between total equity and issued share capital and proxy dividends by the change in retained earnings during the accounting year plus the net profit of the respective period.

[14]Note that only positive dividend payments are considered in the histogram. However, this does not affect the qualitative result.

in line with the theoretical model.[15] The distribution of the investment rate across firm-types indicates that cash-constrained entrepreneurial firms invest substantially less than tax-constrained ones. The same ranking holds for managerial firms: the distribution of investment rates for non-dividend-paying managerial firms is clearly to the left of the distribution of investment for dividend-paying managerial firms. On average, investment rates of the tax-constrained managerial and entrepreneurial firms are 20-25% higher than investment rates of their cash-constrained and severely constrained counterparts.

5 Robustness Checks

We consider two alternative specifications of the empirical model to assess the robustness of the results. In a first robustness check, we code negative investment values as zero investment values.[16] The theoretical model does not explicitly account for negative investments (i.e., divestments) and the data show a discontinuous break in the distribution of investment at zero. This points to a potentially different behavioral response with respect to negative investment. Therefore, it seems reasonable to consider negative investments as zero investments in a robustness exercise.

Table 4 presents the results of this sensitivity analysis. The estimated threshold parameters are nearly identical to those of the main regression which indicates that the estimated classification of firms into regimes is not affected by the mentioned type of coding of the investment variable. Generally, the findings are qualitatively in line with the ones based on the main regression and the relative ranking of coefficients stays the same. Most notably, the effect of corporate taxation on investment is slightly smaller

[15] Note that in this figure negative investments are coded as zero for ease of exposition, since the distribution of investments discontinuously changes at around zero.

[16] Slightly less than 8% of investment rates are negative in the main sample.

across all firm types than in the benchmark analysis.

Insert Table 4 About Here

In a second robustness check we alter the definition of managerial firms. For this, we construct a concentration indicator q_ℓ that equals zero for companies with none of the recorded shareholders holding more than 25% of direct or total ownership as compared to 50% in the main analysis. This naturally leads to a smaller subsample of managerial firms. Results for this analysis are presented in Table 5. Not surprisingly, the estimated thresholds are different from the ones found in the main specification. However, the qualitative results are largely aligned with the benchmark analysis. Corporate taxation has a stronger negative impact on investment for entrepreneurial firms than for managerial firms even though the differences are less pronounced than in the main specification. Dividend taxation impacts investment negatively for cash-constrained entrepreneurial firms and severely constrained managerial firms. However, in contrast to the benchmark analysis, the effect is negative and significant also for tax-constrained entrepreneurial firms albeit somewhat smaller, and insignificant for moderately constrained managerial firms.

The tendency of tax sensitivities to converge across regimes in this setting flows from the shuffling of firms, that are in fact subject to an agency problem of managerial firms, into the subset of entrepreneurial firms relative to the benchmark analysis. Since the thresholds across managerial and entrepreneurial firms are not directly comparable, estimating a threshold that allows for a good classification of firms within a specific agency problem relies on a well-designed a-priori specification of firms being better represented

by an entrepreneurial setting or a managerial setting. The results of this exercise suggest that – based on the predictions of the theoretical model – an ownership cutoff of 50% appears better suited to classify firms as entrepreneurial and managerial firms than one of 25%.

Insert Table 5 About Here

Overall, the robustness checks confirm the consistency of the main results, especially, with respect to the effects of taxation across different firm regimes. 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 non-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, and, second, dividends can easily be smoothed across years thereby weakening their impact on the investment decision in a given year.

6 Conclusion

In this paper, we focus on the heterogeneous investment responses to taxes on corporate profits and taxes levied on dividends. The theoretical framework features small entrepreneur-centered firms and large managerial firms with dispersed ownership and a manager-shareholder tension. Within each class, we distinguish cash-constrained firms, which pay only minimal dividends and are left with unrealized investments, from cash-rich ones which pay large dividends and are able to exploit the tax bias towards debt.

The novel feature is that the model gives rise to threshold levels of own assets which are determined b deep model parameters and separate five types of firms operating in different financial regimes. The transmission channel for taxes is entirely different for each of these firm types. Depending on their level of own assets and ownership structure, firms respond in different ways to corporate and dividend taxes which leads to a substantial heterogeneity of tax elasticities.

Based on the predictions of the theoretical model, the paper sheds light on the heterogeneity of investment responses to corporate and dividend taxation using accounting information from a large balanced panel data-set set of 35,092 firms in 17 European countries for the years 2004-2012. The empirical analysis serves two purposes. First, it permits assessing qualitative model predictions regarding firm regimes and the ranking of thresholds in own assets which separates these regimes. Second, it permits a quantitative analysis of different tax sensitivities across the identified firm types. We find important variation in the tax sensitivity of investment across firm-types for dividend as well as for corporate taxation. The effect of corporate taxation is up to 70% higher for entrepreneurial firms than for managerial firms. In contrast, dividend taxation has a comparably large negative effect for cash-constrained managerial firms and entrepreneurial firms but no significant impact on their unconstrained counterparts.

7 Appendix

A Investment of Entrepreneurial Firms

For an analytical solution, maximize V^E in (3) s.t. (4). Noting the shadow price λ of the financing constraint, optimality with respect to I and $D_0 \geqslant \bar{D}/(1-t)$ requires

$$\begin{aligned} (i) \quad &: \quad \frac{dV^E}{dI} = (1-t+\lambda)(1-\tau)(\theta f' - r) - \lambda\phi = 0, \\ (ii) \quad &: \quad \frac{dV^E}{dD_0} = (1-t)\tau r - \lambda[1+(1-\tau)r] \leq 0. \end{aligned} \tag{A.1}$$

There are two regimes. First, if $dV^E/dD_0\big|_{D_0=\bar{D}/(1-t)} < 0$, 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 constraint binds and implicitly determines investment. Condition (A.1i), in turn, yields λ. Given minimum dividends $D_0 = \bar{D}/(1-t)$, external debt is $B = I - A + D_0$.

Second, cash-rich firms pay debt financed dividends $D_0 > \bar{D}/(1-t)$ to exploit the tax advantage of debt. Condition (ii) gives λ which is used in (i) to get

$$\lambda = \frac{(1-t)\tau r}{1+(1-\tau)r} > 0, \quad \theta f'(I_n) - r = \frac{\tau}{1-\tau}\frac{r\phi}{1+r} > 0. \tag{A.2}$$

Investment is independent of own funds. Given I_n, the constraint in (4) implies a level of dividends D_0. The firm requires debt $B = I + D_0 - A$. In the absence of tax, the shadow price is zero and the firm invests at the unconstrained level noted in (5). Firms are indifferent between retained earnings and debt so that dividends are indeterminate.

Due to the tax bias for debt, the firm always ends up being constrained, $\lambda > 0$,

and earns an excess return, $\theta f'(I) > r$. If investment were unconstrained, $\theta f'(I^*) = r$, the firm would exploit the tax advantage of debt in paying out all earnings, $D_0 = A$, and financing investment entirely with debt, $B = I^*$. With zero retained earnings, the financing constraint would be violated, see Assumption 1.

B Investment of Managerial Firms

Appendix B provides comparative static results for the managerial firm.

(i) Tax-constrained, Cash-rich Firms When firms are cash-rich, the tax bias leads them to raise debt until the financing capacity is exhausted. The differential of (17) yields

$$dI = -\eta_\phi^1 \cdot d\phi - \eta_i^1 \cdot di + \eta_\theta^1 \cdot d\theta - \eta_\tau^1 \cdot d\tau. \tag{B.1}$$

All coefficients are defined positive, $\eta_\phi^1 \equiv \frac{\tau i}{(1-\tau)(1+i)} \frac{1}{-\theta f''}$, $\eta_i^1 \equiv \left[1 + \frac{\tau\phi}{(1-\tau)(1+i)^2}\right] / (-\theta f'')$, $\eta_\theta^1 \equiv \frac{f'}{-\theta f''}$ and $\eta_\tau^1 \equiv \frac{i\phi}{(1+i)(1-\tau)^2} \frac{1}{-\theta f''}$, where the upper index refers to first of three alternative financial regimes. Spending on unproductive projects adjusts by

$$dJ = -\varepsilon_\alpha^1 \cdot d\alpha + \varepsilon_\gamma^1 \cdot d\gamma - \varepsilon_i^1 \cdot di + \varepsilon_t^1 \cdot dt + \varepsilon_\tau^1 \cdot d\tau, \tag{B.2}$$

where $\varepsilon_\alpha^1 \equiv \frac{1}{\alpha} \frac{g'}{-g''}$, $\varepsilon_\gamma^1 \equiv \frac{g'}{-\gamma g''}$, $\varepsilon_i^1 \equiv \frac{1+i+(1+(1-\tau)i)i}{(1+(1-\tau)i)(1+i)i} \frac{g'}{-g''}$, $\varepsilon_t^1 \equiv \frac{-g'/g''}{1-t}$ and $\varepsilon_\tau^1 \equiv \frac{-g'/g''}{(1-\tau)(1+(1-\tau)i)}$ are all positive. Finally, total investment spending changes by

$$d(I+J) = \varepsilon_t^1 \cdot dt - \left(\eta_\tau^1 - \varepsilon_\tau^1\right) \cdot d\tau + \eta_\theta^1 \cdot d\theta - \left(\eta_i^1 + \varepsilon_i^1\right) \cdot di - \eta_\phi^1 \cdot d\phi - \varepsilon_\alpha^1 \cdot d\alpha + \varepsilon_\gamma^1 \cdot d\gamma. \tag{B.3}$$

The only ambiguity is the corporate tax rate which reduces productive investment in proportion to η_τ^1. Since private benefits go untaxed, the tax also shifts spending towards unproductive projects. The net effect depends on relative elasticities. Assuming that unproductive spending as a share of total investment is sufficiently small (it is zero in regime iii), the effect on productive investment must dominate the overall response.

(ii) Weakly Finance-constrained Firms Being constrained, firms do not pay out dividends beyond the minimum amount and cannot adjust retained earnings. In this regime, both types of investment interact and are simultaneously determined together with the shadow price. The financing constraint gives a negatively sloped relationship $I(J)$ in J-I-space. Conditions (16.a-b) establish a positively sloped relationship $J(I)$. Figure 4 illustrates the simultaneous solution of I and J. Using $m^2 \equiv \phi - (1-\tau)(\theta f' - i) > 0$ and noting $(1-t)D_0 = \bar{D}$, the financing constraint yields

$$dI = -\eta_J^2 \cdot dJ + \eta_A^2 \cdot dA + \eta_\theta^2 \cdot d\theta - \eta_i^2 \cdot di - \eta_\phi^2 \cdot d\phi - \eta_\tau^2 \cdot d\tau - \eta_t^2 \cdot dt. \tag{B.4}$$

Coefficients $\eta_J^2 \equiv \frac{(1-\tau)i}{m^2}$, $\eta_A^2 \equiv \frac{1+(1-\tau)i}{m^2}$, $\eta_\theta^2 \equiv \frac{(1-\tau)f}{m^2}$, $\eta_i^2 \equiv \frac{(1-\tau)B}{m^2}$, $\eta_\phi^2 \equiv \frac{I}{m^2}$, $\eta_\tau^2 \equiv \frac{T}{m^2}$ and $\eta_t^2 \equiv \frac{(1+(1-\tau)i)D_0}{(1-t)m^2}$ are all positive. Dividends are at a minimum and retained earnings $A - D_0$ are fixed. When managers use up internal funds to serve private benefits, they cut self-financing of productive investment. The financing constraint tightens and investment I declines which establishes $I(J)$. Given J, other shocks affect productive investment in ways that were discussed in Section 2.2, shifting up or down the constraint in Figure 4.

Unproductive spending is solved from (16.a-b) in terms of I. More investment I reduces the excess return $\theta f' - i$. This can happen only if the financing constraint becomes less tight which diminishes the shadow price. A lower shadow price invites more

unproductive spending. Taking differentials yields

$$\begin{aligned} d\lambda = & \left[(1-t)\,\alpha+\lambda\right]\tfrac{(1-\tau)\theta f''}{m^2}dI+(1-t)\,\tfrac{(1-\tau)(\theta f'-i)}{m^2}d\alpha-\tfrac{\lambda}{m^2}d\phi \\ + & \left[(1-t)\,\alpha+\lambda\right]\tfrac{1-\tau}{m^2}\left(f'd\theta-di\right)-\alpha\tfrac{(1-\tau)(\theta f'-i)}{m^2}dt-\left[(1-t)\,\alpha+\lambda\right]\tfrac{\theta f'-i}{m^2}d\tau, \\ dJ = & \tfrac{(1-\tau)i}{\gamma g''}d\lambda+\tfrac{(1-t)(1-\tau)i}{\gamma g''}d\alpha-\tfrac{g'}{\gamma g''}d\gamma+\tfrac{(1-t)\alpha+\lambda}{\gamma g''}di-\tfrac{(1-t)\alpha+\lambda}{\gamma g''}id\tau-\tfrac{(1-\tau)i\alpha}{\gamma g''}dt. \end{aligned} \tag{B.5}$$

Substituting for $d\lambda$ establishes the positive relationship, i.e., more productive investment spending goes along with more spending on perks,

$$dJ=\varepsilon_I^2\cdot dI-\varepsilon_\alpha^2\cdot d\alpha+\varepsilon_\phi^2\cdot d\phi+\varepsilon_\gamma^2\cdot d\gamma-\varepsilon_\theta^2\cdot d\theta-\varepsilon_i^2\cdot di+\varepsilon_\tau^2\cdot d\tau+\varepsilon_t^2\cdot dt. \tag{B.6}$$

All coefficients $\varepsilon_I^2\equiv\left[(1-t)\,\alpha+\lambda\right]\frac{(1-\tau)i}{m^2}\frac{(1-\tau)\theta f''}{\gamma g''}$, $\varepsilon_\alpha^2\equiv(1-t)\,\frac{\phi}{m^2}\frac{(1-\tau)i}{-\gamma g''}$, $\varepsilon_\phi^2\equiv\frac{(1-\tau)i}{-\gamma g''}\frac{\lambda}{m^2}$, $\varepsilon_\gamma^2\equiv\frac{g'}{-\gamma g''}$, $\varepsilon_\theta^2\equiv\frac{(1-t)\alpha+\lambda}{-\gamma g''}\frac{(1-\tau)^2if'}{m^2}$, $\varepsilon_i^2\equiv\frac{(1-t)\alpha+\lambda}{-\gamma g''}\left[1-\frac{(1-\tau)^2i}{m^2}\right]$, $\varepsilon_\tau^2\equiv\frac{(1-t)\alpha+\lambda}{m^2}\frac{\phi i}{-\gamma g''}$ and $\varepsilon_t^2\equiv\frac{\phi}{m^2}\frac{(1-\tau)i\alpha}{-\gamma g''}$ are all positive except for a slight ambiguity in the interest rate shock.

The system (B.4,B.6) is solved for equilibrium investment and spending on perks. Inverting the system and noting the determinant $\nabla\equiv1+\varepsilon_I^2\eta_J^2>0$ yields

$$\begin{aligned} dI \;=\; & -\frac{\eta_\tau^2+\varepsilon_\tau^2\eta_J^2}{\nabla}\cdot d\tau-\frac{\eta_t^2+\varepsilon_t^2\eta_J^2}{\nabla}\cdot dt+\frac{\eta_\theta^2+\varepsilon_\theta^2\eta_J^2}{\nabla}\cdot d\theta-\frac{\eta_i^2-\varepsilon_i^2\eta_J^2}{\nabla}\cdot di \\ : \;\; & +\frac{\eta_A^2}{\nabla}\cdot dA+\frac{\varepsilon_\alpha^2\eta_J^2}{\nabla}\cdot d\alpha-\frac{\varepsilon_\gamma^2\eta_J^2}{\nabla}\cdot d\gamma-\frac{\eta_\phi^2+\varepsilon_\phi^2\eta_J^2}{\nabla}\cdot d\phi. \end{aligned} \tag{B.7}$$

For example, more own funds directly relax the financing constraint and boost productive investment by $dI=\eta_A^2\cdot dA$. The shadow price falls as the excess return shrinks which reduces the opportunity cost of unproductive spending. As J rises by $dJ=\varepsilon_I^2\cdot dI$ and absorbs part of the financial resources, the rise in productive investment is dampened by the factor $1/\nabla$, since $dI=\eta_A^2\cdot dA-\eta_J^2\cdot dJ=\frac{\eta_A^2}{\nabla}\cdot dA$. The other parameters are intuitive. All effects are well determined except for the interest rate shock, $\eta_i^2-\varepsilon_i^2\eta_J^2\gtrless0$.

For unproductive spending we get

$$\begin{aligned} dJ &= \frac{\varepsilon_\tau^2 - \eta_\tau^2 \varepsilon_I^2}{\nabla} \cdot d\tau + \frac{\varepsilon_t^2 - \eta_t^2 \varepsilon_I^2}{\nabla} \cdot dt - \frac{\varepsilon_\theta^2 - \varepsilon_I^2 \eta_\theta^2}{\nabla} \cdot d\theta - \frac{\varepsilon_i^2 + \varepsilon_I^2 \eta_i^2}{\nabla} \cdot di \\ &: \quad + \frac{\eta_A^2 \varepsilon_I^2}{\nabla} \cdot dA - \frac{\varepsilon_\alpha^2}{\nabla} \cdot d\alpha + \frac{\varepsilon_\gamma^2}{\nabla} \cdot d\gamma + \frac{\varepsilon_\phi^2 - \eta_\phi^2 \varepsilon_I^2}{\nabla} \cdot d\phi. \end{aligned} \tag{B.8}$$

Several coefficients seem ambiguous. By substituting coefficients, one can easily show that $\varepsilon_t^2 - \eta_t^2 \varepsilon_I^2 > 0$ and $\varepsilon_\phi^2 - \eta_\phi^2 \varepsilon_I^2 > 0$. Changes in the interest rate and the corporate tax rate are ambiguous, $\varepsilon_\theta^2 \gtrless \varepsilon_I^2 \eta_\theta^2$ and $\varepsilon_\tau^2 \gtrless \eta_\tau^2 \varepsilon_I^2$.

Finally, adding up (B.7-B.8) shows how shocks affect total investment spending,

$$\begin{aligned} d\left(I + J\right) = & -\tfrac{\left(1+\varepsilon_I^2\right)\eta_\tau^2 + \left(\eta_J^2 - 1\right)\varepsilon_\tau^2}{\nabla} \cdot d\tau - \tfrac{\left(1+\varepsilon_I^2\right)\eta_t^2 + \left(\eta_J^2 - 1\right)\varepsilon_t^2}{\nabla} \cdot dt \\ & + \tfrac{\left(1+\varepsilon_I^2\right)\eta_A^2}{\nabla} \cdot dA + \tfrac{\left(\eta_J^2 - 1\right)\varepsilon_\theta^2 + \left(1+\varepsilon_I^2\right)\eta_\theta^2}{\nabla} \cdot d\theta - \tfrac{\left(1+\varepsilon_I^2\right)\eta_i^2 - \left(\eta_J^2 - 1\right)\varepsilon_i^2}{\nabla} \cdot di \\ & + \tfrac{\left(\eta_J^2 - 1\right)\varepsilon_\alpha^2}{\nabla} \cdot d\alpha - \tfrac{\left(\eta_J^2 - 1\right)\varepsilon_\gamma^2}{\nabla} \cdot d\gamma - \tfrac{\left(1+\varepsilon_I^2\right)\eta_\phi^2 + \left(\eta_J^2 - 1\right)\varepsilon_\phi^2}{\nabla} \cdot d\phi. \end{aligned} \tag{B.9}$$

The term $\eta_J^2 - 1$ introduces an ambiguity. Note $m^2 = \phi - (1-\tau)(\theta f' - i) > 0$, where $1/m^2$ is the multiplier of the partial effects on productive investment as determined by the financing constraint. Economic reasoning requires that $\eta_A^2 > 1$ which implies $1 > \phi - (1-\tau)\theta f'$. A marginal increase in own funds is externally leveraged and raises investment I by more than proportionately. The condition on $\eta_J^2 > 1$ is more restrictive and would require $0 > \phi - (1-\tau)\theta f'$ which is possible if $m^2 \to 0$ and the multiplier $1/m^2$ is large (implying $\eta_A^2 > 1$ a fortiori, giving a rather large multiplier). We may thus allow for $\eta_J^2 < 1$ but close to 1 as well which assures $\eta_A^2 > 1$ such that more own funds are leveraged with external debt at least to a moderate degree. With $\eta_J^2 \gtrless 1$ in a neighborhood of 1, all coefficients in (B.9) are determinate except for the ambiguous effects of α and γ. Better managerial incentives shift spending from unproductive towards

productive uses but may increase or decrease total spending.

(iii) Strongly Finance-constrained Facing a very tight credit constraint, managers set dividends to the minimum and entirely give up private benefits to strengthen the firms debt capacity by raising the availability of internal funds. Investment is exclusively determined by the financing constraint (18). Taking the differential yields comparative static effects on productive and total investment spending in parallel to (B.4), except that the effect of J is missing which is restricted to zero:

$$dI = \eta_A^3 \cdot dA - \eta_\phi^3 \cdot d\phi + \eta_\theta^3 \cdot d\theta - \eta_i^3 \cdot di - \eta_\tau^3 \cdot d\tau - \eta_t^3 \cdot dt. \tag{B.10}$$

Coefficients $\eta_A^3 \equiv \frac{1+(1-\tau)i}{m^3}$, $\eta_\phi^3 \equiv \frac{I}{m^3}$, $\eta_\theta^3 \equiv \frac{(1-\tau)f}{m^3}$, $\eta_i^3 \equiv \frac{(1-\tau)B}{m^3}$, $\eta_\tau^3 \equiv \frac{T}{m^3}$ and $\eta_t^3 \equiv \frac{(1+(1-\tau)i)D_0}{(1-t)m^3}$ are all positive.

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Figure 1: Entrepreneurial investment.

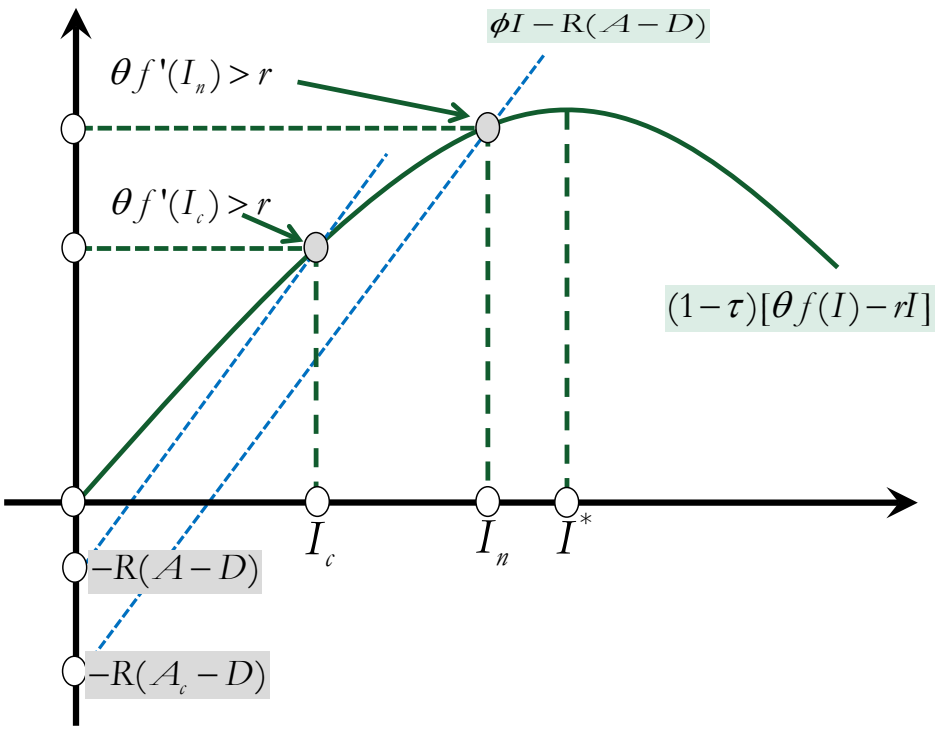


Figure 2: Firm investment in the cross-section.

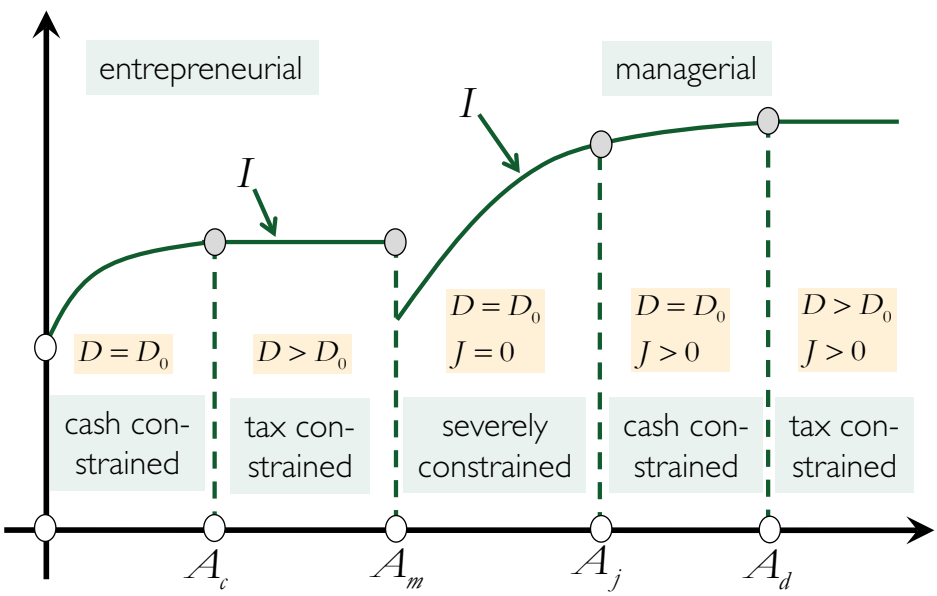


Figure 3: Firm values in the cross-section.

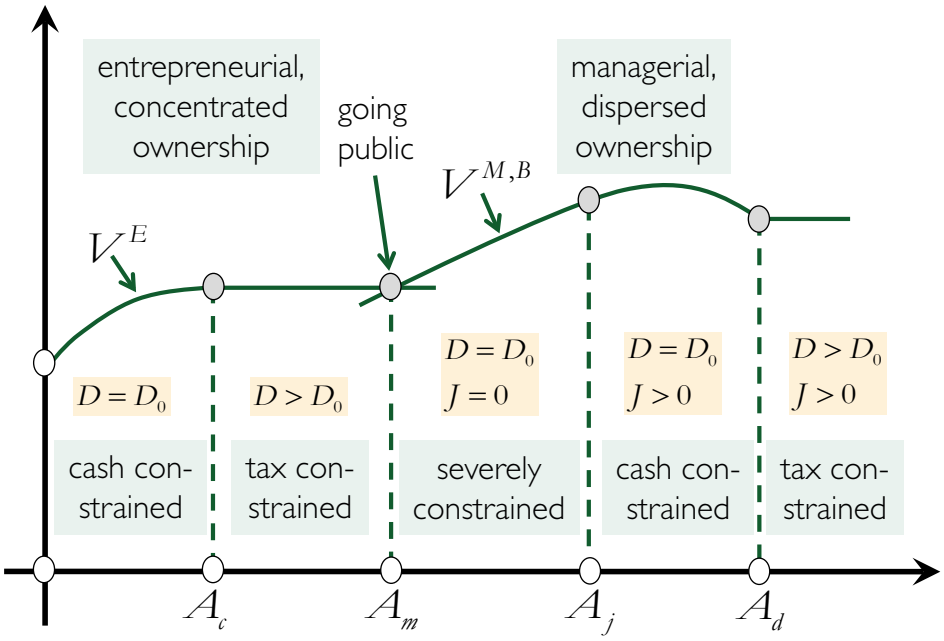


Figure 4: Investment and private benefits.

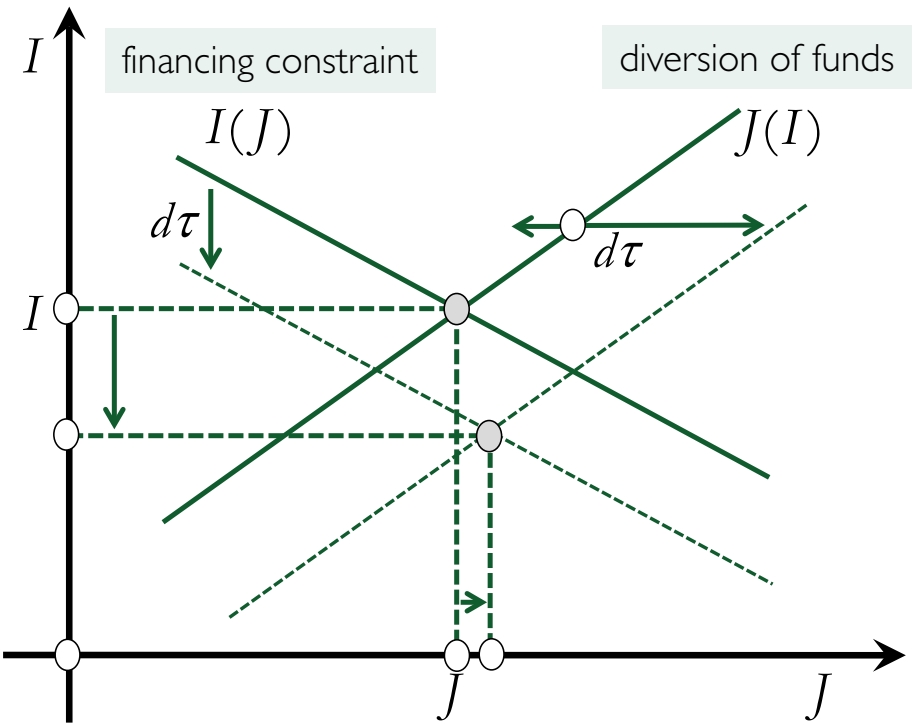


Table 1: Summary statistics.

	Entrepreneurial				Managerial			
Variable	Mean	Std. Dev.	Min.	Max.	Mean	Std. Dev.	Min.	Max.
Investment	0.166	0.233	-1	1	0.154	0.223	-1	1
Cash ratio	0.088	0.119	0	0.991	0.095	0.119	0	0.935
Interest rate	0.024	0.028	0	0.996	0.025	0.025	0	0.902
log(Prod.)	12.103	1.025	-1.946	21.298	12.018	0.965	3.714	19.152
Age	24.004	17.41	0	327	23.574	15.305	1	269
$N \times T$	194,220				121,608			

Notes: We consider firms with none of the recorded shareholders holding more than 50% of direct or total ownership as managerial and consider firms with a recorded shareholder that holds at least 50% of direct or total ownership as entrepreneurial. Investment of firm ℓ at time t, $I_{\ell t}$, is constructed as the relative change in fixed assets between the beginning and end of the accounting year, abstracting from depreciation. The cash ratio is defined as cash and cash-equivalent holdings over total assets and serves as a measure of size-normalized own liquid funds, $A_{\ell t}$. We proxy the interest rate faced by a firm by using the average cost of a loan for any firm ℓ at time t. The latter is defined as the firm-specific ratio of total interest expenses to total liabilities. In order to obtain a measure of productivity, $\theta_{\ell t}$, we use real operating revenues per worker in the previous period.

Table 2: Country-level taxation data.

Country	Avg. corporate tax (2004-2012)	No. of changes (2004-2012)	Avg. dividend tax (2004-2012)	No. of changes (2004-2012)
BEL	0.22	0	0.05	0
BGR	0.08	2	0.00	0
CZE	0.18	5	0.15	0
DEU	0.31	3	0.05	0
DNK	0.23	5	0.28	1
ESP	0.30	2	0.00	0
FIN	0.24	2	0.00	0
FRA	0.28	3	0.04	1
GBR	0.25	3	0.00	0
GRC	0.19	4	0.08	2
HUN	0.13	3	0.00	0
ITA	0.28	3	0.04	1
LUX	0.20	3	0.17	1
POL	0.11	0	0.19	0
ROM	0.08	2	0.11	3
SVN	0.12	5	0.00	0
SWE	0.22	1	0.00	0

Notes: The three-digit country codes in the first column are ISO 3166-1 Alpha-3 codes as also used in the World Bank's World Development Indicators. Corporate tax rates are country-year-specific and measure effective marginal tax rates on the profits of corporations. The data are taken from Bösenberg, Egger, and Erhardt (2014). Dividend tax rates are country-year-specific statutory rates which correspond to effective marginal rates as well. The data are taken from Bösenberg, Egger, and Rydzek (2014).

Table 3: Threshold regression results: Main specification.

	Entrepreneurial firms		Managerial firms		
Investment	Cash-constr.	Tax-constr.	No dividends		Dividends
			Sev. constr.	Cash-constr.	
Cash ratio	0.252***	0.117***	1.253***	0.312***	0.122***
	(0.011)	(0.027)	(0.304)	(0.022)	(0.018)
Corporate tax	-0.836***	-0.684***	-0.490***	-0.528***	-0.485***
	(0.041)	(0.076)	(0.071)	(0.067)	(0.079)
Dividend tax	-0.169***	0.083	-0.109**	-0.167***	-0.093
	(0.033)	(0.095)	(0.050)	(0.040)	(0.057)
Interest rate	-0.512***	-0.177*	-0.945***	-0.642***	-0.318***
	(0.038)	(0.096)	(0.092)	(0.064)	(0.062)
log(Productivity)	0.022***	0.018***	0.016***	0.017***	0.018***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Age	-0.015***	-0.014***	-0.014***	-0.014***	-0.014***
	(0.002)	(0.002)	(0.003)	(0.003)	(0.003)
Age^2	0.000***	0.000***	0.000***	0.000***	0.000***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Constant	0.417***		0.356***		
	(0.069)		(0.092)		
Country-year controls	yes	yes	yes	yes	yes
Firm fixed effects	yes	yes	yes	yes	yes
Year fixed effects	yes	yes	yes	yes	yes
Threshold		0.335		0.015	0.188
		[0.318,0.345]		[0.012,0.015]	[0.183,0.190]
N	194,220		121,608		
R^2 (within)	0.047		0.061		

Notes: Robust standard errors in parentheses. ***, ** and * indicate statistical significance at the 1%, 5% and 10% test levels, respectively. Confidence bounds for the threshold at the 5% level in squared brackets are based on a likelihood ratio statistic. Country-year controls include GDP per capita, FDI inflows (in percent of GDP), the percentage of bank non-performing loans in total gross loans, domestic credit to the private sector provided by banks (in percent of GDP), gross fixed capital formation (in percent of GDP), and gross savings (in percent of GDP).

Table 4: Threshold regression results: Code negative investment as zero investment.

	Entrepreneurial firms		Managerial firms		
Investment	Cash-constr.	Tax-constr.	No dividends		Dividends
			Sev. constr.	Cash-constr.	
Cash ratio	0.220***	0.095***	1.207***	0.296***	0.110***
	(0.010)	(0.025)	(0.181)	(0.021)	(0.017)
Corporate tax	-0.656***	-0.520***	-0.373***	-0.388***	-0.344***
	(0.035)	(0.069)	(0.062)	(0.061)	(0.071)
Dividend tax	-0.183***	0.041	-0.162***	-0.155***	-0.089*
	(0.030)	(0.089)	(0.043)	(0.038)	(0.054)
Interest rate	-0.364***	-0.128	-0.567***	-0.507***	-0.259***
	(0.026)	(0.083)	(0.074)	(0.049)	(0.053)
log(Productivity)	0.020***	0.017***	0.015***	0.017***	0.017***
	(0.001)	(0.002)	(0.002)	(0.002)	(0.002)
Age	-0.008***	-0.007***	-0.009***	-0.010***	-0.010***
	(0.002)	(0.002)	(0.003)	(0.003)	(0.003)
Age^2	0.000***	0.000***	0.000***	0.000***	0.000***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Constant	0.182***		0.183**		
	(0.059)		(0.081)		
Country-year controls	yes	yes	yes	yes	yes
Firm fixed effects	yes	yes	yes	yes	yes
Year fixed effects	yes	yes	yes	yes	yes
Threshold		0.335		0.021	0.188
		[0.314,0.345]		[0.016,0.021]	[0.182,0.190]
N	194,220		121,608		
R^2 (within)	0.053		0.072		

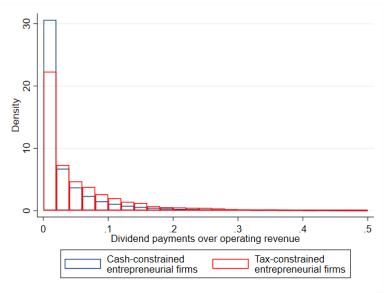
Notes: Robust standard errors in parentheses. ***, ** and * indicate statistical significance at the 1%, 5% and 10% test levels, respectively. Confidence bounds for the threshold at the 5% level in squared brackets are based on a likelihood ratio statistic. Country-year controls include GDP per capita, FDI inflows (in percent of GDP), the percentage of bank non-performing loans in total gross loans, domestic credit to the private sector provided by banks (in percent of GDP), gross fixed capital formation (in percent of GDP), and gross savings (in percent of GDP).

Table 5: Threshold regression results: Ownership cutoff for managerial firms at 25%.

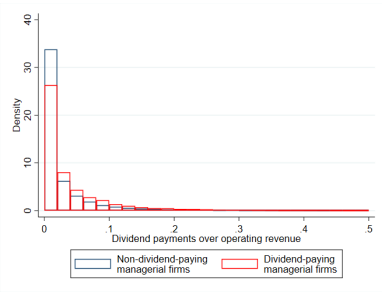
	Entrepreneurial firms		Managerial firms		
Investment	Cash-constr.	Tax-constr.	No dividends		Dividends
			Sev. constr.	Cash-constr.	
Cash ratio	0.430***	0.144***	2.773***	0.198**	0.105***
	(0.030)	(0.008)	(0.778)	(0.097)	(0.033)
Corporate tax	-0.770***	-0.747***	-0.639***	-0.676***	-0.540***
	(0.036)	(0.038)	(0.156)	(0.142)	(0.147)
Dividend tax	-0.175***	-0.138***	-0.280**	-0.131	-0.034
	(0.027)	(0.030)	(0.110)	(0.090)	(0.106)
Interest rate	-0.641***	-0.359*	-1.368***	-0.651***	-0.313***
	(0.042)	(0.037)	(0.167)	(0.120)	(0.089)
log(Productivity)	0.020***	0.021***	0.017***	0.017***	0.015***
	(0.001)	(0.001)	(0.005)	(0.004)	(0.005)
Age	-0.013***	-0.013***	-0.023***	-0.022***	-0.021***
	(0.002)	(0.002)	(0.006)	(0.006)	(0.006)
Age^2	0.000***	0.000***	0.000**	0.000*	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Constant	0.417***		0.356***		
	(0.069)		(0.092)		
Country-year controls	yes	yes	yes	yes	yes
Firm fixed effects	yes	yes	yes	yes	yes
Year fixed effects	yes	yes	yes	yes	yes
Threshold		0.075		0.013	0.094
		[0.072,0.076]		[0.011,0.013]	[0.089,0.095]
N	301,554		25,677		
R^2 (within)	0.051		0.059		

Notes: Robust standard errors in parentheses. ***, ** and * indicate statistical significance at the 1%, 5% and 10% test levels, respectively. Confidence bounds for the threshold at the 5% level in squared brackets are based on a likelihood ratio statistic. Country-year controls include GDP per capita, FDI inflows (in percent of GDP), the percentage of bank non-performing loans in total gross loans, domestic credit to the private sector provided by banks (in percent of GDP), gross fixed capital formation (in percent of GDP), and gross savings (in percent of GDP).

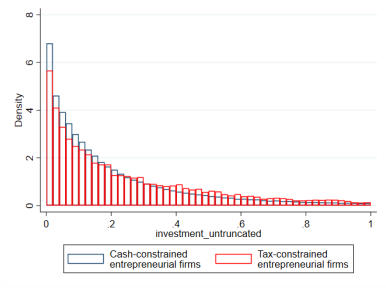
Figure 5: Empirical distribution of dividend payments and investment across firm types.



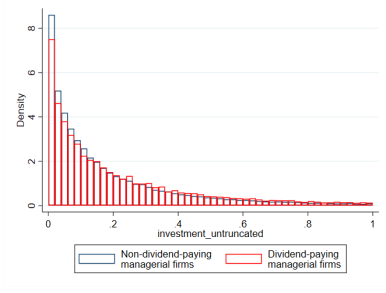
(a) Dividend payments scaled by operating revenues for entrepreneurial firms. The threshold in terms of the cash ratio is set to 0.335.



(b) Dividend payments scaled by operating revenues for managerial firms. The threshold in terms of the cash ratio is set to 0.188.



(c) Investment for entrepreneurial firms. The threshold in terms of the cash ratio is set to 0.335.



(d) Investment for managerial firms. The threshold in terms of the cash ratio is set to 0.188.