Personal Income Taxes, Corporate Profit Taxes and the Heterogeneous Tax Sensitivity of Firm-level Investments*

Peter Egger, Katharina Erhardt & Christian Keuschnigg

May 25, 2014

Abstract

Firms are heterogeneous in size, productivity, ownership concentration, governance, financial structure and other dimensions. The paper introduces a stylized theoretical framework to account for such differences and to explain the heterogeneous tax sensitivity of firm-level investments. We econometrically test the theoretical predictions, taking account of selection of firms into different classes. We find important differences in the tax sensitivity of investment of small entrepreneurial and larger managerial firms in different financial regimes that are largely in line with theoretical results.

JEL classification: D22, G32, H25, L21.

Keywords: Corporate tax, personal taxes, firm heterogeneity, access to capital, manager shareholder conflicts.

Egger: ETH Zuerich, KOF, Weinbergstrasse 35, CH-8092 Zuerich.
Erhardt: ETH Zuerich, KOF, Weinbergstrasse 35, CH-8092 Zuerich.
Keuschnigg: Institute for Advanced Studies, Vienna, and University of St. Gallen (FGN-HSG), Varnbuelstrasse 19, CH-9000 St. Gallen, Christian.Keuschnigg@unisg.ch.

*Keuschnigg appreciates financial support from the Swiss National Science Foundation (project no. 100018_146685).

1 Introduction

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

At some point the entrepreneur wishes to sell out to diversify her wealth and the firm may become public. Large firms are less dependent on external credit. Investment tends to be financed by retained earnings at the margin. Shareholders install an independent management and form a board to supervise the firm. The self-interest and independence of managers leads to a preference for retained earnings over dividend payouts and to partly inefficient investment associated with perks and other benefits in the interest of management. If funds are relatively scarce, firms refrain from paying dividends to maximize retained earnings which are partly diverted to inefficient projects serving the interest of management. Investment depends on dividend and corporate taxes and is also driven by institutional and corporate governance variables such as board composition, voting rights and investor protection. If more internal funds are available, firms pay dividends. In large, dividend paying firms, investment depends on the user cost of capital while dividend payouts are driven by institutional and corporate governance variables.

Empirical research on the tax determinants of investment falls in three groups. First, a large traditional literature does not specifically take account of financial frictions and problems of corporate governance and investigates mainly how investment depends on the user cost of capital. Hassett and Hubbard (2002) review the empirical literature and report estimates of investment elasticities with respect to the user cost in the range between -0.5 and -1.0. Auerbach and Hassett (2003) show how the effect of dividend and corporate taxes depend on the marginal source of funds.[1] In contrast, when firms are finance constrained, investment becomes sensitive to cash-flow, own collateral and institutional country characteristics (see Hubbard, 1998, for an early survey). A second strand of the empirical literature emphasizes the prevalence of credit constraints. In general, young and small firms are more likely to be credit constrained than large firms (Beck et al., 2005; Aghion et al., 2007). Both entry and subsequent firm growth are limited by financial frictions (see Hubbard, 1998; Beck and Demirguc-Kunt, 2006; Aghion et al., 2007). Empirical research also finds that innovative firms tend to face tighter financing restrictions than non-innovative firms (Himmelberg and Petersen, 1994; Guiso, 1998; Hall and Lerner, 2010). Chirinko and Schaller (1995) and Hoshi, Kashyap and Scharfstein (1991) report elasticities of physical capital investment to cash-flow around 0.4-0.5. Estimates for total working capital are significantly higher and vary between 0.8 to 1.3 (see Fazzari and Petersen, 1993; Calomiris and Hubbard, 1995; and Carpenter and Petersen, 2002). Ellul et al. (2012, 2010) find taxes to have a significant impact on investment and to importantly

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

interact with institutional or firm specific characteristics that relate to credit constraints. Finally, a third strand of the literature discusses taxes and other determinants of investment and dividend payout behavior in large firms with a manager shareholder conflict. Chetty and Saez (2005, 2006, 2010) theoretically and empirically consider the effects of dividend and corporate taxes on investment and dividend behavior. Desai et al. (2007) show that corporate taxes interact with investment and rent diversion by managers.

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

The paper will shed light on the heterogeneity of investment responses to effective (personal plus corporate plus dividend) income taxation empirically. We will make use of accounting information from a large data-set on individual firms. This data-set provides information on the profits, sales, financial assets, intangible assets (as a measure of R&D intensity), and owner structure of hundreds of thousands of firms in a set of European countries. In conjunction with detailed information in those countries, we will be able to determine the hypothetical first-best user costs of capital per firm. Moreover, we will be able to assess to which extent the user costs of capital matter more or less depending on the financial constraints firms face. We will pursue an empirical approach which unifies two features: (i) a flexible (non-parametric) impact of taxes and costs of capital on firm-level investment, and (ii) the potential endogeneity of effective taxes due to choices made by the firm (e.g., the degree of dividend payments, etc.). One merit of this approach will be to determine empirically the susceptibility of investments across firms in terms of observable characteristics with special emphasis on the personal and corporate tax system.

Using a large set of country and firm-level data, the empirical analysis largely confirms theoretical predictions. In small entrepreneurial firms subject to credit rationing, investment positively and significantly depends on own cash-flow and on investor protection restraining potential diversion of funds by entrepreneurs. These variables lose power when firms are endowed with more own funds. Taxes negatively affect investment where the personal income tax is most relevant for small entrepreneurial firms while larger ones are most negatively affected by the corporate tax. With non-dividend paying managerial firms, investment is most negatively affected by the corporate tax which becomes less important once firms start paying dividends. Dividend taxes mainly affect the extensive margin of investment. Institutional variables such as investor protection and disclosure index are important determinants of invesment as well.

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

2 The Model

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

Entrepreneurial firms have no independent board that represents shareholder interests and, therefore, have no access to external equity but are rather dependent on bank credit. External equity financing is associated with the entrepreneur 'going public' to raise funds on the stock market or selling out a substantial share to other investors.[2] To obtain

[2]We do not equate 'going public' with stock market listing. Many medium sized firms remain unlisted

the cross-section, we may assume that entrepreneurs have a higher discount rate than investor owned firms (see Michelacci and Suarez, 2004), $r > i$, so that managerial firms have larger firm value, all else equal. On the other hand, selling out to investors requires to set up a board and hire a manager which reduces the value to owners. Given this trade-off, smaller firms with limited own assets remain entrepreneurial and larger choose a managerial structure with diversified ownership.

2.1 Entrepreneurial Firms

We introduce a simple model of a manager owned entrepreneurial firm which might be credit constrained or not. If constrained, investment is rationed, yielding an unexploited excess return on capital. We follow Ellul et al. (2010, 2012) for a simple way of modeling credit constraints. The firm invests I to generate net earnings $\theta f(I)$ were $f' > 0 > f''$. Investment is financed by own funds A and external debt B. Dividends in periods zero and one are D and D_1, and corporate tax liabilities are T and T_1. Capital must earn a rate of return or interest equal to r. By subtracting the opportunity costs of own funds $(1+r)A$, we define firm value as a surplus over own wealth. Financial identities are

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

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

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

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

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

but have several owners, establish a board of directors and hire a professional manager.

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

First-Best: Using $B = D - A + (1 - e\tau) I$ in D_1, optimality conditions are

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

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

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

Raising dividends today reduces dividends tomorrow. In the absence of tax, the effect on net firm value is zero. If the firm pays more dividends, it must raise more external debt. Since interest on debt is deductible, repayment is tax subsidized tomorrow, leaving a net gain to the firm by shifting investment financing from retained earnings to external debt, $(1-e\tau) I = (A - D) + B$. The firm raises dividends as much as possible by raising more external debt which is limited to $B \leq (1-e\tau) I$, or $D \leq A$.

Financing Constraint: In period 1, investment and financing (I, B and D) are predetermined. Suppose insiders can divert earnings $\phi' I$. Depending on the legal environment (investor protection, antidirector laws etc.), diversion is limited to $\phi' \in [0, \phi]$. If the entrepreneur were honest, she can promise external investors at most a repayment of $\theta f + I - \tau T_1 \geq (1+r) B$. If the entrepreneur diverts funds, she reduces pledgeable earnings by $\phi' I$ and can get external funds only if full repayment is credible, i.e. if reported profits are positive, $\pi_1 = \theta f + I - \tau T_1 - \phi' I - (1+r) B \geq 0$. If there is a small cost of diversion, the entrepreneur will never benefit from diverting small amounts since her total income $\pi_1 + \phi' I = \theta f + I - \tau T_1 - (1+r) B$ (prior to getting a return on equity) would not be affected.

If earnings are low and the firm is loaded with too much external funds, there might be a situation of $\theta f + I - \tau T_1 - (1+r) B > 0 > \theta f + I - \tau T_1 - \phi I - (1+r) B = \pi_1$. Since

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

small amounts of diversion don't add to final wealth, she is clearly better off in diverting the maximum amount ϕI, reporting negative book earnings and declaring bankruptcy. Given limited liability, the entrepreneur is left with zero residual profit, but keeps diverted earnings ϕI. External investors would recover only part of the promised repayment, $\theta f + I - \tau T_1 - \phi I < (1+r) B$. To prevent this scenario, they stop lending as soon as the no-diversion constraint becomes binding, $(1-\tau)\theta f(I) + (1-e\tau) I - (1+(1-\tau)r) B \geq \phi I$. When access to external funds is limited, the firm is forced to cut dividends and keep retained earnings to economize on external funds, $B = (1-e\tau) I - (A-D)$, see Appendix A. This leaves the no-diversion constraint [use $R \equiv 1 + (1-\tau) r$]

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

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

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

Entrepreneurial firms may be in two regimes, see Appendix A for an analytical solution. Cash-poor firms are severly constrained and cannot pay any dividends. The financing constraint in (6) binds even if the firm pledges a maximum of own funds by setting dividends to zero ($D = 0$). Investment is implicitly determined by (6) and depends on inside equity or the legal environment as measured by ϕ, and on determinants of pledgeable earnings, including tax payments,[4]

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

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

Figure 1 illustrates how the financing constraint in (6) determines investment. With marginal debt financing, dividend taxes have no impact. Cash-poor firms with little own

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

funds are heavily constrained and do not pay dividends. They are left with unexploited investments and earn an excess return. Investment rises with own funds and declines with higher cost of capital and with deteriorating institutional quality (higher ϕ).

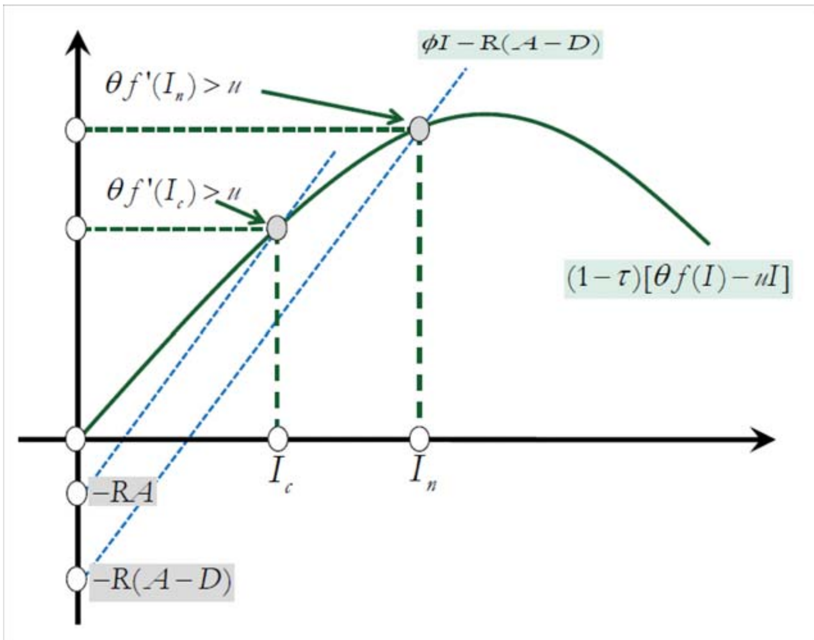

Figure 1: Entrepreneurial Investment

If a firm is endowed with relatively high own funds, it starts to pay dividends (case $D > 0$). It could invest at the first-best level and pay out dividends and raise external debt such that the financing constraint 'just binds'. At that point, pushing for higher dividends would reduce retained earnings even further and restrict investment. Given the tax advantage of debt, this strategy is value increasing since a small cut in investment doesn't affect firm value while a small increase in debt financed dividends is strictly value increasing due to tax savings, see (4). Therefore, the optimal investment of a dividend paying firm is reduced below the first-best level and still earns an excess return, see the discussion of (A.3) and the illustration in Figure 1,

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

Investment of a dividend paying entrepreneurial firm thus changes by

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

Results are as expected. A higher tax rate reduces investment because it makes firms to pay out even more dividends to exploit the larger tax advantage of debt, accepting a somewhat smaller level of investment due to diminishing internal funds. A slight ambiguity remains since a larger tax rate magnifies the value of the investment tax credit which in itself strengthes cash-flow and investment. This effect is unimportant if the tax credit is small ($e \to 0$).

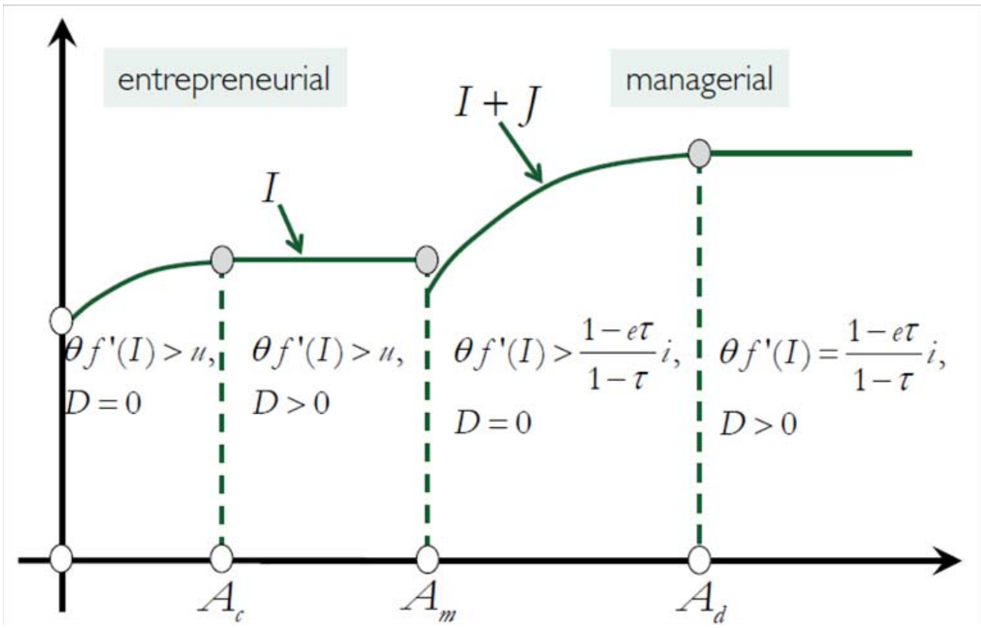

Figure 2: Firm Investment in the Cross-Section

Firm Value: Firms differ in own funds A. Given low own funds, the *financing constraint binds* even if retained earnings are maximized with $D = 0$, implying external debt equal to $B = (1 - e\tau) I - A$. Investment follows from (6) and depends on A. Noting (2), firm value rises with own funds, at least for small taxes ($\tau \to 0$),

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

When own funds are larger, investment I_n is *less constrained* and is independent of A, see (8). Given interest deductibility of debt, the firm wants to pay out dividends and, for that purpose, raises as much external debt as possible. Given I_n, the financing constraint yields the minimum level of retained earnings, $R(A-D) = \phi I - (1-\tau)(\theta f(I) - uI)$, and thereby the maximum level of external debt, $B = (1-e\tau)I - (A-D)$. Hence, both investment and external debt, I and B, are independent of A so that current dividends $D = A + B - (1-e\tau)I$ rise one to one with own funds while period 1 dividends decline in proportion to $1+r$. The net discounted effect is zero.

Clearly, a cash-poor firm is constrained so that more own funds boost investment and add to firm value in proportion to the excess return. The effect eventually disappears when firms start to pay dividends and investment is exclusively driven by the tax advantage of debt. Figure 2 illustrates. There is a cut-off value A_c such that firms with $A < A_c$ are severly constrained and do not pay dividends while richer firms with more own funds $A > A_c$ are less constrained and pay dividends. Figures 2 and 3 compare entrepreneurial and managerial firms and display how firm values and investment change with assets.

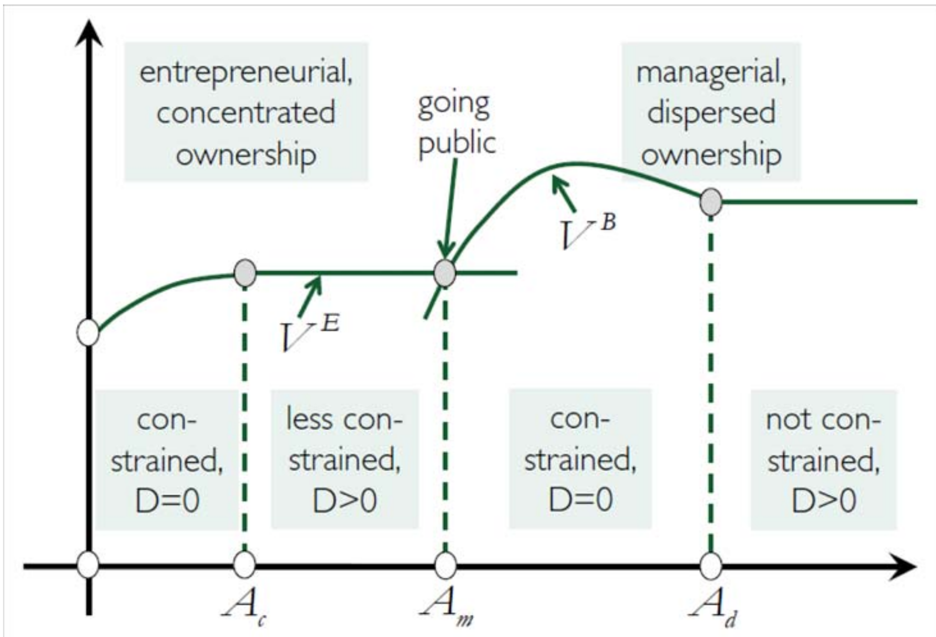

Figure 3: Firm Values in the Cross-Section

2.2 Managerial Firms

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

2.2.1 Agency Model

In large firms (high A), entrepreneurs divest and sell out to external investors who require a lower return on their diversified portfolio, $i < r$, but are passive owners and must hire a manager (possibly the founding entrepreneur). It is now the manager who can divert a part J of the firm's funds, instead of productively investing it. In total, she spends $I + J$ where J does not add to the firm's earnings $f(I)$.[5] After spending on investment, managers use the remaining funds to pay out dividends. Abstracting from new equity issues, the marginal source of finance is retained earnings, leading to the first period financial identity $(1 - e\tau)(J + I) = A - D$. In the second period

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

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

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

[5] In separate calculations, we analyze the more realistic case of $f(I + \kappa J)$ with $\kappa < 1$, without affecting qualitative results.

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

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

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

Active owners (board members) acquire the firm and cede a share α to managers, possibly against a payment B^M. The board thus keeps a residual share of $1-\alpha$. Private benefits from less productive investment J are reduced by tighter monitoring by board members and higher institutional quality relating to investor protection, antidirector rights, accounting standards etc. Given that our focus is on investment decisions, we refrain from endogenizing board monitoring. In our simplified framework, parameter q thus captures the effects of monitoring and institutional quality.[6]

2.2.2 First Best

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

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

[6] More generally, we could take account of a separate monitoring activity γ, giving rise to a monitoring cost $c(\gamma)$, which reduces private benefits of managers beyond the effect of institutional quality. One could also introduce competitive passive shareholders with value $V^S = \alpha^S \cdot V - B^S = 0$. The manager's value would be $V^M = \alpha \cdot V + \frac{g(J)}{(1+i)q\gamma} - B^M$, while $V^B = \left(1 - \alpha - \alpha^S\right)\cdot V - c(\gamma) + B^M + B^S$ would be the value to board members. Adding up gives total value $V^* = V - c(\gamma) + \frac{g(J)}{(1+i)q\gamma}$. Keeping $\gamma = 1$ fixed and normalizing $c(\gamma) = 0$, and abstracting from passive shareholders ($\alpha^S = B^S = 0$) yields (12).

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

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

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

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

2.2.3 Investment and Dividend Policy

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

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

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

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

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

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

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

This condition implicitly determines productive investment I and, in turn, yields J. Investment no longer depends on user cost but rises with internal funds A, higher managerial profit share α, better governance or higher institutional quality (larger q). Using $\nabla \equiv -(1-t_D)(1-\tau)\,\alpha\theta f'' - g''/q > 0$, we have[7]

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

A larger profit share and better governance or a better institutional environment lead managers to focus more on value maximization and productive investment. Taxes or firm level productivity reduce firm value relative to the value of private benefits and thereby induces managers to shift resources from productive investments to unproductive ones.

Unproductive investment changes by $dJ = d\frac{A}{1-e\tau} - dI$ and total spending by

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

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

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

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

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

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

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

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

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

The cross-section includes entrepreneurial and managerial firms, and within each class dividend paying or non-dividend paying firms, giving four types in total. In a life-cycle interpretation, firms start out entrepreneurial with concentrated ownership. (i) Those with low own assets are smallest and do not pay dividends to maximize internal funds. Investment is restricted by pledgeable cash-flow. (ii) Those with larger funds pay dividends. Given the tax advantage of debt, they prefer external credit relative to retained earnings and thereby end up debt constrained as well, but to a minor extent. At some level of funds, entrepreneurs sell out, i.e. the firm is acquired by diversified investors or goes public, requiring a lower return on equity. A manager is hired and a board is installed to control the firm. (iii) Managerial firms with limited own funds are non-dividend paying. They retain all profits for internal financing and, due to diversion of funds, do not fully exploit their productive investment opportunities. (iv) Cash-rich firms with large internal funds pay dividends and invest at an unrestricted level even though some investment is diverted to non-productive uses and thereby limits the amount of dividend distributions. We denote the cut-off values of assets by $A_c < A_m < A_d$, Figures 2 and 3 illustrate.

Table 1: Intensive Investment

		Entrepren. Firms		Managerial Firms			
		No Div.	Div.	No Div.		Div.	
Independent Variables		(7)	(8)	I: (18)	I+J	I: (20)	I+J
Tax credit	e	+	+	+	+	+	+
Corp. tax rate *)	τ	−	−	−	+	−	−
Div. tax rate	t_D	0	0	−	0	0	+
Interest entr. firms	r	−	−				
Interest man. firms	i			0	0	−	−
Firm productivity	θ	+	+	+	0	+	+
Own assets	A	+	0	+	+	0	0
Accounting standards	ϕ	−	−				
Investor protection	q			+	0	0	−
Management share	α			+	0	0	−

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

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

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

Cash-poor firms (low A) do not pay dividends. Investment rises less than proportionally with A, $0 < \frac{dI}{dA} < 1$, since managers divert some funds to unproductive uses that mainly serve managerial benefits. Hence, $J = A - I$ also rises. The marginal returns f' and g' shrink until (16b) holds with equality, moving the firm to the interior regime. For low assets, productive investment is constrained, i.e. $\theta f'(I) > \frac{1-e\tau}{1-\tau} i$. If the excess return is large, then $dV/dA > 0$, even if some funds are invested unproductively. When moving towards the interior regime, $\theta f'(I) \to \frac{1-e\tau}{1-\tau} i$, firm value starts to decline, $dV/dA < 0$, even though the manager's objective still rises since she derives private benefits form perks at the expense of owners. In the limit, firm value $\frac{dV}{dA} = \frac{(1-t_D)(1-\tau)}{1+i}\left[\theta f'(I)\frac{dI}{dA} - \frac{1-e\tau}{1-\tau} i \frac{1}{1-e\tau}\right]$ shrinks with assets near the cut-off, i.e. $\theta f' \to \frac{1-e\tau}{1-\tau} i$ yields $\frac{dV}{dA} \approx \frac{(1-t_D)(1-e\tau)i}{1+i}\left(\frac{dI}{dA} - \frac{1}{1-e\tau}\right) < 0$ since $\frac{dI}{dA} < \frac{1}{1-e\tau}$. Figure 3 illustrates.

3 Empirical Framework

3.1 Data Description

This study employs data from five sources. First of all, at the heart of the analysis are annual firm-level data published in Bureau van Dijk's Orbis database on balance sheets, the subnational location, main industry affiliation, incorporation, status and legal form of 5'073'711 companies in 40 European countries between the years 2000 and 2013.

Second, data on accounting standards (Disclosure Index) as well as investor protection (Investor Protection Index) are taken from the World Bank's Doing Business 2013 Report. Finally, the paper utilizes detailed data from Bösenberg, Egger, and Erhardt (2014) on the taxation of corporate profits, from Bösenberg, Rydzek, and Egger (2014) on the taxation of dividends and from Egger, Radulescu, and Strecker (2013) on the taxation of personal income across countries and time. We describe features of these data in the remainder of this subsection.

3.1.1 Company Balance-sheet Data

The company data include information of the following kind. First of all, key dependent variables to the empirical analysis at the firm level are investments and the value of the firm. Since the theoretical model discerns unlisted and publicly listed companies, information on public listing and paid-out dividends is another important bit of information. Regarding the financial environment, cash flow, external debt, firm size, and firm age are further variables which appear important in this context.

3.1.2 Investor Protection Data

Country-level indicators on investor protection aim at measuring shareholder protection against the misuse of corporate assets and are obtained from a survey of corporate and security lawyers. Based on regulations, company laws, and court rules, the World Bank develops an *extent of disclosure index*, an *extent of director liability index*, and an *ease of shareholder suits index*, ranging from 1 to 10 each. The *investor protection index* is obtained from a weighted average of these indices.

3.1.3 Country-level Data on Profit and Personal Income Tax Schedules

The theoretical model alludes to the role of taxes on profits of manager-entrepreneur firms and on the personal income of managers in listed firms. Details on the effective (average and marginal) tax rates on companies' profits are collected in Bösenberg, Egger, and Erhardt (2014). Firms differ in terms of the composition of their investments and assets (with regard to tangible versus intangible investments and also with regard to the type of fixed tangible investments such as those in machinery, buildings, etc.) and the associated specific tax deductibility and depreciation rates. Egger and Loretz (2010) determine industry-specific and firm-specific effective tax rates by taking the nature of typical investments per 4-digit sector of the NACE industry classification into account, and Bösenberg, Egger and Erhardt (2014) provide an even more detailed approach, using long panel data covering the most recent years. Egger, Radulescu, and Strecker (2013) collect detailed panel data on the personal income tax schedule per country which permits computing effective personal income tax rates for any gross wage by following the OECD's Taxing Wages approach. Finally, Bösenberg, Egger, and Rydzek (2014) collected data on dividend taxes. While the theory in section 2 only differentiates between corporate taxes and dividend taxes we also include income taxes. Depending on the legal form of a firm one of the two taxes might be relevant. Ex ante, we would expect income taxes being more important for small, constrained entrepreneurial firms.

3.1.4 Descriptive Statistics

The main dependent variable **investment** is constructed from the balance sheet data as the percentage increase in fixed assets within a period of three years. Hence, investment at time t is defined as the percentage increase in fixed assets from time t to $t+3$. With respect to the theortical model in section 2 the investment measure observed in the balance sheet data should be interpreted as productive investment I rather than productive plus unproductive investment $I+J$. The **interest rate** is calculated as the total interest expenses of a firm per total liabilities. In order to get a measure of **productivity** we follow recent theoretical work on heterogeneous firms (Melitz, 2003). In a first step, we estimate the industry-specific mark-up over unit-costs by the average ratio of sales to gross profits. This mark-up is used to calculate total production costs from total sales.

Firm-level productivity is calculated as total production costs per worker.

Insert Table 1: Summary Statistics

In the proposed theoretical framework, the main determinant for selection into the different regimes (constrained entrepreneurial, less constrained and dividend paying entrepreneurial firm, non-dividend paying managerial firm and dividend paying managerial firm) are **own assets**. As we assume that entrepreneurial firms cannot raise external equity to finance their investments, they must use either their liquid means or external debt to finance investments. To account for the liquid means firms can use, we choose the **cashflow ratio** defined as cashflows over total assets. Taxes as well as disclosure and investor protection indices are taken directly from the sources named above. In our analysis, we use a cross section of data for the period 2009-2013 and, additionally, we conduct robustness checks for a cross section over the years 2004-2007. Summary statistics of all variables are presented in Table 1 and regime-specific statistics of balance sheet data are provided in Table 4.

3.2 Econometric Strategy

Figure 2 suggests a nonlinear (kinked) relationship between own assets and investment. Most importantly, when starting from small fund levels and moving (to the right) towards larger ones, the figure suggests that there is a kink at a level of own assets for the marginal entrepreneur who becomes financially less constrained and dividend paying. To the left of this entrepreneur (at lower levels of own assets), the marginal effect of own assets on investment is higher than to the right of her (at higher levels of own assets). Most importantly, it is inherently unobservable to the researcher who (where in own assets space) that entrepreneur is. Hence, the threshold is latent and needs to be estimated. Moreover, the figure points to two further threshold levels in own assets space as we raise funds further beyond the level of the marginally less constrained entrepreneur: the first one occurs for the marginal managerial firm (which we associate with being listed at stock markets) and the second one for the marginal dividend-paying firm. The latter two thresholds are inherently observable – it is known which firms have boards and are listed at stock markets and which are not and what their assets are, and it is similarly known which of the listed firms pay dividends and which do not and what their assets are. In light of these features, we propose an econometric strategy which involves a latent, estimable threshold and two observable, endogenous ones.

3.2.1 Unobserved Threshold Regression

In what follows, we will outline a regression framework which is suitable to estimate the endogenous, unobserved threshold in own assets (A_i-)space, A_c, which denotes the *address* in A_i-space of the marginally financially constrained firm. For the subsequent notation, it will be useful to use the subscripts $\{u, c\}$ for the subspaces of A_i where the unconstrained and the constrained firms are located, respectively.

For estimating the unobserved threshold A_c and the parameters of the fundamental drivers to the left (c) and the right (u) of it in own assets (A_i-)space, we follow Seo and Linton (2007) as well as Hansen (2000). This framework allows for different slope estimates for two different regimes around an unobserved threshold. The basic model goes back to Hansen (2000) and takes the form

$$I_i = \begin{cases} x_{c,i}\beta_c + e_i & \text{if } A_i \leq A_c \\ x_{u,i}\beta_u + e_i & \text{if } A_i > A_c. \end{cases} \tag{23}$$

Whereas Hansen (2000) required the threshold to be sharp and uni-dimensionally determined, Seo and Linton (2007) extended Hansen's framework to allow for the threshold not only being determined by smoothed (kernel) regression but also being multi-dimensional. Let the sample considered and information available to consist of $\{I_i, x_{c,i}, x_{u,i}, A_i\}_{i=1}^{n}$ where n denotes the number of cross-sectional units (in the present paper, firms), and the vectors $x_{c,i}$, $x_{u,i}$, and A_i may have elements in common. Then, the model may be written as

$$I_i = x_{c,i}\beta_c + x_{u,i}\beta_u \mathbf{1}\{A_i > A_c\} + e_i. \tag{24}$$

The least-squares estimator proposed by Seo and Linton (2007) minimizes the objective function

$$S_n^*(\theta) = \frac{1}{n}\sum_{i=1}^{n}\left(I_i - x_{c,i}\beta_c - x_{u,i}\beta_u \mathbf{1}\{A_i > A_c\}\right)^2, \tag{25}$$

where $\theta = (\beta_c', \beta_u', A_c)'$ is assumed to exhibit a compact parameter space. Seo and Linton (2007) employ a smoothed least-squares estimator defining a kernel function $\mathcal{K}(\cdot)$ which depends on the bandwidth s with $\underset{s\to-\infty}{\mathcal{K}(s)} = 0$ and $\underset{s\to\infty}{\mathcal{K}(s)} = 1$. The smoothed objective function reads:

$$S_n(\theta) = \frac{1}{n}\sum_{i=1}^{n}\left(I_i - x_{c,i}\beta_c - x_{u,i}\beta_u \mathcal{K}\left(\frac{A_i A_c}{b_n}\right)\right)^2, \tag{26}$$

where b_n denotes the sample-analogue for the bandwidth. The smoothed least-squares estimator estimates

$$\theta_n = (\beta_n', \delta_n', A_{c,n})' = \underset{\theta\in\Theta}{\arg\min} \quad S_n(\theta; b_n). \tag{27}$$

This optimization problem is solved by a two-step procedure. First, one solves the least-squares problem for a given A_c, yielding

$$\begin{bmatrix} \beta_{c,n}(A_c) \\ \beta_{u,n}(A_c) \end{bmatrix} = \begin{bmatrix} \sum_{i=1}^{n} x_{c,i}' x_{c,i} & \sum_{i=1}^{n} x_{c,i}' x_{u,i} \mathcal{K}_i(A_c) \\ \sum_{i=1}^{n} x_{u,i}' x_{c,i} \mathcal{K}_i(A_c) & \sum_{i=1}^{n} x_{u,i}' x_{u,i} \mathcal{K}_i(A_c) \end{bmatrix}^{-1} \begin{bmatrix} \sum_{i=1}^{n} x_{c,i}' y_i \\ \sum_{i=1}^{n} x_{u,i}' y_i \mathcal{K}_i(A_c) \end{bmatrix}. \tag{28}$$

In a second step, one uses these estimates to solve (27) for $A_{c,n}$.

3.2.2 Switching Regressions

The theoretical model suggests two observables (endogenous) thresholds, one at an asset (or A_i) level of the marginally listed firm and one at an assets (or A_i) level of the marginally dividend-paying (and listed) firm. Let us denote those thresholds by A_l and A_d and, in general, by A_ℓ with $\ell = \{l, d\}$, respectively.

For the switching regression models, it is useful to define the latent variables

$$I_{l,i}^* = z_{l,i}\delta_l + u_{l,i} \text{ for all } i \text{ with } A_i > A_c, \tag{29}$$

$$I_{d,i}^* = z_{d,i}\delta_d + u_{d,i} \text{ for all } i \text{ with } A_i > A_d, \tag{30}$$

and the associated indicator variables

$$\mathbf{1}_{\ell,i} = \begin{cases} 1 & \text{if } I^*_{l,i} > 0 \\ 0 & \text{if } I^*_{l,i} \leq 0. \end{cases} \tag{31}$$

Denoting the expected values about quadratic forms of the disturbances as $E[e_i^2] = \sigma_e^2$, $E[u_{\ell,i}^2] = \sigma_\ell^2$, $E[e_i u_{\ell,i}] = \sigma_{eu_\ell}$, and $E[e_i e_j] = 0$ as well as $E[u_i u_j] = 0$ for all $j \neq i$. It is customary to model the trivariate distribution of $\{e_{\ell 1,i}, e_{\ell 0,i}, u_i,\}$ for units to the left and the right of threshold A_ℓ by a trivariate normal of the form

$$\Omega_\ell = \begin{pmatrix} \sigma^2_{e_{\ell 1}} & 0 & \rho_{\ell 1}\sigma_{e_{\ell 1}} \\ 0 & \sigma^2_{e_{\ell 0}} & \rho_{\ell 0}\sigma_{e_{\ell 0}} \\ \rho_{\ell 1}\sigma_{e_{\ell 1}} & \rho_{\ell 0}\sigma_{e_{\ell 0}} & 1 \end{pmatrix}. \tag{32}$$

Then, using $\phi(z_{\ell,i}\delta_\ell)$ and $\Phi(z_{\ell,i}\delta_\ell)$ to denote the probability density function and the cumulative distribution function evaluated at $z_{\ell,i}\delta_\ell$, respectively, we can write the conditional expectation of investments around observable threshold ℓ as

$$\begin{aligned} E[I_{l,i}] &= 1_{l,i}\left[x_{l0,i}\beta_{l0} + \rho_{l1}\sigma_{e_{l1}}\phi(z_{l,i}\delta_l)\frac{1_{l,i} - \Phi(z_{l,i}\delta_l)}{\Phi(z_{l,i}\delta_l)(1-\Phi(z_{l,i}\delta_l))}\right] && (33) \\ &+ (1_{l,i} - 1)\left[x_{l1,i}\beta_{l1} + \rho_{l0}\sigma_{e_{l0}}\phi(z_{l,i}\delta_l)\frac{1_{l,i} - \Phi(z_{l,i}\delta_l)}{\Phi(z_{l,i}\delta_l)(1-\Phi(z_{l,i}\delta_l))}\right] && (34) \\ &\forall \quad i : A_i > A_c \\ E[I_{d,i}] &= 1_{d,i}\left[x_{d0,i}\beta_{d0} + \rho_{d1}\sigma_{e_{d1}}\phi(z_{d,i}\delta_d)\frac{1_{d,i} - \Phi(z_{d,i}\delta_d)}{\Phi(z_{d,i}\delta_d)(1-\Phi(z_{d,i}\delta_d))}\right] && (35) \\ &+ (1_{d,i} - 1)\left[x_{d1,i}\beta_{d1} + \rho_{d0}\sigma_{e_{d0}}\phi(z_{d,i}\delta_d)\frac{1_{d,i} - \Phi(z_{d,i}\delta_d)}{\Phi(z_{d,i}\delta_d)(1-\Phi(z_{d,i}\delta_d))}\right] && (36) \\ &\forall \quad i : A_i > A_s. \end{aligned}$$

Notice that $\phi(z_{\ell,i}\delta_\ell)\frac{1_{\ell,i}-\Phi(z_{\ell,i}\delta_\ell)}{\Phi(z_{\ell,i}\delta_\ell)(1-\Phi(z_{\ell,i}\delta_\ell))}$ is a generalized inverse Mills' ratio for the cases $1_{\ell,i} = 0$ and $1_{\ell,i} = 1$, and $\rho_\ell\sigma_e$ is the parameter estimated on it.

3.2.3 Integrated Threshold and Switching Regressions (preliminary)

The two approaches (unobserved threshold regression and switching regression) can be combined as follows. First of all, it is useful to integrate the processes for the two observable thresholds (stock market listing, l, and dividend payments, d) into a single one. For this, we may define a single indicator

$$1_i = \begin{cases} 2 & \text{if } A_i > A_d \\ 1 & \text{if } \leq A_s < A_i \leq A_d \\ 0 & \text{if } A_i \leq A_s \end{cases}$$

and the latent processes

$$I^*_{2,i} = z_{2,i}\delta_2 + u_i \text{ for } P(1_i = 2), \tag{37}$$

$$I^*_{1,i} = z_{1,i}\delta_1 + u_i \text{ for } P(1_i = 1), \tag{38}$$

$$I^*_{0,i} = z_{0,i}\delta_0 + u_i \text{ for } P(1_i = 0). \tag{39}$$

These latent processes can be estimated either by individual probit models for the three states $\{2, 1, 0\}$ of 1_i (when putting an assumption about the common variance of the disturbances), or they could be estimated by an ordered probit model. Assuming multivariate normality about the variance-covariance matrix of the disturbances, $\{e_{0,i}, e_{1,i}, e_{2,i}, u_i, \}$,[8] we may write the variance-covariance matrix of the disturbances as

$$\Omega_\ell = \begin{pmatrix} \sigma^2_{e_0} & 0 & 0 & \rho_0\sigma_{e_0} \\ 0 & \sigma^2_{e_1} & 0 & \rho_1\sigma_{e_1} \\ 0 & 0 & \sigma^2_{e_1} & \rho_2\sigma_{e_2} \\ \rho_0\sigma_{e_0} & \rho_1\sigma_{e_1} & \rho_2\sigma_{e_2} & 1 \end{pmatrix}.$$

Define the densities, probabilities, and counter-probabilities of taking state $\{2, 1, 0\}$ by $\{\phi_{2,i}, \phi_{1,i}, \phi_{0,i}\}$, $\{\Phi_{2,i}, \Phi_{1,i}, \Phi_{0,i}\}$, and $\{\Phi_{-2,i}, \Phi_{-1,i}, \Phi_{-0,i}\}$, respectively, for brevity. Moreover, define the inverse Mills' ratios for the three states as $\lambda_{h,i} \equiv \phi_{h,i}\frac{1_{h,i}-\Phi_{h,i}}{\Phi_{h,i}\Phi_{-h,i}}$ for $h \in$

[8] We use the convention that $\{e_{0,i}, e_{1,i}, e_{2,i}\}$ are the disturbances for all $\{1_i = 0, 1_i = 1, 1_i = 2\}$, respectively.

$\{2, 1, 0\}$. Then, we may specify four sets of regressors

$$w_{c,i} = \begin{cases} [x_{c0,i}, \lambda_{0,i}, \lambda_{-0,i}, \lambda_{1,i}, \lambda_{-1,i}, \lambda_{2,i}, \lambda_{-2,i}] & \text{if } A_i \leq A_c \\ 0 & \text{otherwise} \end{cases}, \tag{40}$$

$$w_{u1s0,i} = \begin{cases} [x_{c1,i}, \lambda_{0,i}, \lambda_{-0,i}, \lambda_{1,i}, \lambda_{-1,i}, \lambda_{2,i}, \lambda_{-2,i}] & \text{if } A_c < A_i \leq A_s \\ 0 & \text{otherwise} \end{cases} \tag{41}$$

$$w_{s1,i} = \begin{cases} [x_{s1,i}, \lambda_{0,i}, \lambda_{-0,i}, \lambda_{1,i}, \lambda_{-1,i}, \lambda_{2,i}, \lambda_{-2,i}] & \text{if } A_s < A_i \leq A_d \\ 0 & \text{otherwise} \end{cases} \tag{42}$$

$$w_{d1,i} = \begin{cases} [x_{d1,i}, \lambda_{0,i}, \lambda_{-0,i}, \lambda_{1,i}, \lambda_{-1,i}, \lambda_{2,i}, \lambda_{-2,i}] & \text{if } A_d < A_i \\ 0 & \text{otherwise} \end{cases} \tag{43}$$

The joint set of regressors may be referred to as $w_i = [w_{c,i}, w_{u,i}]$, where $w_{u,i} = [w_{u1s0,i}, w_{s1,i}, w_{d1,i}, 1_{c,i}]$. If the ranks of $\{w_{c,i}, w_{u1s0,i}, w_{s1,i}, w_{d1,i}\}$ are $\{R_c, R_{u1s0}, R_{s1}, R_{d1}\}$, then, the rank of w_i is $R = R_c + R_{u1s0} + R_{s1} + R_{d1} + 1$. The least-squares estimator proposed by Seo and Linton (2007) in this case minimizes the objective function

$$S_n^*(\theta) = \frac{1}{n} \sum_{i=1}^{n} \left(I_i - w_{c,i}\beta_c - w_{u,i}\beta_u \mathbf{1}\{A_i > A_c\}\right)^2,$$

with the kernel-smoothing procedure as outlined above. Again, $A_{c,n}$ is solved for in a second step based on (27), given the estimates of θ.

4 Regression Results

In a first step, we estimate the endogenous threshold of constrained to less-constrained dividend-paying entrepreneurial firms using the subset of non-listed firms. Results are presented in Table 2. For the interpretation, it is important to note that the left column of Table 2 presents threshold-independent estimates, while the right column presents the estimates specific (or incremental) to firms to the right of the threshold. Hence, in order to obtain the net effect for firms to the right of the threshold one has to add up the estimates. As suggested by the theoretical model this threshold is supposed to depend on the liquid means a firm can use for productive investments. The threshold found by the regression is slightly negative at $A_c = -0.0433$. Firms to the left of this threshold react significantly different to changes in the covariates as compared to the unconstrained firms to the right of the threshold. As expected for firms to the left of the threshold which are likely to be small and not incorporated, the income tax seems to be the relevant tax. Furthermore, as hypthesized by the theoretical model, the impact of the tax on investment is negative. Equally consistent are the positive signs on productivity and investor protection. Also, investment rises significantly in the cashflow ratio. Even though, in theory, we distinguish between investor protection and accounting standards, the investor protection seems indeed to be a proxy for the possibility to divert earnings, ϕ. As suggested by the theoretical framework in section 2 this index enters the regression positively.

Insert Table 2: Estimation Results of the Threshold Regression

For less constrained firms to the right of the threshold, the cashflow ratio appears to have no or even a slightly negative impact on investment. According to the theoretical model this should be due to the unconstrained credit opportunities these firms have in contrast to firms to the left of the threshold. In total, the own assets of these unconstrained firms should not influence their investment which is completely determined by the marginal return on investment relative to marginal costs. Concerning taxes, as predicted by theory, investment decreases significantly in effective marginal corporate tax rates.

In order to find the effects of taxes on investment for listed versus non-listed and for dividend- versus non-dividend-paying firms we use a switching regression approach. The corresponding results are presented in Table 3. The left columns of that table refer to the switching regression for listed and unlisted firms while the right columns refer to the switching regression for dividend- and non-dividend-paying firms, respectively. The coefficients of regime 1 refer to the regime to the left of the threshold (non-listed firms or non-dividend paying firms) while the coefficients below are the coefficients specific to the regimes to the right of each threshold. Finally, regime selection results refer to the coefficients on the instruments used in the first stage. Surprisingly, for unconstrained managerial firms, the negative coefficient of the corporate tax rate is no longer significant in the switching regression as opposed to the threshold regression. In order to resolve inconsistencies like that we will apply the integrated framework as described in section 3.2.3 in a next step.

Insert Table 3: Estimation Results of the Switching Regression

For listed non-dividend-paying firms the negative impact of corporate taxes seems to be especially high. This effect is consistent with the theoretical hypthesis regarding the effect on productive investment. In line with this, own liquid assets display a significant positive impact on investment. Coefficients on productivity as well as dividend taxes bear the expected sign but are not significant at conventional levels. Interestingly, the disclosure index is positively related to investment for listed firms while it enters negatively for unlisted firms. For dividend-paying firms we find only the cashflow ratio to have a significant positive impact on investment. However, it should be noted that there is a very small number of observations to the right of this threshold.

To shed light on whether the estimated and observed thresholds indeed separate firms into regimes that are different it is useful to look at summary statistics of fundamentals accross the estimated and observed regimes in Table 4. Most firms are less constrained entrepreneurial firms. By comparison, the number of dividend paying managerial firms is quite low. On average, dividend paying managerial firms are the most productive firms followed by less constrained entrepreneurial firms. Interestingly, cash flow ratios are highest for less constrained, dividend paying entrepreneurial firms. The reason might be that they have not yet accumulated as many assets as investor owned firms, leaving them with a higher cashflow ratio. When the entrepreneur sells to diversified external investors who require a lower rate of return, the firm stops paying dividends since managers have a preference for retained earnings and internal funds are needed for further investment.

Insert Table 4: Summary Statistics Across Regimes

Summing up, the empirical results seem to confirm a great part of the theoretical predictions in the first part of the paper, especially, regarding the differential effects of fundamentals on investment across regimes. Most importantly, the empirical analysis allows us to quantify these effects. Overall, (corporate and income) taxes seem to have a negative impact on investments. However, the size of these effects varies substantially across regimes. Listed firms that do not pay any dividends seem to be most affected by taxes while the effect is much smaller for unconstrained managerial firms and quite low for constrained managerial firms. Surprisingly, interest rates seem to have no significant impact in any of the regressions. Finally, the institutional environment as measured by the investor protection index and the disclosure index appear to be important determinants of investment.

5 Conclusions

This paper sets up a theoretical model explaining the hetorogeneous investment response of firms in different financial regimes. Our theoretical model postulates that small entrepreneurial firms are dependent on external credit and those with little own assets are most likely to be credit constrained and do not pay dividends. Larger firms with more own funds are less constrained and afford to pay dividends. When own funds are larger, entrepreneurs prefer to divest and sell to external investors who require a lower rate of return. Investors hire a manager and install a board to provide oversight and control and reduce unproductive self-serving investments by managers. Managers and shareholder have conflicting interests on the use of internal funds which may be allocated to finance productive investments, self-serving projects in the interest of managers, and paying dividends to shareholders. Managerial firms with relatively little own cash do not pay dividends and, since managers divert part of the resources, cannot fully exploit productive investment opportunities to the benefit of shareholders. Large cash-rich managerial firms invest at unconstrained levels while the manager shareholder conflict over residual funds is over dividend payments versus retained earnings to finance less productive projects in the interest of managers. The model predicts heterogeneous investment sensitivities with respect to personal and corporate taxes, own cash-flow and institutional variables affecting the self-serving behavior of entrepreneurs and managers.

Using a large set of country and firm-level data, the empirical analysis largely confirms theoretical predictions. In small entrepreneurial firms subject to credit rationing, investment positively and significantly depends on own cash-flow and on investor protection restraining potential diversion of funds by entrepreneurs. These variables lose power when firms are endowed with more own funds. Taxes negatively affect investment where the personal income tax is most relevant for small entrepreneurial firms while larger ones are most negatively affected by the corporate tax. With non-dividend paying managerial firms, investment is most negatively affected by the corporate tax which becomes less important once firms start paying dividends. Dividend taxes mainly affect the extensive margin of investment. Institutional variables such as investor protection and disclosure index are important determinants of invesment as well.

6 Appendix

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

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

Optimality with respect to I, D requires

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

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

First, if $dV^E/dD\big|_{D=0} < 0$, the firm sets dividends to zero ($D = 0$) to allow for maximum internal financing. In this case, the shadow price is very large, indicating a tight constraint. For cash-poor firms, the financing constraint binds even if no dividends are paid out, $D = 0$. Substituting $B = (1 - e\tau) I - A$, the constraint implicitly determines investment I (with $D = 0$ in 6), which becomes dependent on own funds A. Given I, condition (i) above yields λ.

The second regime applies when firms are cash-rich and pay pays dividends $D > 0$. The second condition above yields λ, which is used in condition (i) to yield

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

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

Due to the tax preference of external debt, the firm ends up always constrained, $\lambda > 0$, and earns an excess return on investment, $\theta f'(I) > (1 - e\tau) r$. To exploit the tax advantage in the first best, where I^* is given by $\theta f'(I^*) = (1 - e\tau) r$, the firm pays out all earnings as dividends, $D = A$, and finances investment entirely with external debt, $B = (1 - e\tau) I^*$. With zero retained earnings, the financing constraint is violated, see Assumption 1, yielding the constrained solution in (A.3). The constraint in (6) introduces a trade-off between investment and dividends, $\partial I/\partial D = -\partial I/\partial D = -R/k$, see (8).[9] Noting the partial effects on firm value in (4), the firm raises dividends and reduces investment until firm value is maximized, $\frac{dV^E}{dD} = \frac{\partial V^E}{\partial D} + \frac{\partial V^E}{\partial I}\frac{\partial I}{\partial D} = 0$. It becomes optimal to reduce investment below the first best level I^* and, instead, use external debt to pay out more dividends. Substituting partial derivatives and using k yields (A.3) again.

Due to the tax preference for debt, entrepreneurial firms always end up constrained. Cash-poor firms do not pay dividends while firms with more own funds are able to raise

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

more external debt and affort to pay dividends. To separate entrepreneurial firms that pay dividends from those that don't, set $D = 0$ and investment I_n as in (A.3) to obtain the threshold value A_c from (6).

B. New and Old Views The new view of dividend taxation holds that firms finance investment with retained earnings as is common with cash-rich firms. The old view applies to cash-poor firms and holds that they raise new equity to finance investment. Allowing for old and new equity, firm valuation by existing owners is governed by the no-arbitrage condition $i = \left[(1-t_D) D + \left(\tilde{V}_1 - \tilde{V} - B\right)\right] / \tilde{V}$ where B_t is new equity and $\tilde{V}_1 - \tilde{V} - B$ stands for capital gains of existing owners. Rearranging and using end of period value $V \equiv (1+i) \tilde{V}$ yields $V = (1-t_D) D - B + V_1/(1+i)$. Substituting the same expression for V_1 and noting end point conditions $V_2 = 0$ and disinvestment $B_1 = -B$ yields

$$V = (1-t_D) D - B + \frac{(1-t_D) D_1 + B}{1+i}. \tag{B.1}$$

Equating inflows and outflows, financial identities in the first and second periods are

$$A + B = D + (1-e\tau) I, \quad (1-\tau) Y + (1-e\tau) I - (1+i) A = D_1 + B. \tag{B.2}$$

The second identity states inflows from earnings plus disinvestment net of the opportunity cost $(1+i) A$ of own assets since we want to state firm value as surplus. The first identity says that net of tax investment spending is financed by retained earnings $A - D$ and new equity B. Substituting into the second one yields

$$(1-e\tau) I = (A-D) + B, \quad D_1 = (1-\tau) Y + A - D - (1+i) A. \tag{B.3}$$

The maximization problem becomes

$$\begin{aligned} V &= \max_{D,B} (1-t_D) D - B + \frac{(1-t_D)\left[(1-\tau)\theta f(I) - D - iA\right] + B}{1+i} \\ &: \quad s.t. \quad I = (A-D+B)/(1-e\tau). \end{aligned} \tag{B.4}$$

Optimality conditions are

$$\begin{aligned} \frac{dV}{dD} &= (1-t_D) + (1-t_D)\frac{-(1-\tau)\theta f'(I)/(1-e\tau) - 1}{1+i} \leq 0, \\ \frac{dV}{dB} &= -1 + \frac{(1-t_D)(1-\tau)\theta f'(I)/(1-e\tau) + 1}{1+i} \leq 0. \end{aligned} \tag{B.5}$$

A firm never pays dividends and issues new equity simultaneously. The old view holds that cash-poor firms with an excess return do not pay dividends and must issue new equity. Since financing investment with new equity doesn't reduce tax liability, the dividend tax reduces the return on investment but not its cost and, therefore, distorts investment:

$$\begin{aligned} \text{old view} &: \frac{dV}{dD} < 0, \frac{dV}{dB} = 0 \quad \Rightarrow \quad \theta f'(I) = \frac{1 - e\tau}{(1 - t_D)(1 - \tau)} \cdot i, \\ \text{new view} &: \frac{dV}{dD} = 0, \frac{dV}{dB} < 0 \quad \Rightarrow \quad \theta f'(I) = \frac{1 - e\tau}{1 - \tau} \cdot i. \end{aligned} \tag{B.6}$$

By the new view, the marginal source of funds is retained earnings rather than external equity. By reducing dividends today (using funds to internally finance investment) and raising dividends tomorrow when retained earnings are distributed, the dividend tax does not affect total tax liability over the firm's life. The dividend tax is neutral, see (B.6).

When firms abstain from issuing new equity and exclusively rely on retained earnings ($B = 0$), firm value (surplus) in (B.4) reduces to [use $A - D = (1 - e\tau) I$]

$$V = (1 - t_D) \frac{(1 - \tau)\theta f(I) - i(A - D)}{1 + i} = (1 - t_D) \frac{(1 - \tau)\theta f(I) - (1 - e\tau) iI}{1 + i}. \tag{B.7}$$

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Table 1: Summary Statistics

Variable	Obs.	Std. Dev.	p(10)	p(90)	Median
log(Investment)	949372	2.0850	-2.9921	1.7922	-0.7509
Income tax	3466150	14.3498	19.4205	67.16508	47.475
Corporate tax	5025668	0.0600	0.1099	0.2753	0.2264
Dividend tax	5028016	7.1839	0	20	5
Interest rate	2241980	1014.031	.0011	.0533	0.0168
log(Productivity)	2059192	1.4801	9.0074	12.54151	11.0612
Cashflow ratio	3409990	1338.706	-0.1394	0.2567	0.0506
Investor protection	4781063	1.0681	4.7	8	5.3
Disclosure index	3900114	2.4143	5	10	7

Table 2: Estimation Results of the Threshold Regression.

log(Investment)	Constrained firms		Diff. of less constrained to constrained firms	
Variable	Coeff.	Std. err.	Coeff.	Std. err.
Cashflow ratio	1.5936***	(0.1218)	-2.1480***	(0.1658)
Income tax	-0.0108***	(0.0006)	0.0130***	(0.0023)
Corporate tax	-0.0600	(0.1469)	-1.4791***	(0.3242)
Disclosure index	0.0008	(0.0029)	0.0096	(0.0115)
Interest rate	0.0025	(0.0147)		
Productivity	0.0590***	(0.0039)		
Investor protection	0.2832***	(0.0076)		
Constant	-2.6401***	(0.0631)		
Threshold (Cashflow ratio)	-0.0433***	(0.0007)		

Table 3: Estimation Results of the Switching Regression.

	Managerial Threshold		Dividend Threshold	
log(Investment) in Regime 1				
Corporate tax	-0.2215	(0.1385)	-8.8366***	(2.1143)
Interest rate	0.0078	(0.0134)	0.0209	(0.3798)
log(Productivity)	0.0483***	(0.0037)	0.0092	(0.0617)
Cashflow ratio	1.4850***	(0.0417)	0.2388**	(0.1074)
Investor protection	0.2652***	(0.0079)	-0.0257	(0.1361)
Disclosure index	-0.0295***	(0.0025)	0.1987***	(0.0631)
Dividend tax			-0.0158	(0.0134)
Constant	-2.6779***	(0.0629)	0.5331	(1.1420)
log(Investment) in Regime 2				
Corporate tax	-7.6019***	(1.8690)	-1.5954	(1.6873)
Interest rate	0.0438	(0.3525)	-0.8210	(2.5046)
log(Productivity)	-0.0772	(0.0645)	0.0509	(0.0498)
Cashflow ratio	2.2030*	(1.3342)	2.8685***	(0.9923)
Investor protection	-0.0977	(0.1285)	0.0167	(0.0706)
Disclosure index	0.2129***	(0.0658)	0.0174	(0.0317)
Dividend tax			-0.0097	(0.0093)
Constant	-0.0439	(0.7721)	-2.2287**	(0.8879)
Regime selection				
Age	0.0177***	(0.0014)	0.0111***	(0.0024)
Age squ.	-0.0000***	(0.0000)	-0.0000*	(0.0000)
Total Assets	0.0000***	(0.0000)	0.0000***	(0.0000)
Income tax	-0.0354***	(0.0021)		
Cashflow ratio	-0.7316***	(0.2413)	5.5402***	(0.5715)
Dividend tax			-0.0342***	(0.0041)
Constant	-1.5860***	(0.0977)	-0.3158***	(0.0830)
lns0	0.6580***	(0.0015)	0.5789***	(0.0357)
lns1	0.4978***	(0.0381)	0.2337***	(0.0366)
r0	0.2892***	(0.0319)	0.2485*	(0.1412)
r1	0.2035**	(0.0832)	0.3226**	(0.1420)
N	217976		1050	

Standard errors in parentheses

$^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$

Table 4: Summary Statistics across Regimes

	Constrained entrepreneurial		Unconstrained entrepreneurial	
Variable	Obs.	Median	Obs.	Median
log(Investment)	55835	-0.5399	891080	-0.7636
Interest rate	318921	0.01629	1917985	0.0168
log(Productivity)	324347	10.2807	1730279	11.1759
Cashflow ratio	587318	-0.1745	2817357	0.0736
	Non-dividend paying managerial		Dividend paying managerial	
log(Investment)	1629	-0.7816	828	-1.1914
Interest rate	3486	0.0298	1588	0.0248
log(Productivity)	3240	10.2982	1326	12.0661
Cashflow ratio	3781	0.0125	1534	0.0722