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Capital Structure, Corporate Taxation and Firm Age

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This paper analyzes the relationship between corporate taxation, firm age and debt. We adapt a standard model of capital structure choice under corporate taxation, focusing on the financing and investment decisions a firm is typically faced with. Our model suggests that the debt ratio is positively associated with the corporate tax rate, and negatively with firm age. Further, we predict that the tax-induced advantage of debt is more important for older than for younger firms. To test these hypotheses empirically, we use a cross-section of 405,000 firms from 35 European countries and 126 NACE 3-digit industries. In line with previous research, we find that a firm's debt ratio increases with the corporate tax rate. Further, we observe that older firms exhibit smaller debt ratios than their younger counterparts. Finally, consistent with our theoretical model, we find a positive interaction between corporate taxation and firm age, indicating that the impact of corporate taxation on debt is increasing over a firm's life-time.

Keywords: Corporate taxation; Capital structure; Firm age
JEL codes: H20, H32, G32, C31

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1 Introduction

Since the seminal work of Modigliani and Miller (1958, 1963) and Miller (1977) a vast number of contributions deals with the optimal financing structure of firms under corporate income taxation (see Graham 2003, for a comprehensive survey). According to this research, firms are weighing the *marginal tax benefits* induced by the deductibility of interest payments on debt against the *marginal financial costs of debt* when determining their 'target' leverage ratio.

The tax-induced benefits of debt are increasing with the statutory corporate tax rate. The costs of debt are typically assumed to increase with the debt level but are independent of other firm characteristics. However, there is an eminent line of research indicating that the costs of debt financing are changing over the life-cycle of a firm. For instance, firms in their start-up phase ('young' firms) typically lack sufficient internal funds to finance investment (see, e.g., Beck, Demirgüç-Kunt and Maksimovic 2008, Keuschnigg and Nielsen 2004), and, due to uncertainty and information asymmetries, have limited access to equity financing (see, e.g., Diamond 1991, Berger and Udell 1998, Fuest, Huber and Nielsen 2002, Beck and Demirgüç-Kunt 2006).[1] Therefore, younger firms typically rely more on debt than older ones (see, Berger and Udell 1998, Gordon and Lee 2001 and Hyytinen and Pajarinen 2007, for empirical evidence). Further, profitable mature firms tend to have more internal funds available from retained earnings. They reduce their reliance on debt, although the costs of external debt financing might decrease with the maturity of a firm. For example, banks might reduce the interest rate for 'surviving' firms (Fazzari, Hubbard and Petersen 1988, Petersen and Rajan 1994 provide empirical evidence). Consequently, if it holds that the costs of debt and, therefore, the reliance on debt financing is changing with the age of a firm, we would also expect that the impact of taxes on a firm's debt policy is varying over its life-time. To our knowledge, there is no study analyzing systematically the relationship between corporate taxation, firm age and debt policy. This paper tries to fill this gap using a large cross-section of manufacturing firms from 35 European countries.

To derive empirically testable hypotheses about corporate taxation, a firm's age and its capital structure, we propose a stylized three-period model of optimal capital structure choice under corporate taxation. The model analyzes the change in the financial structure between these periods, and, therefore, allows to investigate the impact of a firm's age on its debt ratio. We demonstrate that the debt ratio is positively associated with the statutory corporate tax rate, and that older firms rely less on debt than their younger counterparts. Further, we show that

[1] Keuschnigg and Nielsen (2002: p. 175), for instance, argue that *"[F]inancing early stage businesses involves special problems and is fundamentally different from financing mature and well established companies."* In this context, Gordon and Lee (2001: p. 216) emphasize that *"[S]mall firms are more likely to be recent start-ups, that would need to rely much more on outside loans rather than retained earnings in order to finance new investment."* Similarly, Hyytinen and Pajarinen (2007: p. 55) note that *"[Y]oung firms may for example be more prone to default than mature firms, even after holding a number of observable determinants of default risk, such as firm size, amount of tangible assets and industry, constant."*

the (positive) impact of corporate taxation on debt reliance systematically changes with a firm's age, motivating an interaction term between the statutory corporate tax rate and firm age in our empirical analysis.

To test these hypotheses empirically, we use a cross-section of about 405,000 European firms compiled by the Bureau van Dijk's AMADEUS database. We regress the debt ratio (defined as current and non-current liabilities over total assets) on our variables of interest (i.e., the statutory corporate tax rate, firm age and an interaction thereof) along with other controls suggested in the literature (i.e., asset tangibility, firm size, profitability, proxies for financial distress). In line with our theoretical hypotheses, we find that a firm's debt ratio is positively influenced by the statutory corporate tax rate, and negatively affected by firm age. A significantly positive interaction term between firm age and the statutory corporate tax rate indicates that the impact of corporate taxation on the debt ratio is increasing over a firm's life-time, which is consistent with our theoretical expectation.

The remainder of the paper is organized as follows. Section 2 outlines a simple theoretical model that allows to derive empirically testable hypotheses about the relationship between corporate taxation, firm age and debt. Section 3 describes the data and presents some descriptive statistics. Section 4 introduces the econometric specification and presents the empirical results. Section 5 summarizes our main findings.

2 A simple model of corporate taxation, firm age and debt financing

We analyze a firm's investment and financing decisions in a three period model (see Auerbach 1979, Poterba and Summers 1985, for a related two-period framework). Investors are assumed to be risk-neutral. They invest in a firm or, alternatively, in a risk-less asset earning a given market interest rate r. We consider three sources of financing: External equity (i.e., new share issues) denoted by E_t, debt (B_t) and retained earnings. In the initial period, external equity, E_0, is exogenously given with certainty, while it is endogenous in period 2, and denoted by E_1^N. Capital, K_t, is the only factor of production so that output is given by $\pi(K_t)$, with the usual assumptions $\pi'(K_t) > 0$, $\pi''(K_t) < 0$. Further, we normalize the output price to 1. For the sake of brevity and without loss of generality, we ignore economic depreciation and also depreciation for tax purposes. Hence, the current capital stock is equivalent to the sum of past and current investment. Finally, we do not consider personal income taxation at the shareholder level.[2]

[2]This assumption seems especially reasonable under tax systems where imputation is absent, which is the case for most of the countries in empirical analysis below (exemptions are Norway, Spain and the UK).

The timing of investment is as follows: At the end of the founding period 0, the firm invests I_0 using initial equity E_0 and/or debt B_0. Period 1 investment, I_1, is financed out of three sources: New equity, E_1^N, new debt, $B_1 - B_0$, or retained earnings. At the end of period 2, the firm is liquidated, outstanding debt is repaid and the remaining assets are paid out to the shareholders.

Let $b_t = \frac{B_t}{K_t}$ be the debt ratio in period $t = 0, 1$, where b_t is strictly bounded between zero and one. After-tax dividends in period 0, 1 and 2 are given by

$$\begin{aligned} D_0 &= E_0 + B_0 - I_0 = E_0 - (1 - b_0)I_0 \\ D_1 &= (1-\tau)\left[\pi(I_0) - m(b_0)b_0 I_0\right] + \overbrace{b_1\left(I_0 + I_1\right) - b_0 I_0}^{B_1 - B_0} - I_1 \\ D_2 &= (1-\tau)\left[\pi(I_0 + I_1) - m(b_1)b_1(I_0 + I_1)\right] \\ &\quad + I_0 + I_1 - b_1\left(I_0 + I_1\right), \end{aligned} \tag{1}$$

where τ denotes the statutory corporate income tax rate. $m(b_t)$ represents the interest rate paid on debt, comprising the market interest rate r and a risk premium that increases with a firm's debt to asset ratio b_t, e.g., due to information asymmetries between borrowers and/or lenders and other market imperfections (see Stiglitz and Weiss 1981, Fazzari, Hubbard and Petersen 1988, Bernanke, Gertler and Gilchrist 1999, Huizinga, Laeven and Nicodéme 2008, among others). This aspect is captured by the assumptions $m'(b_t) > 0$ and $m''(b_t) \geq 0$. We further assume that the first unit of debt has to pay the market interest rate r, i.e., $m(0) = r$. Following the previous literature, we specify $m(b_t) = r + \frac{\gamma_t}{2} b_t$ (see, e.g., Huizinga, Laeven and Nicodéme 2008 for a similar assumption). The second term, $\frac{\gamma_t}{2} b_t$, represents the risk premium, where γ_t is positive and measures the sensitivity of the risk premium with regard to the debt ratio. Further, we maintain that profits in period 2 guarantee positive dividend payments $D_2 > 0$.

The objective of the firm is to maximize its value, which is given by the present value of the dividend stream. Considering equity constraints in period 0 and assuming that dividends in period 1 might be negative, the Lagrangian is given by

$$\mathcal{L} = D_0 + \frac{D_1 - E_1^N}{1+r} + \frac{D_2}{(1+r)^2} + \lambda_0 D_0 + \lambda_1 \frac{D_1 + E_1^N}{1+r} + \mu_1 \frac{E_1^N}{1+r}, \tag{2}$$

where the Kuhn-Tucker conditions imply that (i) $\lambda_0 \geq 0, \lambda_0 D_0 = 0$, (ii) $\lambda_1 \geq 0$, $\lambda_1(D_1 + E_1^N) = 0$ and (iii) $\mu \geq 0, \mu_1 E_1^N = 0$. The first constraint (i) is not binding if initial equity endowment is sufficiently large, so that $E_0 > I_0 - B_0$. The second constraint (ii) implies that a firm with negative dividends in period 1 is able to obtain new equity. Regarding (iii), we follow Poterba and Summers (1985) assuming that the firm would never simultaneously issue new equity, E_1^N, and pay dividends D_1. Hence, we maintain that $E_1^N = 0$ in case of positive dividend payments in period 1. Further, we rule out that the firm can repurchase shares, implying that $E_1^N \geq 0$.

Therefore, it follows that either $D_1^* > 0 \Rightarrow \lambda_1 = 0, \mu_1 > 0$ and $E_1^{N*} = 0$ or $D_1^* \leq 0 \Rightarrow \lambda_1 > 0, \mu_1 = 0$, where optimal choices are indicated by "*". Under negative dividends, new equity in period 1 is determined as $E_1^{N*} = -D_1^*$ and it is assumed that new equity of this amount is available. The corresponding first order conditions are

$$\begin{aligned}
\frac{\partial \mathcal{L}}{\partial I_0} &= (b_0 - 1)(1 + \lambda_0) + \tfrac{(1-\tau)[\pi'(I_0) - m_0 b_0] + b_1 - b_0}{1+r}(1 + \lambda_1) \\
&\quad + \tfrac{(1-\tau)[\pi'(I_0+I_1) - m_1 b_1] + 1 - b_1}{(1+r)^2} = 0 && \text{(3a)} \\
\frac{\partial \mathcal{L}}{\partial E_1^N} &= \tfrac{-1+\lambda_1+\mu_1}{1+r} = 0 && \text{(3b)} \\
\frac{\partial \mathcal{L}}{\partial I_1} &= \tfrac{b_1 - 1}{1+r}(1 + \lambda_1) + \tfrac{(1-\tau)[\pi'(I_0+I_1) - m_1 b_1] + 1 - b_1}{(1+r)^2} = 0 && \text{(3c)} \\
\frac{\partial \mathcal{L}}{\partial b_0} &= I_0(1 + \lambda_0) + \tfrac{(1-\tau)[-m_0 I_0 - m_0' b_0 I_0] - I_0)}{1+r}(1 + \lambda_1) = 0 && \text{(3d)} \\
\frac{\partial \mathcal{L}}{\partial b_1} &= \tfrac{I_0 + I_1}{1+r}(1 + \lambda_1) + \tfrac{(1-\tau)[-m_1(I_0+I_1) - m_1' b_1 (I_0+I_1)] - (I_0+I_1)}{(1+r)^2} = 0 && \text{(3e)}
\end{aligned}$$

Re-arranging yields

$$\begin{aligned}
\pi'(I_0) &= m_0 b_0 + \tfrac{1}{1+\lambda_1}\left(\tfrac{r(1-b_0)}{1-\tau} + \tfrac{\lambda_0(1-b_0)(1+r)}{1-\tau} - \tfrac{\lambda_1(1-b_0)}{1-\tau}\right) && \text{(4a)} \\
\pi'(I_0 + I_1) &= m_1 b_1 + \tfrac{r(1-b_1)}{1-\tau} + \tfrac{\lambda_1(1+r)(1-b_1)}{1-\tau} && \text{(4b)} \\
m_0 + m_0' b_0 &= \tfrac{r - \lambda_1}{(1-\tau)(1+\lambda_1)} + \lambda_0 \tfrac{1+r}{(1-\tau)(1+\lambda_1)} && \text{(4c)} \\
m_1 + m_1' b_1 &= \tfrac{r}{1-\tau} + \lambda_1 \tfrac{1+r}{1-\tau} \ . && \text{(4d)}
\end{aligned}$$

Inserting $m_t = r + \frac{\gamma_t}{2} b_t$ in (4c) and (4d) simplifies the corresponding first order conditions:

$$\begin{aligned}
b_1^* &= \tfrac{r\tau}{\gamma_1(1-\tau)} + \tfrac{\lambda_1(1+r)}{\gamma_1(1-\tau)} && \text{(5a)} \\
b_0^* &= \tfrac{r\tau(1+\lambda_1) + (\lambda_0 - \lambda_1)(1+r)}{\gamma_0(1+\lambda_1)(1-\tau)} && \text{(5b)} \\
&= \tfrac{r\tau}{\gamma_0(1-\tau)} + \tfrac{\lambda_0(1+r)}{\gamma_0(1+\lambda_1)(1-\tau)} - \tfrac{\lambda_1(1+r)}{\gamma_0(1+\lambda_1)(1-\tau)} && \text{(5c)} \\
b_0^* - b_1^* &= \tfrac{\gamma_1 - \gamma_0}{\gamma_0} b_1^* + \tfrac{\lambda_0(1+r)}{\gamma_0(1+\lambda_1)(1-\tau)} - \tfrac{\lambda_1(1+r)(2+\lambda_1)}{\gamma_0(1-\tau)(1+\lambda_1)}. && \text{(5d)}
\end{aligned}$$

Consider first the case of an initially unconstrained firm with strictly positive dividends in period 1, so that $\lambda_0 = 0$, $D_1 > 0$, $\lambda_1 = 0$, $\mu_1 > 0$ and $E_1^N = 0$. According to conditions (4a) and (4b) the firm invests up to the point where the marginal return on investment is equal to its marginal costs. The latter are given by a weighted average of the opportunity costs of internal funds before taxes, $\frac{r}{1-\tau}$, and the marginal external borrowing costs m_t. The weights of both components depend on the debt ratio and are $1 - b_t$ for the former and b_t for the latter. As a benchmark we can formulate the following result:

Under the following conditions, the age of a firm does <u>not</u> affect its debt ratio (i.e., $b_0^* = b_1^*$):

(a) The firm is initially not equity constrained ($\lambda_0 = 0$).

(b) Dividends in period 1 are strictly positive ($\lambda_1 = 0$).

(c) The risk premium does not depend on firm age, i.e., $m_0(b_t) = m_1(b_t)$ or $\gamma_1 = \gamma_0$.

(d) The corporate tax rate and the interest rate are constant over time.

In this case, we have $b_0^* = b_1^* = \frac{r\tau}{\gamma(1-\tau)}$ and, therefore, $\pi'(I_0) = \pi'(I_0 + I_1)$. In the absence of equity constraints and with time invariant risk premia, the firm neither adjusts its capital stock over time (i.e., $I_1 = 0$) nor does it change its debt to asset ratio ($b_0^* = b_1^*$). Both, investment and debt are initially chosen at their optimal levels. In addition, the firm does not have incentives to finance investment via debt if the corporate tax rate is zero. Then, the marginal return on investment is equal to the market interest rate.

However, if the firm does not possess enough equity initially, period 0 constraint is binding ($\lambda_0 > 0$) and the cost of capital include the additional positive term $\lambda_0 \frac{(1-b_0)(1+r)}{1-\tau}$ in period 0. From the first order conditions in (4a), (4c) and (5) we can see that a firm with an equity constraint in period 1 will invest less in this period and it will have a higher debt ratio as compared to the unconstrained case.

Focusing on deviations from the benchmark case provides three empirically testable hypotheses that establish the relationship between debt, corporate taxation and firm age under more realistic assumptions. Still, we assume that period 1 dividends are strictly positive and $\lambda_1 = 0$.

Hypothesis 1 *The debt ratio increases with the statutory corporate tax rate.*

This result follows by totally differentiating first order condition (4d), $\frac{db_1}{d\tau} = \frac{r}{(1-\tau)^2} \frac{1}{2m_1' + m_1'' b_1} > 0$, since $2m_1' + m_1'' b_1 > 0$ by assumption. Under our specific assumption about m_1, we are left with $\frac{db_1}{d\tau} = \frac{r}{(1-\tau)^2} \frac{1}{\gamma_1} > 0$. In line with the previous literature, the deductibility of interest payments on debt makes debt financing more attractive (see Modigliani and Miller 1963). However, if the risk premium on debt (as expressed by the parameter γ_t) is relatively high, there is an effective limit to excessive debt financing and it pays to finance investment partly via retained earnings.

To demonstrate the effect of firm age on the debt ratio, we compare b_1 with b_0 to isolate two effects:

Hypothesis 2 *The debt ratio is lower for older firms than for younger ones if the firm is equity constrained initially. A reduction of the risk premium ($\gamma_0 > \gamma_1$) induces the opposite effect.*

Formally, from (5) it follows

$$b_0^* > b_1^* \text{ if } \frac{\gamma_1-\gamma_0}{\gamma_0} b_1^* + \frac{\lambda_0(1+r)}{\gamma_0(1-\tau)} > 0. \tag{6}$$

Let us illustrate this result for a young firm with low initial equity ($E_0 = 0$ at the extreme) and, therefore, with $b_0 = 1$. Since debt financing becomes relatively expensive at high debt ratios, it is optimal for an equity constrained but profitable firm to start out small and finance additional investments via retained earnings in period 1. Then, b_1^* is lower than b_0^*, suggesting that the debt ratio of an older firm is smaller than for a younger one. This would be observed under a (small) decrease of the risk premium, so that the first effect in (6) is not the dominating one. On the other hand, assume E_0 is large enough and the equity constraint is non-binding. Then $\lambda_0 = 0$, and the firm chooses the initial debt ratio such that the marginal cost of debt is equal to the market interest rate net of taxes (see equation (4c)). However, given that the risk premium tends to decrease over time for successful firms, it is unlikely that the debt ratio falls as firms grow older under this scenario.

The third hypothesis is concerned with the joint impact of corporate taxation and firm age on debt:

Hypothesis 3 *The difference in the debt to asset ratio between equity constrained younger and older firms is more pronounced under a higher corporate tax rate.*

This hypothesis holds under the assumption that the firm is initially equity constrained, under given initial investment, I_0, and under $\gamma_0 = \gamma_1$. In this case, we have $\lambda_0 > 0$, and from $D_0 = 0$ and obtain a fixed debt to asset ratio $b_0^* = 1 - \frac{E_0}{I_0}$. Hence, $\frac{\partial\left(b_1^* - b_0^*\right)}{\partial\tau} = \frac{1}{\gamma}\frac{1+r}{(1-\tau)^2} > 0$. The intuition behind this result is simple. Hypothesis 2 suggests that an older firm has an incentive to rely more on retained earnings and to reduce its target debt ratio. Since corporate taxation constitutes a tax shield, firms choose higher debt ratios at higher corporate tax rates (Hypothesis 1). Therefore, the reduction in debt ratios is less pronounced at high corporate tax rates.

Finally, the firm may be faced with negative dividends in period 1 and equity constraints in period 0. This would be the case if the firm runs losses in its early stages, but is profitable in its mature phase of the life cycle. In this case, the firm obtains new equity E_1^N in period 1 to guarantee $D_1 + E_1^N = 0$. Then, both λ_0 and λ_1 are positive, while $\mu_1 = 0$. From the first order

condition (3b) it follows that $\lambda_1 = 1$, and

$$\begin{aligned}
\pi'(I_0) &= m_0 b_0 + \tfrac{1}{2}\tfrac{r(1-b_0)}{1-\tau} + \tfrac{1}{2}\left(\tfrac{\lambda_0(1-b_0)(1+r)}{1-\tau} - \tfrac{1-b_0}{1-\tau}\right) && (7)\\
\pi'(I_0+I_1) &= m_1 b_1 + \tfrac{r(1-b_1)}{1-\tau} + \tfrac{(1+r)(1-b_1)}{1-\tau} && (8)\\
b_0^* &= \tfrac{r\tau}{\gamma_0(1-\tau)} + \tfrac{\lambda_0(1+r)}{2\gamma_0(1-\tau)} - \tfrac{(1+r)}{2\gamma_0(1-\tau)} && (9)\\
b_1^* &= \tfrac{r\tau}{\gamma_1(1-\tau)} + \tfrac{(1+r)}{\gamma_1(1-\tau)}. && (10)
\end{aligned}$$

Compared to the unconstrained case with $D_1 > 0$, the period 0 debt ratio is now unambiguously lower, while it is higher in period 1. This leads to higher investment in period 0, since the marginal product of capital is reduced in period 0. In contrast, the marginal product in period 2 is higher as compared to the unconstrained case and, therefore, investment in period 1 is smaller. In this period the firm cannot rely on retained earnings to finance investment at the same amount as it would do in period 1 with positive dividends. Notice that a high corporate tax rate would reinforce the effect of equity financing.

To summarize, our model implies a negative relationship between the debt ratio and firm age if firms are equity constrained in the founding stage, which is also documented in the firm growth literature (see, e.g., Cabral and Mata 2003). However, the three hypotheses are subject to qualifications suggesting that the debt ratio does not necessarily fall with firm age. First, it requires that a possibly lower risk premium of older firms does not outweigh the impact of the equity constraint. Theory suggests a lower risk premium for surviving firms, weakening the hypothesized negative age effect on debt. Second, the availability of equity financing in the early stage of the firm life cycle, where firms may run losses, implies lower debt ratios during this phase of firm growth and higher debt ratios later. Then, the presumed age induced decrease of a firm's debt ratio might be less pronounced. Overall, it will be a matter of empirical evidence to see whether the conditions behind these hypotheses hold.

The three hypotheses stated above indicate that one should control for firm age in addition to the corporate tax rate, among other determinants, when investigating the capital structure of firms empirically. The model predicts a positive relationship between the statutory corporate tax rate and the debt ratio (Hypothesis 1), and a negative one for firm age (i.e., older firms rely less on debt than their younger counterparts; Hypothesis 2). Hypothesis 3 motivates an empirical specification, where firm age is interacted with the corporate tax rate. We expect this interaction term to exhibit a positive sign given a negative age effect and a positive impact of corporate taxes on debt.

3 The data

Data description: We use firm-level data from 35 European countries as compiled by the Bureau van Dijk's AMADEUS database (Update 146, published in November 2006).[3] The database includes about 8 million firms between 1993 and 2006 and it is available as a panel. However, its major advantage lies in the cross-section rather than the time series variation. For instance, the database exhibits substantial attrition and lots of missing observations, especially in the early years of coverage. Further, missing data are frequently inter- or extrapolated rendering the time variation of the data biased. For these reasons, we focus on cross-section of 959,125 firms, averaged over the time period between 1999 and 2004.

We confine our interest on financing decisions of active companies in the manufacturing sector (according to NACE 1-digit classification codes 15-37; see Table A.4 for a list of the included industries and the corresponding sample coverage). To ensure that each firm's financial statement is unambiguously attributable to the corporate tax rate of one single country, we exclude consolidated accounts (50,698 firms). On the one hand, this avoids double counting since such firm accounts are frequently reported for a whole group of firms under common ownership as well as for the corresponding affiliates. On the other hand, it is impossible to obtain country-specific debt figures for the consolidated firms. Further, we drop all unincorporated firms (79,383 firms), since we only focus on corporate taxation. The remaining dataset includes a cross-section of 829,044 firms. From these, we drop the ones with an operating revenue or total assets below zero (17,069 firms).

Regarding the debt variable, our theoretical model suggests to focus on debt ratios rather than debt levels or changes in debt levels. The debt ratio has been frequently used in previous empirical research (see Graham 1999 for a discussion). In our case, the total debt ratio is defined as the sum of current- and non-current liabilities over total assets. Some studies rely on subcomponents of debt, i.e., long-term and short-term debt (e.g., Booth, Aivazian, Demirgüç-Kunt and Maksimovic 2001 make extensive use of long-term debt). To provide a comparison to such studies, we use variants of the total debt ratios in a sensitivity check. In our sample, we exclude firms with a total debt ratio below zero and above 200 percent (14,702 firms).[4]

[3] In contrast to the earlier versions of the AMADEUS database, there are no inclusion criteria (minimum number of employees, minimum operating revenue or minimum total assets) in this version of the database. One obvious advantage of this database is, therefore, the inclusion of small and medium-sized enterprises.

[4] In the middle- and short-run, a debt ratio above 100 percent might be possible due to losses in previous periods inducing negative shareholder equity in the current period. To include such firms in the sample, we set the threshold for the total debt ratio at a value of 200 percent. It turns out that our empirical results are unchanged when applying a threshold below 200 percent (see the robustness section).

Descriptive statistics: Table 1 presents some country-specific stylized facts about debt, corporate taxation and firm age (Table A.2 provides further descriptives for the whole set of variables; the variable definitions are laid out in Table A.1). For all three variables together, our sample contains full information of about 541,483 firms in 35 countries and 126 NACE 3-digit industries. As can be seen from the table, about two thirds of the firm coverage is due to Spanish, UK, French, Romanian and Italian firms. In three countries (Cyprus, Malta and Switzerland), firm-level information is only available for less than 100 firms.[5]

From Table 1 we can see that the total debt ratio at the country-level is around 71.6 percent on average, with a minimum of about 36 percent (Cyprus) and a maximum of about 81 percent (Romania). Most of the countries lie within a range of 50 and 70 percent, which is very close to the debt ratios reported in Rajan and Zingales (1995). The next three columns summarize the statutory corporate tax rates (including company taxes at the local level) in 1999 and in 2004 (columns 3 and 4), and the average rate within these years (column 2). The average corporate tax rate between 1999 and 2004 is around 32.3 percent, ranging from 10.83 (Ireland) to 41.17 (Germany). Most of the countries reduced their corporate tax rates considerably within this time period. On average, the statutory corporate tax rate fell from 35 percent in 1999 to 31 percent in 2004. Substantial changes in tax rates took place in the Slovak Republic (from 40 to 19 percent), in Germany (from 50.1 to 36.4 percent) and in Poland (from 34 to 19 percent). In three countries, we observe a fairly small increase in corporate tax rates (in Finland from 28 to 29 percent, in Ireland from 10 to 12.5 percent and in Spain from 35 to 35.3 percent).

Firm age is defined as the time period between the year 2006 and the year of a firm's incorporation.[6] Table 1 illustrates that the average firm is about 16.8 years old in our sample. As expected, the youngest firms are observed in the transition economies (e.g., in Romania the average firm is about 8.7 years old). With the exemptions of Switzerland (firm age of about 67.8 years) and Cyprus (around 33.4 years), for which our sample includes less than 100 firms, the oldest firms are located in the Russian Federation (27.8 years), in the Netherlands (27.4 years), in Germany (24.1 years) and in Italy (24 years), on average.

Figure 1 provides further information on the age structure of all firms in the sample. Moreover, it contains information on the relationship between total debt ratios and firm age. Specifically, we plot the average total debt ratios against firm age in 5-year age cohorts. The entries in the figure indicate the mean debt ratios of each age cohort, and the whiskers illustrate the corresponding standard deviations. From the figure, we can draw three important conclusions regarding the

[5]In the empirical analysis below, we account for the low sample coverage in these countries by applying a sensitivity check, where all countries with a coverage lower than 500 firms are excluded. Further, we also leave out observations from Spain, UK, France and Romania to see whether the coverage from these countries is influential.

[6]The year of incorporation is equal to the year where a firm is founded or a significant reorganization (e.g., change in legal form, acquisitions) has taken place.

Table 1: Average debt ratios, corporate tax rates and firm age per country

Country	Debt ratio	Corporate tax rate			Age	Obs.	Share in sample
		99-04	1999	2004			
Austria	69.97	34.00	34.00	34.00	21.00	999	0.18
Belgium	68.06	38.11	40.17	33.99	19.56	21,040	3.89
Bosnia and Herzegovina	48.52	30.00	–	30.00	8.76	538	0.10
Bulgaria	63.06	26.58	32.50	19.50	20.18	1,788	0.33
Croatia	64.87	25.00	35.00	20.00	18.80	3,183	0.59
Cyprus	35.99	23.33	25.00	15.00	33.39	23	0.00
Czech Republic	64.39	31.17	35.00	28.00	9.98	9,477	1.75
Denmark	66.93	30.67	32.00	30.00	14.92	8,566	1.58
Estonia	53.23	26.00	26.00	26.00	9.04	5,930	1.10
Finland	58.32	28.83	28.00	29.00	17.23	11,081	2.05
France	71.69	35.82	40.00	34.30	16.30	76,415	14.11
Germany	75.11	41.17	50.08	36.39	24.10	8,723	1.61
Greece	59.77	37.08	40.00	35.00	14.64	6,856	1.27
Hungary	57.47	17.67	18.00	16.00	10.63	3,622	0.67
Iceland	78.66	24.00	30.00	18.00	12.51	1,600	0.30
Ireland	70.43	10.83	10.00	12.50	15.31	8,033	1.48
Italy	76.33	39.75	41.20	37.30	24.04	45,878	8.47
Latvia	66.63	21.83	25.00	15.00	10.39	795	0.15
Lithuania	57.48	20.33	29.00	15.00	9.30	1,458	0.27
Luxembourg	64.58	33.92	37.45	30.38	19.03	247	0.05
Macedonia	57.60	15.00	15.00	15.00	20.64	190	0.04
Malta	53.73	35.00	35.00	35.00	23.63	94	0.02
Netherlands	77.93	34.75	35.00	34.50	27.37	17,651	3.26
Norway	74.99	28.00	28.00	28.00	11.40	10,799	1.99
Poland	60.94	27.67	34.00	19.00	21.69	5,617	1.04
Portugal	72.32	33.55	37.40	27.50	19.95	10,523	1.94
Romania	80.86	27.17	38.00	25.00	8.67	53,894	9.95
Russian Federation	64.82	29.50	35.00	24.00	27.80	7,893	1.46
Serbia and Montenegro	51.77	18.00	20.00	14.00	19.05	2,464	0.46
Slovak Republic	61.97	27.83	40.00	19.00	10.70	1,186	0.22
Spain	74.78	35.05	35.00	35.30	13.87	95,471	17.63
Sweden	62.44	28.00	28.00	28.00	20.21	23,877	4.41
Switzerland	64.09	24.61	25.04	24.37	67.82	11	0.00
Ukraine	45.00	29.17	30.00	25.00	22.69	4,182	0.77
United Kingdom	71.06	30.00	30.00	30.00	17.96	91,379	16.88
Average	*71.62*	*32.34*	*34.85*	*30.97*	*16.81*	–	–

Notes: The sample includes 541,483 manufacturing firms in 35 countries and 126 industries (NACE 3-digit classification codes 150-372; see Table A.5 in the Appendix).

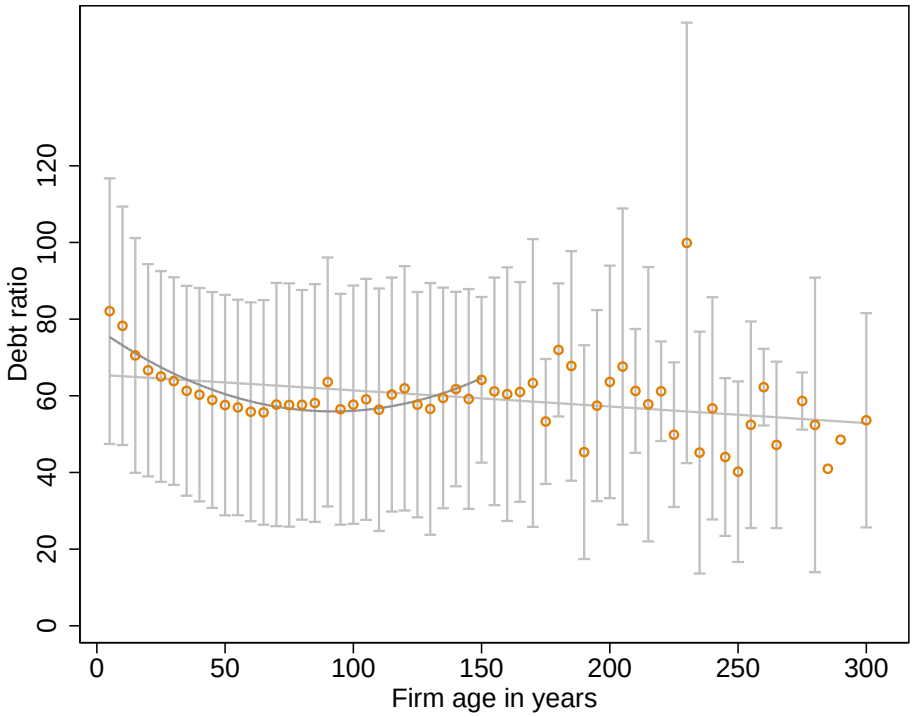

Figure 1: Average debt ratio per age cohort (stratified sample)

subsequent empirical analysis. First, most of the total debt ratios are lying within a range of 50 to 70 percent, which is consistent with Table 1. This warrants the use of a linear specification (rather than a logistic one) when estimating the impact of firm age and taxation on debt. Second, up to a firm age of about 300 years we observe considerable variation in total debt ratios, which seems to be constant over the age cohorts. 13 firms in the sample are older than 300 years,[7] indicating potential outliers. In the basic regressions below, we include all observations in the regressions. As a robustness check, we account for potentially outlying observations regarding firm age by excluding firms (i) older than 150 years, and (ii) older than 50 years. Third, and even more importantly, the sheer graphical inspection of Figure 1 indicates a negative relationship between debt and firm age in the whole sample, and a non-linear one in a sample of younger firms (e.g., firms that are younger than 150 years; see the dark solid line in the figure). In our theoretical model, this would be the case if the risk premium on debt financing γ decreases with a firm's age (e.g., due to an increased survival probability). In any case, Figure 1 suggests to include a quadratic term for firm age in our regressions to test for the possibility of a non-linear age impact on debt.

[7]The single entries above 300 years are breweries, printing companies and firms from metal processing. The oldest firm is 872 years old; interestingly, there is one firm in the sample with zero leverage and firm age of 526 years; overall, we have 5,577 firms, or about 1 percent of the sample, with zero debt.

4 Empirical Analysis

Specification: We are interested in the effects of corporate taxation and firm age on debt financing, and on how the influence of corporate taxation changes over the life-time of a firm. This motivates an empirical model, where the debt ratio is regressed on the statutory corporate tax rate, firm age and an interaction term between those variables. We introduce additional control variables that are not captured by our stylized model. However, these variables turned out important in previous research. The econometric specification reads as

$$b_{i,jk} = \beta_1 \tau_j + \beta_2 A_i + \beta_3 A_i^2 + \beta_4 \tau_j A_i + \mathbf{Z}_i \boldsymbol{\delta} + \gamma_k + \varepsilon_{i,jk}, \tag{11}$$

where i, j, and k are firm-, country- and industry indices, respectively. $b_{i,jk}$ is the debt to asset ratio for the ith firm in country j and industry k, τ_j denotes the statutory corporate tax rate in country j, and A_i is the firm-specific age. Note that A enters three times in (11): The first two terms capture a possible non-linear impact of firm age on debt (according to Figure 1), and the interaction term between firm age and the corporate tax rate allows to analyze whether the influence of corporate taxation on debt financing is changing over the life time of a firm.[8] From Hypothesis 3 we expect a positive estimate for β_4.

γ_k indicate NACE 3-digit industry fixed effects (overall, we include 126 industry dummies) and $\varepsilon_{i,jk}$ is the remainder error term. $\mathbf{Z}_i$ is a vector of additional firm-specific control variables (including the constant) suggested by the previous empirical literature (Graham 2003 provides an excellent survey). Firstly, it comprises asset tangibility as measured by the share of fixed assets to total assets. This variable captures a firm's ability to borrow against fixed assets potentially serving as collateral in case of bankruptcy (see Rajan and Zingales 1995). Hence, we would expect a positive relationship between asset tangibility and debt ratios. On the other hand, DeAngelo and Masulis (1980) argue that firms with a high share of fixed assets may gain from non-debt tax shields resulting from higher amounts of depreciation and investment tax credits. Hence, depreciable assets might serve as a substitute for tax deductible interest payments when firms are trying to minimize their taxable profits. This, in turn, motivates a negative impact of asset tangibility on debt financing. Overall, the sign of this variable remains ambiguous. Further, we include the size of a firm, defined as the logarithm of sales.[9] Graham (1999) argues that large companies tend to be more diversified and might have more stable cash flows, making it easier to

[8] Including a possible interaction term between the corporate tax rate and age squared leaves our estimation results below virtually unchanged. For this reason, and to keep the econometric analysis simple, we decided to leave out this interaction term.

[9] Since sales are log-normally distributed in the sample, we use the log of sales in the regressions (see, e.g., Rajan and Zingales 1995). Alternatively, we include the total number of employees as size measure. However, we obtain more or less the same parameter estimates when applying this size measure. Therefore, we do not report the results of this specification here. The results are available from the authors upon request.

obtain external funds. Therefore, we expect that large firms are more likely to be debt financed than smaller ones (see also Alworth and Arachi 2001, and Gropp 2002, for empirical studies).

The next variable in $\mathbf{Z}_i$ is firm profitability as measured by the return on assets (ROA), which is defined as the ratio of EBIT (earnings before interest and taxes) over total assets (see Fama and French 2002). The previous literature is not entirely clear about the effects of firm profitability on debt financing. On the one hand, profitable firms may use their profits to pay back debt or to finance investment via retained earnings and, therefore, need less external funds (see Myers and Majluf 1984, Rajan and Zingales 1995, Gropp 2002). This is exactly the channel raised in our theoretical model and it motivates a negative relationship between ROA and the debt ratio. On the other hand, profitable firms typically possess free cash flow at their disposal. Some authors argue that debt financing in this situation is an effective instrument to restrict managers from undertaking less profitable investments (see Jensen 1986). In this case, we expect a positive parameter estimate for profitability.

Finally, following the previous empirical literature explaining debt financing, we add three variables informing about the financial situation of a firm (see, e.g., MacKie-Mason 1990, Graham 1999 or Alworth and Arachi 2001). First, we define a dummy variable with entry one if a firm reports a net operating loss in the period 1999 to 2004, and zero else (henceforth, we refer to this variable as NOL). Second, we include a dummy variable equal to one if a company reports negative shareholder funds (NSF), and zero else. Net operating losses and negative shareholder funds are associated with losses in previous (NOL) and consecutive (NSF) periods, the vanishing equity reserves automatically increase the debt position of a firm (see Graham 1999). Hence, we predict a positive sign on both coefficients. Third, the variable Z-score captures a firm's probability of bankruptcy, and, therefore, the expected financial distress of a firm (see Altman 1968).[10] Financial distress affects debt financing via two channels. First, highly-leveraged firms are more exposed to bankruptcy, inducing additional costs (e.g., legal fees). Thus, a company in financial distress should be more cautious in using debt. Second, firms in financial distress are more likely to pay no taxes in the future, alleviating the tax-induced advantages of interest deductions from debt financing. In both cases, we predict a negative relationship between $Z-$score and the debt ratio (Graham, Lemmon and Schallheim 1998).

Estimation results: The empirical results are presented in Table 2. In all of the empirical models discussed below, we exclude observations with a remainder error in the upper and lower

[10]We follow Graham (1999) to define the Z-score as

$$\begin{aligned} Z\text{-score} &= 3.3 \cdot \frac{\text{EBIT}}{\text{Total assets}} + 1.0 \cdot \frac{\text{Operating revenue}}{\text{Total assets}} + 1.4 \cdot \frac{\text{Shareholder funds}}{\text{Total assets}} \\ &+ 1.2 \cdot \frac{\text{Working capital}}{\text{Total assets}} \end{aligned}$$

Due to data restrictions, we include shareholder funds instead of retained earnings (as in Alworth and Arachi 2001).

Table 2: Estimation results (*dependent variable*: debt to asset ratio)

	Statutory corporate tax rate in the year(s)			
	1999	2002	2004	99-04
Corporate tax rate (SCTR)	0.476 ***	0.513 ***	0.566 ***	0.566 ***
	(0.010)	(0.012)	(0.012)	(0.013)
Firm age	−0.832 ***	−0.846 ***	−0.772 ***	−0.930 ***
	(0.018)	(0.025)	(0.026)	(0.026)
Firm age^2	0.003 ***	0.003 ***	0.003 ***	0.003 ***
	(0.0001)	(0.0001)	(0.0001)	(0.0001)
SCTR·Age	0.008 ***	0.008 ***	0.006 ***	0.011 ***
	(0.0004)	(0.001)	(0.001)	(0.001)
Asset tangibility	−0.036 ***	−0.042 ***	−0.041 ***	−0.038 ***
	(0.002)	(0.002)	(0.002)	(0.002)
Firm size (log of sales)	1.288 ***	0.963 ***	1.061 ***	0.974 ***
	(0.021)	(0.021)	(0.020)	(0.021)
Profitability (ROA)	−0.150 ***	−0.141 ***	−0.140 ***	−0.142 ***
	(0.005)	(0.005)	(0.005)	(0.005)
Net operating loss (NOL)	6.779 ***	6.540 ***	6.792 ***	6.605 ***
	(0.119)	(0.114)	(0.115)	(0.114)
Negative shareholder funds (NSF)	44.951 ***	45.830 ***	45.653 ***	45.689 ***
	(0.117)	(0.127)	(0.116)	(0.117)
Financial distress (Z-score)	−0.016	−0.004	−0.012	−0.005
	(0.039)	(0.035)	(0.037)	(0.035)
Observations	404,849	405,373	405,373	405,373
R^2	0.436	0.437	0.438	0.439
Industry fixed effects: F-statistic	636.00	582.08	535.42	578.96
p-value	0.000	0.000	0.000	0.000

Notes: Constant and industry dummies not reported. White (1980) robust standard errors in parentheses. ***Significant at 1%, **Significant at 5%, *Significant at 10%.

end 1 percent percentile range (about 40,000 observations of the sample). Correcting for outliers in this way, we are left with about 405,000 observations.[11]

As discussed above, our sample encompasses a cross-section of firms with averages over the period 1999 to 2004. Since the corporate tax rate has changed considerably over time (see Table 1), we estimate several versions of (11). One, where we use the average corporate tax rate within this period (column 4), and three further specifications applying the statutory corporate tax rates in 1999 (column 1), in 2002 (column 2) and in 2004 (column 3). It turns out that the estimation results are not sensitive to these variations in tax rates, and, therefore, we refer to the results in column 4 when discussing our empirical findings.

Generally, the model seems well specified. The R^2 is relatively high, the industry effects are significant and the control variables are almost as expected. Asset tangibility enters significantly

[11]The results from these regressions are virtually the same as for the full sample (i.e., the ones including outliers), but it turns out that the fit of the regressions (in terms of R^2) improves substantially in the outlier-corrected models. Further, applying median regressions we obtain very similar results as for our outlier-corrected ones. To save space, we do not report the results of the median regressions, but they are available from the authors upon request.

negative, which apparently lends support to the view that a higher share of fixed assets makes debt financing less attractive in our sample (similar evidence, also based on the AMADEUS database, is provided by Huizinga, Laeven and Nicodéme 2008). Large firms exhibit higher debt ratios than smaller ones, which is consistent with prior evidence (see Rajan and Zingales 1995, Alworth and Arachi 2001, and Gropp 2002). Further, profitability (ROA) has a significantly negative coefficient, indicating that profitable firms tend to reduce their debt position via retaining profits. This finding is in accordance with the theoretical predictions of our model (and also Myers and Majluf 1984 and the empirical findings in Rajan and Zingales 1995 and Huizinga, Laeven and Nicodéme 2008). Finally, the impact of a firm's financial situation on debt financing seems decisive. As expected, firms with operating losses reported in their profit and loss account rely more on debt. Similarly, for firms with negative shareholder funds (NSF) we observe higher debt ratios, which seems plausible as discussed above (see also Graham 1999). The $Z-$score variable takes the expected negative sign, but is insignificant throughout.

Regarding our variables of interest, we find a significantly positive impact of corporate taxation on debt ratios, as expected from Hypothesis 1. The tax advantage of debt obviously provokes firms to increase their leverage. In line with Hypothesis 2, we find a negative effect of firm age, indicating that older firms exhibit lower debt ratios than younger ones, on average. However, as is indicated by the positive parameter estimate on age squared, there is a non-linear impact of firm age on debt financing over a wide range of the age distribution. From the estimated parameters of Table 2, we can see that the firm age, where the influence of age changes from negative to positive, is around 98 years.[12] Finally, we observe a positive interaction term between firm age and the statutory corporate tax rate, which is significantly positive in all regressions. This finding seems to confirm Hypothesis 3, indicating that the role of corporate taxation on debt financing is changing over the life-time of a firm.

Table 3 reports the elasticities of corporate taxation with regard to the debt ratios for the four versions of (11) presented in Table 2. Taking the specification with the average corporate tax rate between 1999 and 2004, the elasticity of corporate taxation evaluated at the mean of firm age is around 0.34 $\left[\approx (0.566 + 0.011 \cdot 16.60) \cdot \frac{32.24}{71.62}\right]$, and only slightly lower for a firm with median age. Considering the whole distribution of firm age, we can see that the elasticities are within a range of 0.25 and 0.65. Accordingly, a change in the statutory corporate tax rate of 10 percent is associated with an increase in the debt ratio by about 2.5 to 6.5 percent. Although our empirical model is not directly comparable to previous research, this marginal effect seems broadly in line with the evidence presented there. For instance, Gordon and Lee (2001), focusing on a panel of U.S. firms to analyze the differential impact of taxation on debt financing of small and large

[12] Taking the first derivative of (11) with regard to age and setting this expression equal to zero we obtain $\frac{\partial b}{\partial A} = \widehat{\beta}_2 + 2\widehat{\beta}_3 A + \widehat{\beta}_4 \tau = 0$. At the mean value of τ (32.60 in the sample), we have a minimum for A at $\tilde{A} = (\widehat{\beta}_2 - 32.60\widehat{\beta}_4)/2\widehat{\beta}_3 = 97.59$.

Table 3: Elasticities corporate tax rate τ

	Firm age	SCTR in the year(s)			
	(99-04)	1999	2002	2004	99-04
Mean	16.60	0.303	0.287	0.289	0.338
Median	13	0.289	0.275	0.280	0.321
Lower 25 percent quartile	8	0.270	0.258	0.267	0.297
Upper 75 percent quartile	20	0.317	0.300	0.298	0.354
Lower 1 percent percentile	2	0.246	0.236	0.251	0.268
Upper 1 percent percentile	82	0.560	0.519	0.458	0.651

Notes: Elasticities are calculated by $\mu = \frac{\partial b}{\partial \tau} \cdot \frac{\bar{\tau}}{\bar{b}}$, where $\bar{\tau}$ is the mean statutory tax rate, $\bar{b}$ is the mean debt ratio, and $\frac{\partial b}{\partial \tau}$ indicates the marginal effect, calculated from the parameter estimates of Table 2 using $\frac{\partial b}{\partial \tau} = \widehat{\beta}_1 + \widehat{\beta}_4 A$.

firms, find a slightly lower marginal effect of about 0.35. In a similar study, Gordon and Lee (2007) estimate a effect of corporate taxation of 0.47.[13]

Robustness: We analyze the sensitivity of our results (i) by using different definitions of the debt ratio, (ii) by focusing on alternative tax rate concepts, (iii) by restricting our sample in various ways (e.g., by excluding highly leveraged firms), and (iv) by including additional country-specific variables (e.g. the bank lending rate). In all robustness checks, we refer to the specification with the average corporate tax rate between 1999 and 2004 as reported in the last column of Table 2. The results of the sensitivity analysis are depicted in Table 4. For the sake of brevity, we only report the variables of interest (τ, A, A^2 and $\tau \cdot A$) along with the sample size and the R^2.

In the first set of robustness experiments, we use alternative definitions of the debt ratio based on three sub-components of total liabilities, i.e., (i) short-term liabilities, (ii) total liabilities excluding trade accounts, and (iii) long-term liabilities.[14] The corresponding debt ratios are restricted to the range between zero and 200 percent; in each of the regressions we use exactly the same number of observations (i.e., 390,546 firms). To facilitate a comparison to our earlier results, we also re-estimate the baseline specification from Table 2, but now with the sample of 390,546 firms. A comparison between the last column of Table 2 and the first row in Table 4 shows that the parameter estimates of the baseline specification remain fairly unchanged when focusing on a sample where all debt ratios are limited to the 0-200 percent range. Then, we rely on short-term debt, i.e., the ratio of current liabilities to total assets. Such a specification has been suggested by Rajan and Zingales (1995) and Gordon and Lee (2001). Not surprisingly

[13] Huizinga, Laeven and Nicodéme (2008), focusing on international debt shifting of multinational firms using the (small) AMADEUS database (around 18,000 firms), estimate a effect of domestic corporate taxation of about 0.25.

[14] In our sample, the short-term debt ratio is around 58 percent (consisting of 10 percent loans, 22 percent trade credits, and the remaining 68 percent other current liabilities), and the long-term debt ratio is around 14 percent.

Table 4: Robustness

	τ	A	A^2	τ·A	Obs.	R^2
(i) Definition of the debt ratio						
Total debt ratio (basic regression from Table 2)	0.637 ***	−0.895 ***	0.003 ***	0.009 ***	390,546	0.442
	(0.014)	(0.027)	(0.0001)	(0.001)		
Short-term debt ratio	0.216 ***	−0.559 ***	0.002 ***	0.004 ***	390,546	0.352
	(0.013)	(0.024)	(0.0001)	(0.001)		
Total debt ratio excluding trade credits	0.922 ***	−0.651 ***	0.002 ***	0.006 ***	390,546	0.372
	(0.014)	(0.024)	(0.0001)	(0.001)		
Long-term debt ratio	0.425 ***	−0.226 ***	0.0006 **	0.003 ***	390,546	0.193
	(0.010)	(0.015)	(0.0001)	(0.0004)		
(ii) Marginal tax rates as proposed by Graham (1996)						
MCTR1	0.174 ***	−0.549 ***	0.003 ***	0.001 ***	405,373	0.428
	(0.005)	(0.011)	(0.0001)	(0.0002)		
MCTR2	0.258 ***	−0.562 ***	0.003 ***	0.001 ***	405,373	0.431
	(0.006)	(0.013)	(0.0001)	(0.0003)		
MCTR3	0.324 ***	−0.548 ***	0.003 ***	0.001 ***	405,373	0.431
	(0.007)	(0.013)	(0.0001)	(0.0003)		
MCTR4	0.310 ***	−0.569 ***	0.003 ***	0.001 ***	405,373	0.432
	(0.007)	(0.014)	(0.0001)	(0.0003)		
MCTR5	0.291 ***	−0.539 ***	0.003 ***	−0.001 ***	405,373	0.432
	(0.005)	(0.011)	(0.0001)	(0.0002)		
MCTR5[a)]	0.562 ***	−1.103 ***	0.003 ***	0.014 ***	316,782	0.294
	(0.016)	(0.033)	(0.0002)	(0.001)		
(iii) Sample restrictions						
Firms with $b \leq 100$ percent	0.665 ***	−1.065 ***	0.003 ***	0.012 ***	361,584	0.178
	(0.014)	(0.030)	(0.0001)	(0.001)		
Firms with $A \leq 150$	0.551 ***	−1.189 ***	0.006 ***	0.013 ***	405,133	0.441
	(0.012)	(0.019)	(0.0001)	(0.001)		
Firms with $A \leq 50$	0.435 ***	−1.750 ***	0.010 ***	0.023 ***	391,362	0.441
	(0.014)	(0.028)	(0.0003)	(0.001)		
Countries with more than 500 firms	0.563 ***	−0.936 ***	0.003 ***	0.011 ***	405,114	0.439
	(0.013)	(0.027)	(0.0001)	(0.001)		
NACE 2-digit industries with more than 5,000 firms	0.570 ***	−0.930 ***	0.003 ***	0.011 ***	397,128	0.439
	(0.013)	(0.027)	(0.0001)	(0.001)		
Excluding firms from UK, Romania, France and Spain	0.785 ***	−0.690 ***	0.001 ***	0.009 ***	151,698	0.429
	(0.013)	(0.019)	(0.00008)	(0.0004)		
Domestic firms only (multinationals excluded)	0.533 ***	−1.094 ***	0.004 ***	0.013 ***	397,029	0.440
	(0.014)	(0.030)	(0.0001)	(0.001)		
(iv) Including additional country-specific variables[b)]	0.822 ***	−0.954 ***	0.003 ***	0.010 ***	363,931	0.440
	(0.103)	(0.121)	(0.0005)	(0.004)		

Notes: White (1980) robust standard errors in parentheses. ***Significant at 1%, **Significant at 5%, *Significant at 10%.
[a)] Sample restricted to observations with positive EBIT. [b)] Additional country-specific variables are (i) bank lending rate, (ii) GDP growth, (iii) inflation rate and (iv) creditor rights index (entries between 0 and 4, 4 indicating strongest creditor rights). (i), (ii) and (iii) are taken from the World Development Indicators 2009 and are averaged over 1999 and 2004, (iv) is reported in Djankov, McLiesh und Shleifer (2007). Here, we take the entries from 2002.
MCTR1: $\tau = 0$ if EBIT ≤ 0 in 2 or more years, $\tau =$ SCTR otherwise.
MCTR2: $\tau = 0$ if EBIT ≤ 0 in 3 or more years, $\tau =$ SCTR otherwise.
MCTR3: For each year separately, we set $\tau_t = 0$ if the annual EBIT ≤ 0, otherwise $\tau_t =$ SCTR. Then, we calculate the average corporate tax rate as $\tau = \bar{\tau}_t$
MCTR4: $\tau = 0$ if EBIT ≤ 0 in 4 or more years, $\tau = 0.5 \cdot$SCTR if EBIT ≤ 0 in 2 or 3 years, otherwise $\tau =$ SCTR.
MCTR5: $\tau = 0$ if the sum of EBIT within the sample period is ≤ 0, and $\tau =$ SCTR otherwise.

(compare the relatively close correlation between the total debt ratio and the short term debt ratio in Table A.3), we conclude that the results regarding our main variables of interest are qualitatively very similar to the ones of the baseline specification. The corporate tax rate enters significantly positive (and somewhat lower than in the original model), firm age exhibits a positive but diminishing impact on debt, and the interaction term between the corporate tax rate and firm age is significantly positive.

Next, we deduct trade credits from total liabilities to re-define the numerator of the debt ratio. Trade credits are typically used by younger firms, especially to cope with short-term liquidity shortages (see Berger and Udell 1998). Again, we find that our results regarding the influence of corporate taxation and firm age on debt financing do not change substantially when relying on the remaining part of total debt. Finally, we focus on long-term debt (see, e.g., Booth, Aivazian, Demirgüç-Kunt and Maksimovic 2001). Since firms might not adjust their long-term liabilities immediately on a year-to-year basis, we would expect that firm age is of less importance here. We observe a positive parameter estimate for corporate taxation but a much smaller impact of firm age as compared to the baseline specification, which seems to confirm this expectation. The interaction term between the statutory corporate tax rate and firm age is significantly positive, again.

In the second set of sensitivity analysis, we refer to an alternative definition of the tax measure by taking account of loss-carry forwards. Specifically, following Graham (1996) and Plesko (2003) we define five versions of 'marginal' tax rates (MCTR). The first one, MCTR1, is equal to zero if the EBIT within the observed time period 1999 to 2004 is negative in two or more years. Otherwise, MCTR1 is the same as the statutory corporate tax rate. MCTR2 has entry zero if the EBIT is negative in three or more years, and equal to the statutory corporate tax rate else. To compute MCTR3 we account for the year-by-year realizations of the EBIT. In particular, we set τ_t =SCTR if the EBIT in a given year is positive, and zero else. Then, MCTR3 is calculated as the average of τ_t. In MCTR4, we set the marginal corporate tax rate to equal zero if the EBIT is less than zero in four or more years of the sample period, and equal to 0.5·SCTR if the EBIT is negative in two or three years. Otherwise, MCTR4 is equal to the SCTR (this variant has been proposed by Graham 1996). Finally, we define MCTR5 as equal to zero if the sum of the EBIT over the whole period is negative, and equal to the statutory corporate tax rate else.

In all variants of MCTR, our sample includes exactly the same observations as in Table 2 (i.e., 405,373 firms). Therefore, the estimation results can be directly compared to the ones in the last column of Table 2. We find that the parameter estimates do not vary strongly among the five variants of MCTR. This is not surprising given the fact that the correlations between the MCTRs are relatively high (see Table A.4). Compared to the baseline specification of Table 2 we now observe much lower coefficients for the corporate tax rate and the first power of age.

However, this does not really come as a surprise as we take into account potential tax-loss-carry-forwards. Considering a non-debt-tax-shield, which serves as a substitute for tax-deductible interest payments, reduces the impact of corporate taxation on debt financing (see, e.g., DeAngelo and Masulis 1980, Gropp 2002 for empirical evidence). Age squared still enters positively with significance levels above the conventional levels. Finally, with the exception of MCTR5 we find a significantly positive interaction term between firm age and the marginal corporate tax rate, which is in line with Hypothesis 3. Regarding the negative interaction term for MCTR5 one should keep in mind that our sample includes a relatively large number of firms with zero MCTR5 (about 90,000 firms). This might induce a downward bias in the interaction term. Therefore, we re-estimate this equation by only focusing on firms with non-zero marginal tax rates. Applying this sample restriction, we now observe a significantly positive interaction. In sum, the findings from these robustness experiments are qualitatively very similar to the previous ones. Therefore, the (joint) influence of corporate taxation and firm age on debt is insensitive to the change in tax rate measures.

In an additional series of sensitivity exercises, we exclude potentially influential outliers from the sample. The corresponding results are summarized in the third block of Table 4. First, we reduce the threshold for the total debt ratio from 200 percent to 100 percent. This reduces the sample by about 44,000 observations. Obviously, the parameter estimates from Table 2 are virtually unchanged (perhaps one exception is the impact of corporate taxation, which is slightly higher now). Second, to assess whether the estimated effects of corporate taxation and firm age are affected by the firm age distribution of the sample (see Figure 1 above), we confine our analysis to firms younger than 150 years (lowering the sample by 240 firms), and, alternatively, to companies younger than 50 years (losing 14,011 firms). It turns out that this does not change the tax parameter substantially. We now observe somewhat higher parameter estimates for firm age (A and A^2), and a more pronounced interaction term between firm age and corporate taxation, which translates into a (calculated) turning point of about 49 years (from the parameter estimates in Table 2 we calculated a value of around 98 years). Further, as might be suspected by the graphical inspection of Figure 1, the estimate for the quadratic age term is much higher than in the baseline regression. This, in turn, suggests that the non-linear relationship between firm age, corporate taxation and debt is more pronounced when excluding very old firms. All in all, however, the qualitative results regarding the relationship between corporate taxation, firm age and debt are insensitive to these sample restrictions.

Next, we check whether the empirical results are influenced by the sample composition. For instance, it is obvious from Table 1 that the sample coverage is relatively weak for some countries (e.g., Cyprus, Malta or Switzerland). Therefore, we drop (i) countries with less than 500 firms (about 260 observations), and (ii) industries with less than 5,000 firms (about 8,000 observations). Again, we obtain almost the same parameter estimates as in the original model. Similarly, it is

obvious from Table 1 that our sample is dominated by four countries (France, Romania, Spain and UK) accounting for about two thirds of all observations. However, excluding firms from these countries leaves our estimation results almost unaffected.

Further, one might suspect that our empirical findings are driven by the existence of multinational firms. Multinational firms are able to reduce tax payments by shifting debt from a low-tax jurisdiction to a high-tax jurisdiction taking advantage of the high-interest deduction in the high-tax jurisdiction (see Desai, Foley and Hines 2004, Huizinga, Laeven and Nicodéme 2008, Egger, Eggert, Keuschnigg and Winner 2010, for empirical evidence). To examine whether the observed relationship between corporate taxation, firm age and debt is sensitive to such debt shifting activities we exclude multinational firms from the dataset. In our sample, a multinational firm is defined as a firm that is owned by a foreign firm (about 8,300 firms). As can be seen from the last line of Table 4, we obtain almost the same parameter estimates as in the baseline specification of Table 2 when focusing on domestic firms only.[15]

One remaining concern might be that the statutory corporate tax rate is country-specific and, therefore, only picks up other country-specific factors that are decisive for a firm's leverage ratio. Therefore, we include the following additional country-specific controls to the original specification of Table 2: (i) the bank lending rate charged by banks on loans to prime customers, (ii) GDP growth, (iii) the inflation rate, and (iv) the creditor rights index informing about borrowing costs (the index is scaled between zero and four, the latter indicating relatively stronger legal protections of creditors in case of bankruptcy). This index has been developed by La Porta, Lopez-de-Silanes, Shleifer und Vishny (1998) and is published in Djankov, McLiesh und Shleifer (2007). (i), (ii) and (iii) are taken from the World Development Indicators 2009 and are averaged over 1999 and 2004, regarding (iv) we use the corresponding entries from 2002. Most of these variables, though not reported in Table 4, enter as expected, i.e., GDP growth, the inflation rate and the creditor rights index exert a significantly positive sign. Only for the bank lending rate we observe an insignificantly negative parameter estimate. More importantly, Table 4 shows that our variables of interest are almost unaffected by this change. Only the estimated parameter of the statutory corporate tax rate is somewhat higher than in the original specification of Table 2.

5 Conclusions

This paper analyzes optimal debt financing of firms under corporate taxation, which induces an incentive to increase leverage as a result of the deductibility of interest on debt. The benefits from corporate taxation are dampened by the costs of financial distress arising from increased debt

[15]Focusing exclusively on multinational firms, we obtain very similar parameter estimates to those in the full sample. Only for firm age we find a slightly lower, but again a significantly negative coefficient.

levels. We argue that a firm's leverage might change over the life-cycle of a firm. For example, younger firms exhibit higher debt ratios and find it more difficult to raise external financing sources. This, in turn, suggests that the debt ratios are changing over a firm's life-time, and also that the impact of corporate taxation is age dependent.

We provide a simple three period model with corporate taxation and endogenous financing decisions that allows to derive empirically testable hypotheses regarding the relationship between corporate taxation, firm age and debt financing. We test these hypotheses in a cross section of 405,000 firms from 35 European countries and 126 NACE 3-digit industries. Our empirical findings can be summarized as follows. First, and in line with previous research, we find a positive impact of corporate taxation on a firm's debt ratio, suggesting that the corporate tax system provides a systematic incentive for higher leverage. Second, firm age exerts a negative impact on debt ratios, indicating that older firms rely less on debt than younger ones. Finally, we observe a significantly positive interaction effect between corporate taxation and firm age. This result implies that the debt ratio of older firms is much more affected by a cut in corporate tax rates than that of younger firms. This, together with a significantly negative coefficient of a quadratic age term, lends support to the view that the effects of corporate taxation on debt financing is changing over the life-time of a firm.

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Table A. 1: Variable definitions

Variable	Description
Debt to asset ratios	
Total debt ratio	Current plus non-current liabilities to total assets (in percent)
Short-term debt ratio	Current liabilities to total assets (in percent)
Total debt ratio excluding trade credits	Current plus non-current liabilities minus trade credits to total assets (in percent)
Long-term debt ratio	Non-current liabilities to total assets (in percent)
Statutory corporate tax rates	
SCTR 1999	Statutory corporate tax rate in 1999 (in percent)
SCTR 2002	Statutory corporate tax rate in 2002 (in percent)
SCTR 2004	Statutory corporate tax rate in 2004 (in percent)
SCTR 1999-2004	Statutory corporate tax rate, average between 1999 and 2004 (in percent)
Marginal corporate tax rates	
MCTR1	$\tau = 0$ if EBIT ≤ 0 in 2 or more years, $\tau =$ SCTR otherwise (in percent)
MCTR2	$\tau = 0$ if EBIT ≤ 0 in 3 or more years, $\tau =$ SCTR otherwise (in percent)
MCTR3	For each year separately, we set $\tau_t = 0$ if the annual EBIT ≤ 0, otherwise $\tau_t =$ SCTR Then, we calculate the average corporate tax rate as $\tau = \bar{\tau}_t$ (in percent)
MCTR4	$\tau = 0$ if EBIT ≤ 0 in 4 or more years, $\tau = 0.5 \cdot$SCTR if EBIT ≤ 0 in 2 or 3 years, otherwise $\tau =$ SCTR (in percent)
MCTR5	$\tau = 0$ if the sum of EBIT within the sample period is ≤ 0, and $\tau =$ SCTR otherwise (in percent)
Independent variables	
Firm age	2006 minus year of incorporation
Firm size	Logarithm of sales
Asset tangibility	Fixed assets + other fixed assets to total assets (in percent)
Return on assets (ROA)	Earnings before interest and taxes (EBIT) to total assets (in percent)
Net operating losses (NOL)	Dummy with entry 1 if average profit and loss per period < 0, zero else
Negative shareholders funds (NSF)	Dummy with entry 1 if average shareholder funds ≤ 0, zero else
Z-score	(3.3·earnings before interest and taxes + 1.0·operating revenue + 1.4·shareholder funds + 1.2·working capital)/total assets

Table A. 2: Descriptive statistics

Variable	Mean	Std. Dev.	Min	Max	Obs.[a)]
Debt to asset ratios					
Debt ratio	71.89	31.20	0.00	200.00	515,741
Short-term debt ratio	57.60	30.59	0.00	200.00	515,741
Total debt ratio excluding trade credits	60.73	33.18	0.00	200.00	515,741
Long-term debt ratio	14.30	19.75	0.00	200.00	515,741
Statutory corporate tax rates					
SCTR 1999	35.07	5.94	10.00	50.08	515,203
SCTR 2002	31.94	5.64	10.00	40.30	515,741
SCTR 2004	31.13	5.34	12.50	37.30	515,741
SCTR 1999-2004	32.52	5.25	10.83	41.17	515,741
Marginal corporate tax rates					
MCTR1	27.85	12.59	0.00	41.17	515,741
MCTR2	30.09	10.12	0.00	41.17	515,741
MCTR3	27.17	9.04	0.00	41.17	515,741
MCTR4	29.61	9.29	0.00	41.17	515,741
MCTR5	26.15	13.85	0.00	41.17	515,741
Independent variables					
Firm age (in years)	16.91	16.00	0.00	872.00	515,741
Firm age^2	541.91	2,173.15	0.00	760,384.00	515,741
Asset tangibility	33.64	24.24	0.00	100.00	498,187
Firm size (log of sales)	6.35	2.16	-1.79	18.82	422,337
Return on assets (ROA)	7.24	53.98	-15,983.44	13,800.86	443,198
NOL-dummy	0.23	0.42	0.00	1.00	515,741
NSF-dummy	0.13	0.33	0.00	1.00	515,741
Z-score	2.82	23.50	-1,100.70	12,993.81	421,903
Variables used for calculation					
Operating revenue (in tsd. EUR)	10,533.24	378,685.40	0.17	$150 \cdot 10^6$	422,337
Number of employees	72.10	1,877.02	1.00	757,846.50	368,750
Total assets (in tsd. EUR)	8,556.36	387,896.90	0.17	$188 \cdot 10^6$	515,741
Fixed assets (in tsd. EUR)	3,829.59	168,037.10	-2,029.00	$79 \cdot 10^6$	515,727
Other fixed assets (in tsd. EUR)	1,337.08	63,871.77	$-1.018 \cdot 10^6$	$19.7 \cdot 10^6$	506,368
EBIT (in tsd. EUR)	490.86	20,822.26	$-1.127 \cdot 10^6$	$8.004 \cdot 10^6$	443,198
Profit/loss per period (in tsd. EUR)	326.47	20,510.27	$-1.639 \cdot 10^6$	$7.758 \cdot 10^6$	443,693

Notes: [a)] Number of firms (in 35 countries and 126 NACE 3-digit industries).

Table A. 3: Correlation matrix

		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
(1)	Debt ratio	1.000												
(2)	Short term debt ratio	0.767	1.000											
(3)	Total debt ratio excl. trade credits	0.170	0.116	1.000										
(4)	Long term debt ratio	0.339	−0.343	0.080	1.000									
(5)	Firm age	−0.214	−0.184	−0.043	−0.044	1.000								
(6)	Firm age^2	−0.120	−0.107	−0.019	−0.024	0.846	1.000							
(7)	Asset tangibility	−0.020	−0.265	0.360	0.018	0.007	0.021	1.000						
(8)	Firm size (log of sales)	−0.135	−0.151	0.023	−0.051	0.382	0.233	0.034	1.000					
(9)	Return on assets (ROA)	−0.272	−0.176	−0.141	−0.042	−0.044	−0.025	−0.100	0.003	1.000				
(10)	NOL dummy	0.338	0.237	0.147	0.057	−0.006	0.012	0.093	−0.099	−0.404	1.000			
(11)	NSF dummy	0.595	0.480	0.167	0.110	−0.139	−0.063	−0.004	−0.259	−0.223	0.366	1.000		
(12)	Z-score	−0.085	−0.004	−0.119	0.366	−0.025	−0.013	−0.136	0.008	0.362	−0.141	−0.061	1.000	
(13)	SCTR 99-04	0.082	0.026	0.082	0.018	0.132	0.044	−0.083	0.268	−0.097	0.013	−0.089	−0.073	1.000

Table A. 4: Correlations in tax rates

		(1)	(2)	(3)	(4)	(5)	(6)
(1)	SCTR 99-04	1.000					
(2)	MCTR1	0.429	1.000				
(3)	MCTR2	0.535	0.740	1.000			
(4)	MCTR3	0.569	0.855	0.803	1.000		
(5)	MCTR4	0.579	0.939	0.837	0.901	1.000	
(6)	MCTR5	0.347	0.606	0.546	0.688	0.615	1.000

Table A. 5: Manufacturing firms according to NACE classification

2-digit	3-digit	Name	Obs.	2-digit	3-digit	Name	Obs.
15	150	Manufacture of food products and beverages	189		222	Printing and service activities related to printing	34,597
	151	Production, processing and preserving of meat and meat products	10,745		223	Reproduction of recorded media	1,281
				23	230	Coke, refined petroleum products and nuclear fuel	11
	152	Processing and preserving of fish and fish products	2,454		231	Coke oven products	48
	153	Processing and preserving of fruit and vegetables	3,313		232	Refined petroleum products	701
	154	Vegetable and animal oils and fats	1,401		233	Processing of nuclear fuel	40
	155	Dairy products	3,835	24	240	Chemicals and chemical products	132
	156	Grain mill products, starches and starch products	3,162		241	Basic chemicals	4,405
	157	Prepared animal feeds	2,205		242	Pesticides and other agro-chemical products	350
	158	Other food products	31,327		243	Paints, varnishes and similar coatings, printing ink and mastics	2,352
	159	Beverages	6,973				
16	160	Tobacco products	269		244	Pharmaceuticals, medicinal chemicals and botanical products	2,638
17	170	Textiles	93				
	171	Preparation and spinning of textile fibres	2,155		245	Soap and detergents, cleaning and polishing preparations, perfumes and toilet preparations	3,161
	172	Textile weaving	2,367				
	173	Finishing of textiles	2,173		246	Other chemical products	3,390
	174	Made-up textile articles, except apparel	4,630		247	Man-made fibres	251
	175	Other textiles	4,064	25	250	Rubber and plastic products	39
	176	Knitted and crocheted fabrics	1,047		251	Rubber products	3,005
	177	Knitted and crocheted articles	2,333		252	Plastic products	17,978
18	180	Wearing apparel; dressing and dyeing of fur	169	26	260	Other non-metallic mineral products	68
	181	Leather clothes	652		261	Glass and glass products	3,863
	182	Other wearing apparel and accessories	18,356		262	Non-refractory ceramic goods other than for construction purposes; manufacture of refractory ceramic products	2,388
	183	Dressing and dyeing of fur; manufacture of articles of fur	541				
19	190	Tanning and dressing of leather; manufacture of luggage, handbags, saddlery, harness and footwear	19		263	Ceramic tiles and flags	751
					264	Bricks, tiles and construction products, in baked clay	1,443
	191	Tanning and dressing of leather	1,288		265	Cement, lime and plaster	748
	192	Luggage, handbags and the like, saddlery and harness	2,055		266	Articles of concrete, plaster or cement	7,879
	193	Footwear	6,219		267	Cutting, shaping and finishing of ornamental and building stone	5,630
20	200	Wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials	23				
					268	Other non-metallic mineral products	1,401
	201	Sawmilling and planing of wood, impregnation of wood	10,610	27	270	Basic metals	56
	202	Veneer sheets; manufacture of plywood, laminboard, particle board, fibre board and other panels and boards	1,220		271	Basic iron and steel and of ferro-alloys (ECSC)	2,250
					272	Tubes	772
	203	Builders' carpentry and joinery	11,654		273	Other first processing of iron and steel and production of non-ESCS ferro-alloys	784
	204	Wooden containers	2,257				
	205	Other products of wood; manufacture of articles of cork, straw and plaiting materials	6,070		274	Basic precious and non-ferrous metals	1,947
					275	Casting of metals	2,393
21	210	Pulp, paper and paper products	31	28	280	Fabricated metal products, except machinery and equipment	153
	211	Pulp, paper and paperboard	1,350		281	Structural metal products	27,572
	212	Articles of paper and paperboard	6,638		282	Tanks, reservoirs and containers of metal; manufacture of central heating radiators and boilers	2,203
22	220	Publishing, printing and reproduction of recorded media	113				
	221	Publishing	25,682				

Table A. 5: cont.

2-digit	3-digit	Name	Obs.	2-digit	3-digit	Name	Obs.
	283	Steam generators, except central heating hot water boilers	2,900	33	330	Medical, precision and optical instruments, watches and clocks	107
	284	Forging, pressing, stamping and roll forming of metal; powder metallurgy	3,664		331	Medical and surgical equipment and orthopaedic appliances	7,148
	285	Treatment and coating of metals; general mechanical engineering	29,938		332	Instruments and appliances for measuring, checking, testing, navigating and other purposes, except industrial process control equipment	5,012
	286	Cutlery, tools and general hardware	6,135		333	Industrial process control equipment	2,310
	287	Other fabricated metal products	15,869		334	Optical instruments and photographic equipment	1,433
29	290	Machinery and equipment n.e.c	596		335	Watches and clocks	345
	291	Other general purpose machinery	5,324	34	340	Motor vehicles, trailers and semi-trailers	153
	292	Agricultural and forestry machinery	14,729		341	Motor vehicles	1,059
	293	Machine-tools	4,091		342	Bodies (coachwork) for motor vehicles; manufacture of trailers and semi-trailers	2,955
	294	Other special purpose machinery	4,126				
	295	Weapons and ammunition	12,202		343	Parts and accessories for motor vehicles and their engines	3,319
	296	Domestic appliances n.e.c	327	35	350	Other transport equipment	20
	297	Office machinery and computers	1,435		351	Building and repairing of ships and boats	5,649
30	300	Office machinery and computers	3,908		352	Railway and tramway locomotives and rolling stock	765
31	310	Electrical machinery and apparatus n.e.c	255		353	Aircraft and spacecraft	1,100
	311	Electric motors, generators and transformers	2,846		354	Motorcycles and bicycles	625
	312	Electricity distribution and control apparatus	2,652		355	Other transport equipment n.e.c	476
	313	Insulated wire and cable	986	36	360	Furniture; manufacturing n.e.c	162
	314	Accumulators, primary cells and primary batteries	258		361	Furniture	23,619
	315	Lighting equipment and electric lamps	2,486		362	Jewellery and related articles	3,890
	316	Other electrical equipment n.e.c	7,169		363	Musical instruments	570
32	320	Radio, television and communication equipment	13		364	Sports goods	1,096
	321	Electronic valves and tubes and other electronic components	3,369		365	Games and toys	1,241
					366	Other manufacturing n.e.c	11,938
	322	Television and radio transmitters and apparatus for line telephony and line telegraphy	2,085	37	370	Recycling	65
					371	Recycling of metal waste and scrap	3,373
	323	Television and radio receivers, sound or video recording or reproducing apparatus and associated goods	1,356		372	Recycling of non-metal waste and scrap	2,946