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Capital structure in the Danish non-financial corporate sector

Resumé:

This paper is concerned with the improvement of a particular part of the financial sub-model of ADAM. The goal is to search for a better way to explain the capital structure of non-financial corporate sector in ADAM. One of the key findings are that the market-to-book ratio seems to be very important for sector level leverage.

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Capital structure in the Danish non-financial corporate sector

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1. Introduction / Motivation

This paper is concerned with the improvement of a particular part of the financial sub-model of the **A**nnual **D**anish **A**ggregate **M**odel (ADAM). ADAM is an empirical macroeconomic model of the Danish economy. The model displays features which are characteristically Keynesian in short run and in the long run the features are neoclassical. The latest version of ADAM, dating April 2008, contains 2624 endogenous and 4767 exogenous variable. The model gives a simplified mathematical description of the interactions in the Danish economy. It is used by Danish government agencies for macroeconomic forecasting and planning.

The main users of ADAM are the Danish ministries of finance and of economic affairs. In addition to the ministries a number of associations and financial institutions use the model. This is mainly because of the forecasting abilities, but also because it is a valuable tool in keeping track of interactions between many simultaneous changes across the Danish economy. ADAM consists of a series of sub models; one of these is the **F**inancial **S**ub **M**odel (FSM). The main purpose of the financial sub model is to keep track of the public, private and foreign sectors price-adjusted net worth. In addition FSM determines how net worth is distributed among a group of financial instruments. In the current FSM the capital structure of non-financial companies is determined by distributing the annual net placement need among foreign- and domestic debt and equity with fixed weights. This is of course a very simple way to model the leverage of the non-financial corporate sector which leaves room for improvement. The goal of this paper is to search for a better way to explain the capital structure of non-financial corporate sector in ADAM.

The rest of this paper is organized as follows: section 2 contains a presentation of two benchmark capital structure models. Section 3 is a review of foreign empirical studies on capital structure. Sections 4 and 5 review necessary econometrics. Sections 6 and 7 discuss preparations for the estimation in section 8. Section 9 concludes.

2. Theoretical introduction

Franco Modigliani and Merton Miller (1958) introduced a proof showing that financing does not matter in a perfect capital market. The market value of a firm is indifferent to the capital structure. This was the first take on a theoretic approach to capital structure.[1] The model was based on unrealistic assumption such as zero taxes and costless bankruptcy. This prompted surveys on capital structure using the 1958 Modigliani-Miller theory as a benchmark, but with more realistic assumptions. The most common model extensions are non-zero taxes,

[1] Franco Modigliani and Merton Miller later received a Nobel price alia for this indifferent theorem.

transaction costs, bankruptcy cost, agency conflicts, adverse selection, time-varying financial market opportunities and so on. Covering all of the different theories is beyond the scope of this paper. Instead the focus will be on the more contemporary benchmark models.

2.1 The pecking order theory

In his book Donaldson (1961) was the first to describe the popular story based on a financing pecking order. He observed: *"Management strongly favoured internal generation as a source of new funds even to the exclusion of external funds except for occasional unavoidable 'bulges' in the need for funds"*[2] But the common "pecking order theory" stems from Myers (1984).

Definition - *A firm follow the pecking order if it* ***prefers***[3] *internal to external financing and debt to equity if external financing is used.*

Adverse selection as a motivation

Myers (1984) motivated the theory by adverse selection considerations between managers and investors. The idea is that the firm manager knows the true value of the firm's assets and real growth opportunities. All this is unknown for outside investors. They can only guess on these values. If the manager issues new equity the investors will ask themselves why. Investors could see equity issues as a signal of the firm being overvalued. Managers will happily sell equity if the firm is overvalued and vice versa. Investors take this into account when they decide how much to offer for the newly issued equity. This means the firm receives worse terms from the market than it would if there were no asymmetric information between investors and management. In the extreme case these terms may be so unfavourable that the firm decides to stay out of the market. This is unfortunate because such a decision involves forgoing opportunities to undertake positive net present value projects. The above intuition was modelled by Myers and Majluf (1984). The model presented below is the reformulation to a sequential game by Cadsby (1990).

Consider a manger of a firm and potential investors. All are risk-neutral and there are no transaction cost and no discounting.

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[2] Donaldson (1961) [13, p.67]

[3] The definition can be interpreted in different ways due to the verb "prefers". Prefer could be interpreted as "strictly prefer" so that firms will use all available internal finance before using any debt or equity issues. Or it could mean something like "prefer ceteris paribus" such that firms will rather use internal financing before using external financing. It is important decide on the meaning because the interpretation matters when testing. If "prefer" is interpreted in the ceteris paribus manner then the any test of the theory depends on the specification of ceteris paribus. On the other hand if it means "strictly" then the definition is much more direct testable.

The manager problem: The firm has some existing assets (A_i) all initially equity financed. The firm decides whether or not to invest in a project. It is assumed that the project has positive net value denoted (B_i). The subscript *i* refer to the firm's type. The firm may either be of type H (high) or L (low). The 2 types are equally likely. The sum of the initial assets plus the net value of the project is larger for a firm of type H than for a firm of type L. The firm knows the true worth of both its assets and the project. To undertake the project the firm needs $I > 0$ from the investors. It is assumed that $(A_i < I)$ and that it is not possible for management to obtain debt for this project.[4] If the firm does not undertake the project the value of the firm (V_i) is $V_i = A_i$. If the project is undertaken the terminal value of all the claims to the firm are $V_i = A_i + B_i + I$. But (V_i) no longer belongs entirely to the original owners and must therefore be shared with outside investors. Let $s_i \in [0;1]$ denote the fraction of the revenue that will go to the new investors. The original owners gets $(1-s_i)V_i$ if the new project is undertaken. The largest value of *s* that the manager is willing to give up, is the fraction that will leave the value of the existing firm unchanged:

$$(1-s_i)V_i = A_i \Leftrightarrow 1-s_i = \frac{A_i}{V_i} \Leftrightarrow 1-\frac{A_i}{V_i} = s_i \Leftrightarrow s_i = \frac{V_i - A_i}{V_i} \Leftrightarrow s_i^{\max} = \frac{B_i - I}{V_i}.$$

The investor problem: investors form their beliefs on the probability that the firm is type *i* given that a particular *s* has been presented. The smallest value of *s* the investor will accept is the fraction that makes their fraction of the revenue equal to the amount invested: $s_i^{\min} = \frac{I}{V_i}$.

Note that $s_H^{\min} < s_L^{\min}$. An auction is held among the investors. The winning investor bids the lowest value of *s* and provides *I* in exchange for $s_i V_i$. Therefore investors must attempt to determine *s* by comparing *I* to $s_i V_i$. The true value of $s_i V_i$ is unknown so investors have to compare *I* with the expected value of $s_i V_i$. The investors will have a loss if $E[s_i V_i] < I$ and have profit if $E[s_i V_i] > I$. Given many risk-neutral investors the winner expects to breakeven: $E[s_i V_i] = I$ [5].

[4] A model that also contains debt financing is far more complicated and will not be presented here. Noe (1988) provides an analysis of the problem.
[5] Since the investors know the true distribution of H and L type firms the investors' expectation is equal to the statistical expectation.

The equilibrium of the above asymmetric information model depends on the specific parameter values. The following equilibriums are obtained by proposition 1 and 2 in Giammarion and Lewis (1988) combined with the higher- and lower limit of *s*.

Pooling equilibrium: in the present context a pooling equilibrium means that both types of firms will want to undertake the new investment project. The *i* type firm will undertake the project if and only if the fraction of new revenue to the original investors is at least as large as the revenue without the project. Therefore the fraction *s* presented by the manager must satisfy: $(1-s)V_H \geq A_H \wedge (1-s)V_L \geq A_L$

There is a pooling equilibrium if and only if: $\frac{I}{V_L} < \frac{B_H + I}{V_H}$.

As said both the high and the low type firm will undertake the new project. This means that both types are in the financial market and the expectations of the total firm value is: $E[V_i] = 0.5V_L + 0.5V_H$ and the breakeven demand: $I = E[sV_i] = sE[V_i] = s\left(0.5V_L + 0.5V_H\right) \Leftrightarrow$

$s^* = \frac{I}{\left(0.5V_L + 0.5V_H\right)}$. In this equilibrium the asymmetric information does not cause any project loss.

Separating equilibrium: in this context a separating equilibrium means that the type L firm will undertake the new project but type H firm will not. The H type firm will forgo the project if $(1-s_H)V_H < A_H$. H knows $s^* = \frac{I}{\left(0.5V_L + 0.5V_H\right)}$ if H enters the project. Therefore:

$(1-s^{\bullet})V_H < A_H$ is the criteria giving the equilibrium: $\frac{B_H + I}{V_H} < \frac{I}{\left(0.5V_L + 0.5V_H\right)}$ [6]. As said only type L will undertake the new project and the expectations to the total firm value is therefore $E[V_i] = V_L$. The breakeven share demand is therefore: $I = E\left[s_i V_i\right] = s_L V_L \Rightarrow s_L^* = \frac{I}{V_L}$.

Investors know that only the low type firm is entering the project and demand terms therefore reflect this fact.

There is also a pooling and separating equilibrium (see Giammarion and Lewis (1988)) but it for the conclusion and therefore it is not shown.

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[6] $\left(1 - \frac{I}{\left(0.5V_L + 0.5V_H\right)}\right)V_H < A_H \Leftrightarrow \left(1 - \frac{I}{\left(0.5V_L + 0.5V_H\right)}\right) < \frac{A_H}{V_H} \Leftrightarrow$

$\left(1 - \frac{I}{\left(0.5V_L + 0.5V_H\right)}\right) < \frac{V_H - B_H - I}{V_H} \Leftrightarrow -\frac{I}{\left(0.5V_L + 0.5V_H\right)} < -\frac{B_H + I}{V_H} \Leftrightarrow$

In the above model internal financing was not possible. External equity financing could result in firms forgoing positive net present value projects due to costly external financing. Consider the possibility that the value of the existing assets is sufficiently high so that internal financing is possible $(A_i \geq I)$. This will eliminate the problem of costly asymmetric information and firms will never forgo projects with a positive net present value. I.e. firms prefer internal financing to external equity. As mentioned debt is not formally included in the above analysis. Myers (1984) argues intuitively that it ought to fall somewhere between internal- and equity financing. This is the motivation for the benchmark pecking order theory. A criticized part of the benchmark pecking order theory is the non-formal way debt is included.

2.2 The trade-off theory

The original trade-off theory grew out of the debate over the Modigliani-Miller theorem (1958). When taxes are introduced to this model this creates a benefit for debt financing in that it served to shield earnings from taxes. The trade-off theory also introduces an offsetting cost of debt namely that bankruptcy is costly[7]. The original trade-off theory provided by Kraus and Lizenberger (1973) stated:

-Optimal leverage reflects a trade-off between the tax benefits of debt and the deadweight loss of bankruptcy

Bankruptcy is costly because there are some direct fixed costs and some indirect permanent costs associated with bankruptcy. The direct cost could for example be lawyer fees and accountant fees, whereas indirect cost could be permanently damaged management reputation[8]. Myers (1984) argue that firms that follow the trade-off theory set a target debt-to-value ratio and then moves towards this target. They set the target by balancing the trade-off between tax benefits and the bankruptcy cost.

The Static-trade-off theory – Bradley (1984)

"A firm is said to follow the static trade-off theory if the firm's leverage is determined by a single period trade-off between the tax benefits of debt and the deadweight costs of bankruptcy" (F&G 2007Dec).

[7] Modigliani and Miller (1963) introduced taxed with no cost to debt with the result of an optimal leverage ratio of 100 % or until the tax-shield is fully utilized.

[8] L. Weiss (1990) found in an empirical investigation that the direct bankruptcy cost is about 3 pct. of the total firms value. See Haugen and Senbet (1978) for a more thorough discussion of bankruptcy cost.

The Bradley (1984) model does not assume a strictly realistic tax structure. The model does however contain some important elements of common tax codes.

Investors are risk-neutral and creditors face a progressive tax. Equity income is taxed with a fixed rate. Investors cannot deduct any payments. Firms face a constant marginal tax rate on wealth. Firms can deduct both interest and principle payments. If the firm is unable to make a promised payment it incurs bankruptcy costs (deadweight).

The cash-flow (*X*) generated by a firm is distributed among taxes, debt- and equity holders.

The distribution depends on the value of X:

If $X < 0$ then both the payments to debt (D) and equity holders as well as tax payments are zero. If $0 < X < D$ the firm defaults. Let k be a fraction of the cash-flow that is lost when the firm defaults. When the firm defaults the stocks of the firm has no value and therefore there will be no payment to equity holders. Debt holders will receive the fraction of the cash-flow that is not lost in default cost. *(X(1-k)).* There is a deadweight loss of *kX* when earnings are positive but not large enough to cover promised debt payments.

The firm has a non-debt tax shield that reduces the end-of period tax liability. If the non-debt tax shield is fully used the tax reduction is ϕ. If the cash flow is large enough that the firm does not default, but less than the size of the non-debt tax shield, then the debt holders will receive the promised debt payment (D). The equity holders will receive the rest of the cash-flow (X-D). There will be no deadweight loss since the firm does not default.

If the cash-flow is larger than the non-debt tax shield the firm owes a tax payment equal to ($T_C(X-D)-\phi$) where T_C is a constant marginal tax on corporate income. Debt holders will receive the promised debt payment D. Equity holders will receive $X-D-T_C(X-D)+\phi$. The boundary in which the firm begins to pay taxes is determined by:

$$\underbrace{X-D}_{\substack{\text{Payment to equity holders}\\ \text{when no taxes are paid}}} = \underbrace{X-D-T_C(X-D)+\phi}_{\substack{\text{Payment to equity holders}\\ \text{when taxes are paid}}} \Leftrightarrow T_C(X-D)=\phi \Leftrightarrow X = D+\frac{\phi}{T_C}$$

Let f(X) be the probability density of the cash-flow (X) and F(X) be the cumulative probability density function belonging to it. The market value of debt is found by integrating the debt holders' discounted, after-tax return across the different states of *X*.

$V_D = \left(\frac{1-T_D}{1+r_f}\right)\left[\int_D^\infty Df(X)dX + \int_0^D X(1-k)f(X)dX\right]$ where T_D is a progressive tax rate on debt holders. Likewise the market value of equity can be obtained by integrating the stock holders' discounted, after-tax return across all states of the cash-flow *X:*

$$V_E = \left(\frac{1-T_E}{1+r_f}\right)\left[\int_{D+\phi/T_c}^{\infty}\left[(X-D)(1-T_C)+\phi\right]f(X)dX + \int_{D}^{D+\phi/T_c}(X-D)f(X)dX\right]$$ where T_E is the tax rate on equity income. The total value of the firm is obtained by adding the market value of debt and equity: $V = V_D + V_E$. The optimal debt level is chosen such that it maximizes the total firm value.[9] The solution to this maximization problem can be a boundary- or an interior solution. If it is an interior solution the first order condition is (FOC)[10]:

$$\frac{\partial V}{\partial D} = \left(\frac{1-T_D}{1+r_f}\right)\left[(1-F(D))\left(1-\frac{(1-T_C)(1-T_E)}{1+T_D}\right)-\frac{T_C(1-T_E)}{1+T_D}(F(D+\phi/T)-F(D))-kDf(D)\right]$$

From the FOC it can be seen that the firm's debt decision involves a trade-off between the marginal tax advantage of debt and the marginal costs of bankruptcy. The optimality condition has been differentiated with respect to each of the relevant exogenous variables in appendix 1. From appendix 1 it can be seen that optimal debt level is negatively correlated with k and ϕ. An increase in either the cost of financial distress or in non-debt tax shields will lead to a reduction in the optimal level of debt. It can also be seen that an increase in taxes on equity income will increase the optimal debt level. An increase in the marginal debt tax rate decreases the optimal level of debt. It should be mentioned that with respect to Myers (1984) definition of the trade-off theory the Bradley (1984) trade-off model has a problem since it does not treat the movement towards a debt target explicitly.

3. Some evidence on the non-financial corporate debt ratio[11]

Since data on the Danish financial sector is only available since 1994 the following will survey studies on foreign data on much larger samples.

Wright (2004) presents data describing the US non-financial corporate sector 1900 - 2002. As can be seen from enclosure 1 different measures of the debt ratio have varied within bounds of around ten percentage points. The gross debt ratio average around 50 % and the net debt ratio average around 20 %. As can be seen both measures of the debt ratio cross their means several times over the period indicating stationarity. Lemmon et Al. (2007) finds an average debt ratio of 0.32 for all non-financial firms in the Compustat database. A UK study on the Datastream database on 859 non-financial firms finds an average debt ratio of 0.2 for individual firms.

Statement 1: The debt ratio is stationary, both at the aggregate and the firm level

[9] This is conventional, but it is important to acknowledge that this is not necessary true. A firm's could also maximize the value of equity instead the firm value. In this model such agency problems are assumed away.
[10] The size of the appendix prohibits presenting this derivation. But it can be provided on demand.
[11] This section builds on F&G 2007Dec.

Lemmon et Al. (2007) divide the non-financial corporate sector into quartile firm portfolios based on initial leverage ratio. Holding constant the initial portfolio selections they then compute the leverage ratios and graph them along the time axis. This graph is shown in enclosure 2. As can be seen there is significant initial cross-sectional variation in the leverage of the portfolios. The difference between the highest- and the lowest leverage is 52 %-points. There is evidence of convergence in the debt ratio between firms, but it is also clear that initial values have long lasting effects with only 36 %-points of the difference having disappeared after 20 years. Most of this is happening within the first few years.[12]

The same study by Lemmon et Al. regress debt ratios on *standard*[13] cross-sectional determinants. What they call "the unexpected leverage", defined as the residuals from these regressions, are then divided into quartile groups and the average is graphed along the time axis. This graph is shown in enclosure 3. As can be seen from enclosure 3 the graph of "the unexpected leverage" is almost identical to the graph of the leverage ratio in enclosure 2. The significance of this being that the *standard* cross-sectional regressors cannot account for a vast amount of the cross-sectional variation. Lemmon et Al. argue that the residual cross-sectional variation is firm specific. They show that firm specific effects account approximately 60 % of all variation.

Statement 2: there is economically- and statistically significant cross-sectional variation in the debt ratio. The within firm variation in the debt ratio seems to disappear with time, but at a very slow rate. Around 60 % of the total variation is firm specific, time invariant and remains unexplained.

In a cross-sectional examination of the data from 1950 – 2003 on non-financial US firms F&G (Oct. 2007) finds a set of 6 factors which are empirically robust as well statistically- and economically significant. The robustness of these explanatory variables are tested in both the time dimension and across firm types and are found to be relatively stable across all tested dimensions. A review on theoretical justifications and implied signs can be found in F&G 2007Dec for the 6 factors. Frank and Goyal (2007Oct):

"Starting from a large set of factors that have been used in previous studies, we find that a set of six factors provides a solid basic account of the patterns in the data:

[12] To rule out the possibility that results are biased from market entries/exits Lemmon et Al. reports similar results from a control group they term "survivors". These are defined as firms with at least a 20 year sample.

[13] These standard regressors are proxies for: firm size, profitability, market-to-book, and tangibility.

Firms that compete in industries in which the median firm has high leverage tend to have high leverage. Firms that have a high market-to-book ratio tend to have low levels of leverage. Firms that have more tangible assets tend to have more leverage. Firms that have more profits tend to have less leverage. Larger firms tend to have high leverage. When inflation is expected to be high firms tend to have high leverage."

Rajan & Zingales show in their study from 1996 that 4 of the above factors, namely profitability, size, market-to-book ratio and tangibility, are also robustly important across the G-7 countries[14]. Although the parameters do vary across countries they are not very dissimilar especially when considering the confidence bounds. The signs are almost exclusively the same across countries.

Statement 3: A small number of variables have been identified as being the robust determinants of leverage across countries, firm size, time and more. These are in particular market-to-book ratio, profitability, size and tangibility.

Enclosure 4 shows the aggregate U.S. federal flow of funds 1945 - 2003. The data are for the non-farm non-financial corporate sector[15]. From this figure it can be seen that at an aggregate level capital expenditures and internal funds fluctuate together. It can also be seen that the variables have been rather stable over the time period. The figure also shows tendency for similar fluctuation in financing deficit and debt issues. This could indicate that debt finances are a rather large part of the financing deficit.

In enclosure 5 the same graph is shown for small public firms. Enclosure 5 shows that small public firms have a different pattern in the flow variables. Capital expenditures and internal funds fluctuate together and capital expenditures are larger than internal funds. The financial deficit and debt issues do not fluctuate together. But equity issuances and the financing deficits appear to be correlated. It seems small public firms are special.

As can be verified from figures 2 and 4 in F&G 2007Dec the graphs of large public firms and private firms follow a pattern much like the aggregated flow of funds figure.

Statement 4: At the aggregate level, capital expenditures are very close to internal funds and the financing deficit is very close to debt issues. This is not true for small public firms. For small public firms, financing deficits very closely match equity issues.

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[14] See table IV in Zingales and Rajen (1996) p. 1453.

[15] We use U.S. data since such data like this does not exits in the same extend for Denmark.

4. Empirical models[16]

The review of international evidence on the debt ratio suggests some general *facts* on the data generating process. These *facts* were summarized in statements 1 – 4. This section will discuss what they imply for an econometric specification of the problem in both a trade-off theory and a pecking order theory setting.

Empirical studies on leverage are almost exclusively done on panel data. Therefore we will present the econometric models in panel data form. This allows econometric representation of empirical results in the setting in which they were found. The Danish data we have available for estimation is aggregated sector data. The yearly sector data is equivalent to firm data summed across firms *(i).* This is going to present problems in somewhat unknown directions, which makes econometric specification simpler in the panel data form.

Modelling the (static) trade-off theory

What is general about the (static) trade-off theories is that each firm has an optimal debt level. The optimal debt level is determined by the point at which the benefits of increasing debt are equated by the costs. In a trade-off theory framework the above statements 1- 3 could be captured by a specification for the optimal debt ratio of the form:

(1.1) $$D^*_{it} = \sum_{k=1}^{N} \beta_k x_{kit} + \mu_i$$

This states that the optimal debt ratio of firm *i* is a linear function of some general characteristics (captured by the vector x) and some firm specific component[17] (a different intercept for each firm *(i)*). Also since, empirical studies suggest time-specific effects are not important for the debt ratio[18] these have been excluded from (1.1).

Since the (static) trade-off theory is static adjustment towards an optimal debt ratio has to be ad hoc. This is in itself a problem for the static trade-off theory and has given rise to a new branch of literature on dynamic trade-off theories. Although these have proven useful in understanding what determines the debt ratio their conclusions are not unanimous and the literature is still new and ongoing. After an extensive review of literature on dynamic trade-off models, F&G 2007Dec (p.17) state that one common finding in these models is path dependence. This might be why most authors propose a partial adjustment model (PAM) or

[16] This section builds on Viet Anh Dang (2005).

[17] This component can either really be firm specific or simply a way of capturing some general time-invariant characteristics which haven't been accounted for in *x*

[18] As can be seen from table III Lemmon (2007) time specific effects explain only approximately 1 % of total variation in leverage.

an error correction model (ECM) for the adjustment towards the optimum. In the following we will adopt this view and take as an example the ECM since the PAM is a common factor restriction on the ECM. An ECM for the debt ratio is:

(1.2) $$D_{it} - D_{it-1} = \delta\left(D_{it}^{*} - D_{it-1}^{*}\right) - \lambda\left(D_{it-1} - D_{it-1}^{*}\right) + v_{it}$$

Substituting (1.1) into (1.2) we get:

$$D_{it} - D_{it-1} = \delta\left(\sum_{k=1}^{N}\beta_k x_{kit} + \mu_i - \left(\sum_{k=1}^{N}\beta_k x_{kit-1} + \mu_i\right)\right) - \lambda\left(D_{it-1} - \left(\sum_{k=1}^{N}\beta_k x_{kit} + \mu_i\right)\right) + v_{it} \Leftrightarrow$$

$$D_{it} - D_{it-1} = \delta\sum_{k=1}^{N}\beta_k x_{it} - \lambda D_{it-1} + (\lambda - \delta)\sum_{k=1}^{N}\beta_k x_{kit} + \lambda\mu_i + v_{it} \Leftrightarrow$$

(1.3) $$\begin{gathered} D_{it} = (1-\lambda)D_{it-1} + \sum_{k=1}^{N}\phi_k x_{kit} + \sum_{k=1}^{N}\varphi_k x_{kit-1} + \eta_i + v_{it} \\ \textit{where } \phi_k = \delta\beta_k,\ \varphi_k = (\lambda-\delta)\beta_k,\ \eta_i = \lambda\mu_i \end{gathered}$$

(1.3) is an autoregressive panel data model with exogenous variables for the debt ratio. The adjustment speed is given by λ. This is from statement 1 is expected to be different from zero. For identification on the parameters in (1.3) assumptions has to be made on the error term (v_{it}). We assume that the error term is identically, independently distributed with mean zero and some variance:

(1.4) $$v_{it} \sim IID(0, \sigma_v)$$

Imposing (1.4) on (1.3) requires that after controlling for firm characteristics in the vector **x** and allowing each firm to have a different intercept, there is no correlation across firms or time in the debt ratio. From (1.3) it is clear that $E\left[(\eta_i + v_{it})D_{it-1}\right] \neq 0$ meaning that the OLS moment condition is not fulfilled[19]. The firm specific component therefore has to be removed, which can be done by first differencing (1.3):

(1.5) $$\Delta D_{it} = (1-\lambda)\Delta D_{it-1} + \sum_{k=1}^{N}\phi_k \Delta x_{kit} + \sum_{k=1}^{N}\varphi_k \Delta x_{kit} + \Delta v_{it}$$

Modelling the pecking order theory

Shyam-Sunder and Myers (1999) gives the word *prefer* in the definition of the pecking order theory a strict interpretation. If after an initial public offering a firm will only issue debt if no internal financing is available and only equity in extreme cases when financial distress is high, then the pecking order theory gives rise to a simple empirical model:

[19] See enclosure 7 where the OLS estimates from Monte Carlo experiments on this type of model are shown.

(1.6) $\Delta D_{it} = \alpha + \beta \cdot DEF_{it} + \varepsilon_{it}$, where DEF_{it} is the period t cash flow deficit

This strict version of pecking order theory predicts that $\alpha = 0$ and $\beta = 1$ in (1.6) such that any cash flow deficit is covered by an equal change in debt. It seems very reasonable that $\alpha = 0$ since $\alpha \neq 0$ corresponds to a trend stationary debt ratio, which from statement 1 seems unlikely. As to the value of β, Shyam-Sunders and Myers (1999) finds support for a β close to 1 for a small sample of 157 large firms. But Vieth Anh Dang (2005) and Frank & Goyal (2003) both find a β much smaller than 1 from larger samples of different firm types. Lemmon et Al. suggest that larger firms have larger β's due to the fact that smaller firms tend to be more debt constrained and that they issue equity when constrained. While (1.6) finds some empirical support with private- and large public firms it seems that small public firms tend to prefer equity to both internal funds and debt (as is discussed in prior to statement 4).

A more general model

Neither the trade-off theory nor the pecking order theory seems to completely capture the empirical facts. Therefore a natural way to proceed is to let an empirical specification represent both the trade-off theory framework and the pecking order theory framework. In a context of testing the theories against each other this is what is done in some recent empirical papers.[20] In these papers $\beta \cdot DEF_{it}$ is simply added to the right hand side of a specification similar to (1.5). This paper, though, is not concerned with testing the theories against each other, but simply with finding the best empirical specification. Therefore it seems natural to take statement 4 into account and allow for the case where small public firms are special. This can be done with the more general specification:

(1.7) $$\Delta D_{it} = (1-\lambda)\Delta D_{it-1} + \sum_{k=1}^{N} \phi_k \Delta x_{kit} + \sum_{k=1}^{N} \varphi_k \Delta x_{kit-1} + \xi_1 DEF_{it}(1-SPF_{it}) + \xi_2 DEF_{it} \cdot SPF_{it} + \Delta v_{it}$$

$$where\ SPF_{it} = \begin{cases} 1 \text{ if firm } i \text{ at time } t \text{ is a small public firm} \\ 0 \text{ if firm } i \text{ at time } t \text{ is not a small public firm} \end{cases}$$

and everything else is as previously defined in (1.5) and (1.6).

5. Econometric issues

Instrumental variables (Anderson and Hsaio 1981)

The starting point for an empirical investigation thus becomes (1.7). But there is an inherent problem with (1.7) since: $E[\Delta D_{it-1}\Delta v_{it}] = E[(D_{it-1} - D_{it-2})(v_{it} - v_{it-1})] = E[D_{it-1}v_{it-1}] = \sigma_v^2 \neq 0$,

[20] Shyam-Sunders and Myers (1999), Frank and Goyal (2003) and Vieth Anh Dang (2005).

which means that the OLS moment condition is not fulfilled and no alternative transformation could remove this problem[21]. But what is pleasant about (1.7) is that it gives rise to a natural instrumental variable for ΔD_{it-1} .An instrumental variable must satisfy a moment condition which in this case is $E\left[z_{it}v_{it}\right]=0$. Also it must be the case that $Cov\left(z_{it}D_{it-1}\right)\neq 0$. Both of these requirements are tautologically satisfied by D_{it-2} and ΔD_{it-2} .[22] Thus as long as the error term is in fact IID as assumed in (1.4) we can estimate (1.7) using the instrumental variables estimator (IVE). Let Z_{it} be a column vector of instruments. Either D_{it-2} or ΔD_{it-2} is used as an instrument for ΔD_{it-1}[23] and the other explanatory variables in (1.7) are instruments for themselves. A valid moment conditions is:

(1.8) $$E\left[Z_{it}\Delta v_{it}\right]=0$$

Writing (1.7) in compact form as:

(1.9) $$\Delta D_{it}=\prod \Delta X_{it}^{T}+\Delta v_{it}$$

$$\textit{where } \Pi=\left\{\lambda,(\phi_1,\phi_2,...,\phi_k),(\varphi_1,\varphi_2,...,\varphi_k),\xi_1,\xi_2\right\} \textit{ and}$$
$$\Delta \mathrm{X}=\left\{\Delta \mathrm{D}_{\text{t-1}},\left(\Delta x_{1t},\Delta x_{2t},...,\Delta x_{Nt}\right),\left(\Delta x_{1t-1},\Delta x_{2t-1},...,\Delta x_{Nt-1}\right),DEF_{it}\cdot(1-SPF_{it}),DEF_{it}\cdot SPF_{it}\right\}$$

Substituting (1.9) into (1.8) we get:

$$E\left[Z_{it}\Delta v_{it}\right]=0\Leftrightarrow E\left[Z_{it}\left(\Delta D_{it}-\hat{\prod}\Delta X_{it}{}^{T}\right)\right]=0\Leftrightarrow\hat{\prod}E\left[Z_{it}\Delta X_{it}{}^{T}\right]=E\left[Z_{it}\Delta D_{it}\right]\Leftrightarrow$$

(1.10) $$\hat{\prod}=E\left[Z_{it}\Delta X_{it}{}^{T}\right]^{-1}E\left[Z_{it}\Delta D_{it}\right]$$

Taking sample averages from (1.7) provides the IV (AH) estimator:

(1.11) $$\hat{\prod}=\left(\sum_i\sum_t Z_{it}\Delta X_{it}{}^{T}\right)^{-1}\left(\sum_i\sum_t Z_{it}\Delta D_{it}\right)$$

6. Adapting the model to time series data

Since ADAM is an aggregated model for the Danish economy the data is aggregated as well. As mentioned above the data available from ADAM's Databank is equivalent to annual panel data aggregated across *i*. As documented prior to statement 2 there are economically significant firm specific components in the data at the firm level, which must also be accounted for at the sector level. What also becomes a problem at the sector level is the need

[21] The within transformation which is the common static panel data transformation does not solve the problem either. The bias when using this transformation and disregarding the endogeneity is shown in Verbeek p.361. See also enclosure 8 where Monte Carlo experiments are shown.

[22] This holds as long as the error term exhibits no autocorrelation.

[23] Both can be used as instruments at the same time, but this is left out of the exposition so as to save space. See Veerbek p. 142-145.

to allow for the possibility that small public firms react differently than the rest of the corporate sector with regards to the financing deficit. Assuming a data generating process of the form (1.7):

$$\Delta D_{it} = (1-\lambda)\Delta D_{it-1} + \sum_{k=1}^{N} \phi_k \Delta x_{kit} + \sum_{k=1}^{N} \varphi_k \Delta x_{kit-1} + \xi_1 DEF_{it}(1-SPF_{it}) + \xi_2 DEF_{it} \cdot SPF_{it} + \Delta v_{it}$$

The time series equivalent becomes:

$$\sum_i \Delta D_{it} = \sum_i \left[(1-\lambda)\Delta D_{it-1} + \sum_{k=1}^{N} \phi_k \Delta^2 x_{kit} + \sum_{k=1}^{N} \varphi_k \Delta x_{kit-1} + \xi_1 DEF_{it}(1-SPF_{it}) + \xi_2 DEF_{it} \cdot SPF_{it} + \Delta v_{it} \right]$$

This can be written as:

$$\Delta D_t = (1-\lambda)\Delta D_{t-1} + \sum_{k=1}^{N} \phi_k \Delta x_{kt} + \sum_{k=1}^{N} \varphi_k \Delta x_{kt-1} + \xi_1 \sum_i DEF_{it} + (\xi_2 - \xi_1)\sum_i DEF_{it} \cdot SPF_{it} + \Delta v_t$$

$$\textit{where } \Delta D_t \equiv \sum_i \Delta D_{it}, \Delta x_{ikt} \equiv \sum_i \Delta x_{ikt}, \Delta v_t \equiv \sum_i \Delta v_{it}$$

But data is not available for $\sum_i DEF_{it} \cdot SPF_{it}$. This gives rise to a problem since if we estimate the time series equivalent of (1.7) with only the term $\tilde{\xi}_2 \sum_i DEF_{it}$, we have an omitted variable[24] which is certainly correlated with $\sum_i DEF_{it}$ producing inconsistent estimates. Removing this inconsistency will require an assumption. One could potentially create the variable $\sum_i SPF_{it} \left(\sum_i 1 \right)^{-1}$ and assume that $\alpha \sum_i SPF_{it} \left(\sum_i 1 \right)^{-1} = \sum_i DEF_{it} SPF_{it} \left(\sum_i DEF_{it} \right)^{-1}$ and substitute. This assumes the ratio of small firms to all firms is proportional to the ratio of the financing deficit of small firms to the financing deficit of all firms. As is shown in appendix 2 this will remove the inconsistency given that the assumption is appropriate. Making the above assumption and substituting is only potentially going to remove the inconsistency though. This will require the collection of a lot of data and the fraction of small public firms to all firms in Denmark is probably rather small. If this is the case the needed correction will not be economically significant and on this basis this will be beyond the scope of this paper. Instead we are going to assume that firms react homogenously to financing deficits ($\xi_2 = \xi_1 = \xi$) knowing that this will likely create lesser inconsistencies. Our model thus becomes:

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[24] The omitted variable becomes: $\sum_i SPF_{it} \cdot DEF_{it} (\xi_2 - \xi_1)$, which is only zero for $\xi_2 = \xi_1$. As discussed prior to statement 4 this is unlikely.

(1.12) $$\Delta D_t = (1-\lambda)\Delta D_{t-1} + \sum_{k=1}^{N}\phi_k \Delta x_{kt} + \sum_{k=1}^{N}\varphi_k \Delta x_{kt-1} + \xi DEF_t + \Delta v_t$$

$$where\ \Delta D_t \equiv \sum_i \Delta D_{it}, \Delta x_{ikt} \equiv \sum_i \Delta x_{ikt}, \Delta v_t \equiv \sum_i \Delta v_{it}, DEF_t \equiv \sum_i DEF_{it}$$

Another problem which is probably the most important one is that of firm entry and exit. The non-financial corporate sector in a given year consists of all non-financial firms in that year. Because of firm entry and exit the aggregate leverage ratio is unlikely to be describing the same firms in two consecutive years. As a result the coefficients to the aggregated explanatory variables become averages of different firms. This is not a problem if these average coefficients are constant over time, which we will assume as this is basically the usual time series assumption of constant parameters.[25]

A potential problem is that firm composition is going to affect the leverage ratio. Enclosures 4 and 5, discussed prior to statement 4, indicated that firms could be systematically heterogeneous with respect to leverage. Heterogeneity in firm leverage can give aggregate coefficient estimates which are unlike the panel data estimates. If both an included explanatory variable and leverage are correlated with an omitted variable the effect of the omitted variable on leverage can show up in the coefficient to the included explanatory variable. A variable which could potentially exhibit such behavior is a variable measuring firm entry and exit. To diminish[26] this problem we will therefore include the state of the economy (SoE_t) as a proxy for firm and exit. Newly started small business will probably be more heavily debt financed and entries usually happen in better states of the economy. Thus it seems likely that the distribution of firms will be correlated with the state of the economy. The proxy variable (SoE_t) is chosen to be the above average logarithmic change in GDP. This gives the time series model to be estimated:

$$\Delta D_t = (1-\lambda)\Delta D_{t-1} + \sum_{k=1}^{N}\phi_k \Delta x_{kt} + \sum_{k=1}^{N}\varphi_k \Delta x_{kt-1} + \xi DEF_t + \theta SoE_t + \Delta v_t$$

Removing firm specific effects is necessary in time series as in panel data. Above this is done by taking first differences. Taking first differences create correlation between the lagged dependent variables in differences and the differenced error term. As in the panel data case IV methods are needed to provide consistent estimates. The natural the time series instruments are ΔD_{t-2} and D_{t-2}. The IV estimator is obtained by utilizing the time series moment

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[25] This is of course a not a trivial assumption, but one that can be tested by means of recursive estimation procedures. This is not done in our estimation section because of the short sample.

[26] We are not aware of any method which can remove the bias caused by this problem.

condition, which is the time series equivalent of (1.8): $E\left[Z_{it}\Delta v_{it}\right]=0$. The time series equivalent of (1.9) becomes: $\Delta D_t = \prod \Delta X_t^T + \Delta v_t$. (1.8) with (1.9) leads to the time series equivalent of (1.11), which is the time series IV estimator: $\hat{\prod} = \left(\sum_t Z_t \Delta X_t^T\right)^{-1}\left(\sum_t Z_t \Delta D_t\right)$.[27]

7. Speed of adjustment[28]

The speed of adjustment (λ) cannot be estimated by OLS since the moment condition is not valid. Methods such as IV or GMM (discussed below) should be employed to identify the parameter. But as will be shown in section 8 the IV approach produces estimates with huge variance for our very short sample. Although GMM methods will likely reduce the variance of the estimated parameters it will almost certainly show not produce reasonably narrow confidence bounds on λ. So due to the very short sample available we have chosen to rely on the foreign empirical estimates of the speed of adjustment.[29]

As discussed prior to statement 1 leverage certainly does seem to be stationary over longer periods of time. But whether this stationarity is the result of adjustment towards a possibly time varying optimal debt level is still not perfectly clear. The discussion on the size of the speed of adjustment is not settled either. Since the millennium several economically different estimates of the speed of adjustment have been reported. Fama and French (2002) report speeds of adjustment in the area of 7 % for dividend paying firms and 15 % for non-dividend paying firms using pooled OLS ignoring firm specific effects. Kayhan and Titman (2007) report adjustment speeds of 10 % for all firms using pooled OLS. The Monte Carlo experiment in enclosure 7 shows the pooled OLS estimate of the autoregressive parameter is likely to be biased upwards. This means that the adjustment speed is likely to be downwards biased in these two studies. Flannery and Rangan (2006) employ the IV (AH) estimator to mean-differenced leverage. They find adjustment speeds of 35.5 % per year. Pooled OLS estimates on their data gives adjustment speeds of 14 % and mean-differencing without instrumental variables produces an adjustment speed of 38 %. OLS estimates are likely to be downwards biased mean differencing estimator is likely upwards biased (as can be motivated by the Monte Carlo experiment shown in enclosure 7 and as is shown in Hsaio (2003)). This means that the pooled OLS estimate gives a downwards bound- while the mean-differencing

[27] Calculations showing that this will work for time series as well have been done and are available on demand.
[28] In the following all leverage is taken to mean market leverage (debt and equity in market prices) unless anything else is mentioned. Since estimation will be performed on market leverage this is our main focus.
[29] In the extended GMM case we would also need to assume constant correlation between the differenced exogenous variables and the time invariant components. Due to firm entry and exit this would be hard to justify.

gives an upward bound on the speed of adjustment. Therefore the speed of adjustment should be in the range of 14 % - 38 % for the US speed of adjustment.

The extended GMM estimator is currently most commonly used when estimating the speed of adjustment. It will therefore be presented informally in the following. This presentation is meant to give an idea of the possible problems- and benefits of this estimator. To understandably present the extended GMM estimator we briefly discuss the Arellano and Bond (1991) GMM estimator first. Arellano and Bond (1991) follow the line of thought of Anderson and Hsiao (1981). They propose a GMM estimator which by extending the number of moment conditions is more efficient when estimating a model like: $\Delta D_{it} = (1-\lambda)\Delta D_{it-1} + \Delta v_{it}$. The idea is that if we have a balanced panel of data with a number of time periods greater than one then there is more than one valid moment condition. In fact, if there are T time periods there are 1+2+3+…+T-1 moment conditions:

$$\begin{aligned}
&For\ t=2\ we\ have:\\
&E[(v_{i2}-v_{i1})D_{i0}]=0\\
&For\ t=3\ we\ have:\\
&\left.\begin{aligned}E[(v_{i3}-v_{i2})D_{i0}]=0\\ E[(v_{i3}-v_{i2})D_{i1}]=0\end{aligned}\right\}\Leftrightarrow E\left[(v_{i3}-v_{i2})\begin{pmatrix}D_{i0}\\ D_{i1}\end{pmatrix}\right]=\begin{pmatrix}0\\0\end{pmatrix}\\
&for\ t=T\ we\ have:\\
&\left.\begin{aligned}E[(v_{iT}-v_{iT-1})D_{i0}]=0\\ E[(v_{iT}-v_{iT-1})D_{i1}]=0\\ \vdots\qquad\\ E[(v_{iT}-v_{iT-1})D_{iT-2}]=0\end{aligned}\right\}\Leftrightarrow E\left[(v_{iT}-v_{iT-1})\begin{pmatrix}D_{i0}\\ D_{i1}\\ \vdots\\ D_{iT-2}\end{pmatrix}\right]=\begin{pmatrix}0\\0\\ \vdots\\0\end{pmatrix}
\end{aligned}$$

If in (1.9) one can assume strictly exogenous variables: $E\left[X_{is}^T v_{it}\right]=0\ \forall s,t$ this provides *T* new moment conditions in each period. If in (1.9) one can assume predetermined variables: $E\left[X_{is}^T v_{it}\right]=0\ \forall s\leq t$, this provides *t-1* new moment conditions in period *t* for the differenced equation (1.9). The GMM estimator thus builds on the IV estimator in the sense that it utilizes the same moment condition as the IV, but also others. This makes GMM estimation more efficient than IV.

Using the Arellano and Bond approach (GMM) Viet Anh Dang reports an estimate of the speed of adjustment of 61 %. Viet Anh Dang also reports a number of other estimates which are generally economically different. He summarizes his results by stating that speeds of adjustment are above 50 % for the UK data. The results of Viet Anh Dang have not yet been replicated and are not very robust to choice of instruments. As a result we have chosen not to give the estimates of Viet Anh Dang much weight in a best guess on the speed of adjustment. Arrellano and Bover (1995) present Monte Carlo experiment results from IV (AH) estimation of the autoregressive parameter in panel data models. These results have been repeated from their article in enclosure 6 where the AH column denotes this estimator. As can be seen from enclosure 6 the AH estimator performs much worse than the extended GMM estimator (L1 in the table). This is in particular true for higher values of the autoregressive parameter and larger variance of the time invariant component.

The extended GMM estimator by Arellano and Bover exploits the idea that information in a levels equation like: $D_{it} = (1-\lambda)D_{it-1} + ... + \mu_i + \varepsilon_{it}$ can be used simultaneously with the differences equation: $\Delta D_{it} = (1-\lambda)\Delta D_{it-1} + ... + \Delta\varepsilon_{it}$ making estimation more efficient.

Arrelano and Bover make a useful observation. If one can assume constant correlation between explanatory variables and the time invariant component this means the existence of natural instruments for the levels equation. That is, if we can assume:

(1.13) $$E\left[x_{it}\eta_i\right] = E\left[x_{is}\eta_i\right]\forall s,t \Rightarrow E\left[\left(x_{it} - x_{is}\right)\eta_i\right] = 0\forall s,t$$

According to Arellano and Bover: "*This type of restrictions could be justified on the grounds of stationarity, and in many instances its validity or otherwise can be regarded as an empirical issue*" (p.45). With the usual assumption of predetermined explanatory variables: $E\left[x_{it}v_{is}\right] = 0\forall s \geq t$, we have the valid moment condition:

(1.14) $$E\left[\left(x_{it} - x_{is}\right)\left(\eta_i + v_{is}\right)\right] = 0\forall s \geq t$$

This insight leads Arellano and Bover to conclude that first differenced explanatory variables can be instruments for the levels of explanatory variables if the assumption of constant correlations is appropriate. It should be noted that the extended GMM estimator therefore relies minimally on the very strict assumption (1.14). This assumption is rarely mentioned and not tested in the literature.

Using extended GMM Lemmon et Al. (2007) finds an adjustment speed of 25 % for book leverage. Vieth Anh Dang also uses the extended GMM approach for UK data and reports a speed of adjustment estimate of 23 %. But with respect to this estimate he writes that: "*the system estimation [extended GMM] results need treating with care*" (p.19, VAD).

Hahn et Al. (2005) show that GMM and extended GMM might not solve the identification problem for small samples when the autoregressive parameter approaches unity. Tables from Hahn et Al. (2005) are shown in enclosure 8. The tables give results from Monte Carlo experiments on the size of the autoregressive parameter in a panel data regression with a first order autoregressive part and firm specific effects. The extended GMM estimate for a true value of the autoregressive part *0.9* is 0.664 with a root mean squared error (RMSE) of 0.388. To solve the problem for very persistent panel data series Hahn et Al. propose to use a long differencing operator. As can be seen from the enclosure 8[30] the long differencing operator performs considerably better for larger values of the autoregressive parameter. For a true value of 0.9 the mean of the best long-differencing estimator is 0.902 with RMSE 0.264. Huang and Ritter (2007) use a long differencing estimator and report an estimated adjustment speed of 17 % per year. To our knowledge this has not been done for UK data and it could be the case that the estimates of Viet Anh Dang would show to be too high.

8. Estimation[31]

In the following we present result from estimation of:

(1.15) $$\Delta D_t = (1-\lambda)\Delta D_{t-1} + \sum_{k=1}^{N} \phi_k \Delta x_{kt} + \sum_{k=1}^{N} \varphi_k \Delta x_{kt-1} + \xi DEF_t + \theta SoE_t + \Delta v_t$$

$$\textit{where } \phi_k = \delta\beta_k,\ \varphi_k = (\lambda-\delta)\beta_k$$

$$\text{and: } X = \begin{Bmatrix} \textit{profit(profit), tangibility(tang), expected inflation of consumer prices(rpcpe),} \\ \textit{log of assets(l\_assets), Non-debt tax shields (ndts), market to book ratio (MtBk)} \end{Bmatrix}$$

As discussed in the section on the speed of adjustment latter research shows that the speed of adjustment in the US lies in the area of 20 %. Specifically we have chosen the estimate of 17 % of Huang and Ritter to be the one we trust in most. While we believe this to be the best guess on a speed of adjustment we are aware of the great uncertainty associated with this chosen speed of adjustment. The UK estimates of Viet Anh Dang could indicate economically different country to country speeds of adjustment. We make this choice on the basis that the US speed of adjustment is much more comprehensively investigated than the UK counterpart. The available Danish sample size prohibits better methods for now. We will therefore treat the $\lambda = 0.17$ parameter as being the true parameter in the estimation section. That is, we will estimate the system: $\lambda = 0.17$ with (1.15). In this case all parameters are properly identified and OLS can be applied with consistency. Since we have a very limited number of observations (13) the full model cannot be estimated. As a result we will start by assuming that: $\lambda = \delta$ giving the Partial adjustment model (PAM):

[30] The long-differencing estimators which do particularly well are: LD1, LD2 and LD3. The subscript refers to the number of iterations in finding more precise residuals for use as instruments.
[31] A description of the data is presented in Enclosure 11.

(1.16) $$\Delta D_t = (1-0.17)\Delta D_{t-1} + \sum_{k=1}^{N} \phi_k \Delta x_{kt} + \xi DEF_t + \theta SoE_t + \Delta v_t \;\; where \;\; \phi_k = \delta\beta_k$$

The partial adjustment model estimations results can be seen table 1.

Table 1: The **P**artial **A**djustment **M**odel	PAM 1	PAM 2	PAM 3	PAM4
ΔNDTS	-3.14 *[-0.63]*	-6.38 *[-1.58]*	-2.44 *[-1.36]*	-2.59** *[-2.54]*
ΔEBIT	-086 *[0.24]*	-1.95 *[-0.56]*	0.25 *[0.13]*	
ΔMtBk	-0.73 *[-1.50]*	-0.44 *[-1.07]*	-0.08 *[-0.34]*	
ΔTANG	-0.09 *[-0.34]*	-0.29 *[-0.99]*		
Δlog(ASSETS)	-0.50 *[-0.58]*	-0.96 *[-1.26]*		
ΔRPCPE	-17,44 *[-0.72]*	-26.24 *[-1.14]*		
DEF	0.61 *[0.98]*	0.51 *[0.52]*	0.03 *[0.04]*	
SoE	2.79 *[1.06]]*			
Log-likelihood	24.97	23.47	21.22	21.12
AR 1-1 test:	NA	0.63 *[0.4712]*	1.17 *[0.3148]*	1.36 *[0.2703]*
ARCH 1-1 test:	0.03 *[0.86]*	0.17 *[0.7047]*	0.25 *[0.6329]*	0.56 *[0.4739]*
Normality test:	0.07 *[0.96]*	4.89 *[0.0867]*	1.28 *[0.5275]*	1.04 *[0.5941]*
Hetero test:	NA	NA	NA	0.30 *[0.7504]*
Hetero-X test:	NA	NA	NA	0.30 *[0.7504]*
RESET test:	0.03 *[0.87]*	0.04 *[0.8467]*	0.03 *[0.8711]*	0.01 *[0.9362]*

Note: t-values in bracket next to parameters. P-values in brackets next to test results

In the most general version of the model (PAM1) none of the parameters are significantly different from zero at a 5 pct. significance level. We reduce the PAM1 by the proxy for the state of the economy which reduces the model to (PAM2) that only contains the basic panel data variables. Parameter signs that are in contrast to foreign investigations are removed. This gives the second partial adjustment model (PAM3). We reduce PAM3 by the deficit and the market-to-book variables since they are insignificant and economically small. The profit proxy (EBIT) is removed because it is both economically and statistically insignificant. Reducing by these 3 variables gives PAM4:

(1.17) $$\Delta D_t = (1-0.17)\Delta D_{t-1} - \underset{SE:1.02^{**}}{2.59} \cdot \Delta NDTS_t \,.$$

The test results are all accepted at 5%, but the normality test for PAM1 is only boarder line accepted. Likelihood ratio tests on the model specifications are shown in enclosure 9. None of the reductions are rejected. Therefore a general-to-specific type approach thus results in the PAM4. Next we will assume that: $\delta = 0$ giving an error correction model with no short run effects: $\Delta D_t = (1-0.17)\Delta D_{t-1} + \sum_{k=1}^{N} \varphi_k \Delta x_{kt-1} + \xi DEF_t + \theta SoE_t + \Delta v_t \;\; where \;\; \varphi_k = \lambda\beta_k$.

The estimation results from the error correction model (ECM) can be seen in table 2.

Table 2

Long run Effects	LRE1	LRE2	LRE3	LRE4	LRE5	LRE6	LRE7
ΔNDTS(−1)	7.86** *[4.17]*	7.03** *[2.08]*	5.20** *[2.03]*	2.50 *[1.39]*	1.00 *[0.80]*		
ΔEBIT(−1)	3.98 *[1.33]*	3.18 *[1.49]*	2.87 *[1.40]*				
ΔTANG(−1)	0.67 *[1.58]*	0.55* *[1.94]*	0.39* *[1.84]*	0.19 *[1.15]*			
Δlog(ASSETS(−1))	1.58* *[1.93]*	1.36** *[2.31]*	1.19** *[2.19]*	0.71 *[1.59]*	0.22 *[1.56]*		
ΔRPCPE(−1)	59.79***[2.31]*	56.23***[2.51]*	41.98** *[2.85]*	34.52** *[2.36]*	21.19** *[2.35]*	11.72 *[1.71]*	
ΔMtBk(−1)	0.78** *[2.94]*	0.78** *[2.94]*	0.81** *[3.14]*	0.93** *[3.61]*	0.87** *[3.38]*	0.57** *[3.06]*	0.44** *[2.38]*
DEF	1.06 *[1.21]*	0.90 *[0.86]*					
SoE	1.27 *[0.43]*						
Log-likelihood	28.1517	27.8832	27.05	25.37	24.34	22.40	20.86
AR 1-1 test:	NA	0.01 *[0.92]*	0.52 *[0.5046]*	0.51 *[0.5004]*	0.68 *[0.4359]*	1.34 *[0.2773]*	1.59 *[0.2356]*
ARCH 1-1 test:	0.04 *[0.87]*	0.08 *[0.80]*	0.06 *[0.8190]*	0.15 *[0.7179]*	0.01 *[0.9083]*	0.07 *[0.8025]*	0.60 *[0.4586]*
Normality test:	0.90 *[0.64]*	3.20 *[0.20]*	3.33 *[0.1891]*	0.40 *[0.8187]*	0.20 *[0.9064]*	1.36 *[0.5057]*	1.49 *[0.4746]*
Hetero test:	NA	NA	NA	NA	NA	1.66 *[0.2938]*	0.17 *[0.8506]*
Hetero-X test:	NA	NA	NA	NA	NA	NA	0.17 *[0.8506]*
RESET test:	0.45 *[0.56]*	0.96 *[0.38]*	1.88 *[0.2289]*	0.48 *[0.5155]*	0.04 *[0.8528]*	0.14 *[0.7156]*	0.30 *[0.5953]*

Note: t-values in bracket next to parameters. P-values in brackets next to test results

In the general version of the $\delta = 0$ model (LRE1) we again find that the state of the economy variable is insignificant at 5 % level. We therefore first reduce the model by imposing $\theta = 0$. The rest of the model specifications are reductions on insignificant parameters. We end with LRE7. But from the likelihood ratio tests in enclosure 9 it can be seen that it is not allowed to reduce the model from LRE1 to LRE7. The can however be reduced from model LRE1 to LRE6. But the reduction LRE2 to LRE6 is rejected on a 5 % significance level. We prefer the model LRE5. The test results are all accepted at 5 %. A general-to-specific type approach thus results in the final long run effects model LRE5:

$$\Delta D_t = (1-0.17)\Delta D_{t-1} + \underset{SE:1.25}{1} \cdot \Delta NDTS_{t-1} + \underset{SE:0.39}{0.22} \cdot \Delta \log(Assets_{t-1}) + \underset{SE:0.26^{**}}{0.87} \cdot \Delta MtBk_{t-1} + \underset{SE:9.01}{21.19} \cdot \Delta RPCPE_{t-1} \quad (1.18)$$

Specific-to-general (reintroducing variables)

To check the robustness of the estimated equations we reintroduce all combinations of two variables to the reduced equations to see if any significant variables have been omitted[32]. It turns out that the current market-to-book ratio is reintroduced with the lagged market-to-book

[32] We do not present these results since this would take up a lot of space. The results can be provided on enquiry.

ratio all other variables have no significance in the relation. As a result of this it seems that the best possible description of our limited sample is:

(1.19) $$\widehat{\Delta D_t} = (1-0.17)\Delta D_{t-1} - \underset{(SE:0.168^{**})}{0.4142} \cdot \Delta MtBk_t + \underset{(SE:0.169^{**})}{0.6129} \cdot \Delta MtBk_{t\text{-}1}$$

In this case the structural parameter β_{MtBk} (from (1.1)) which from theory and empirical studies we would expect to be negative becomes 1.17.[33] A significant amount of the uncertainty in β_{Mtbk} stems from the way in which the speed of adjustment has been chosen, but the sign β_{MtBk} of cannot be effected by this. Therefore we have to explain this sign in another way. A possible explanation for the *wrong* signage on the time series market-to-book ratio could be that it proxies for the state of the economy as well as for growth opportunities for the individual firms. As discussed it is likely that better states of the economy cause new firm to enter the market. Also it does not seem unlikely that very new firms will not immediately issue equity but will finance with debt. If the current state of the economy affects the market-to-book with a lag this causal chain could explain the observed positive estimate to the lagged market-to-book value. As can be verified $Corr(SoE_t, MtBk_{t-1}) = 0.82$ which lends some support to this explanation. To look a little closer at the plausibility of this explanation we can decompose the market-to-book ratio into to orthogonal parts. To do this we obtain residuals from the regression: $\Delta MtBk = \alpha_1 SoE_t + \alpha_2 SoE_{t-1} + res_t^{\Delta MtBk}$. The residuals $res_t^{\Delta MtBk}$ now contain only the part of the market-to-book ratio which does not have to do with the state of the economy[34]. The first differenced debt ratio is then regressed onto these residuals and the state of the economy variable. The estimated reduced equation becomes:

(1.20) $$\Delta D_t = (1\text{-}0.17)\Delta D_{t\text{-}1} - \underset{(SE:\ 0.217^{**})}{0.6678} \cdot res_t^{\Delta MtBk} + \underset{(SE:\ 1^{**})}{2.564} \cdot SoE_t$$

The estimated effect of the market-to-book ratio is now negative as expected from theory and foreign research. The estimated effect of an above average state of the economy is positive as could be expected from the above discussion.

In the following we will present the uselessness of IV/GMM methods for our limited sample. In (1.22) and (1.23) we present the result of estimating all parameters in (1.21) and (1.20) equation with the AH instrumental variables estimator:

---

[33] $\beta = \dfrac{\phi + \varphi}{\lambda} = \dfrac{-0.4142 + 0.6129}{0.17} = 1.17 > 0$, which can be found from (1.18) and (1.20)

[34] This decomposition is only meant to explain the signage and we do not pretend to present unbiased or better estimates using this method.

(1.21) $$\Delta D_t = \underset{SE:\ 0.358}{0.4088}\cdot \Delta D_{t-1} - \underset{SE:\ 0.163}{0.589}\cdot res_t^{MtBk} + \underset{SE:\ 1.44}{1.438}\cdot SoE_t$$ [35]

(1.22) $$\Delta D_t = -\underset{SE:\ 0.559}{0.2125}\cdot \Delta D_{t-1} - \underset{SE:\ 0.135}{0.5545}\cdot \Delta MtBk_t + \underset{SE:\ 0.23}{0.21}\cdot \Delta MtBk_{t-1}$$ [36]

From (1.22) it can be seen that free estimation of all parameters gives a significant parameter to the market-to-book ratio in the area of the one reported above. The estimated effect of the state of the economy is somewhat different but within 95 % confidence bound. The estimate of the speed of adjustment *(1-0.4088)* is economically very different than the one we have assumed, but the standard error on the parameter is very large. The 5 % and 10 % confidence bound on the speed of adjustment is respectively: [-0.11;1.29] and [0.00;1.18] meaning that our assumption is not nearly rejected. In (1.23) the estimate of the speed of adjustment implies that the leverage ratio is explosive. The 5 % and 10 % confidence bounds are: [-1.31;0.88] and [-1.13;0.7] respectively. The estimate on the market-to-book ratio in (1.20) is well within the confidence bounds found in (1.23) while the estimate on the lagged market-to-book ratio in (1.20) is within the 5 % confidence interval from (1.23) but not in the 10 % interval. To examine the practical importance of our choice in speed of adjustment for the parameter estimates in the final models, the two final models (1.20) and (1.21) have been estimated for different values of the speed of adjustment[37]. These are shown in enclosure 12. As can be seen the estimates are not very different. As a consequence the estimates of the underlying parameters $\beta_k = \frac{\phi_k + \varphi_k}{\lambda}$ are very different and our β_k's are determined with great uncertainty. For modeling purposes this is not of much consequence though.

9. Conclusion

This paper has provided a theoretical- and an empirical introduction to the capital structure of non-financial corporations. The focus of the paper has been improving the way capital structure is modeled in ADAM's financial sub model. Since data is only available from 1994 – 2007 econometric modeling will be inherently uncertain. Therefore any conclusions from this paper have to be tentative. Because of the small sample available a part of this paper was concerned with foreign empirical studies on much larger samples.

[35] The instrument for the lagged difference of leverage is the twice lagged level of leverage. The results from using the twice lagged difference of leverage as an instrument are not presented since they were considerably worse.

[36] The instrument for the lagged difference of leverage is the twice lagged difference of leverage. The results from using the twice lagged level of leverage as an instrument are not presented since they were considerably worse.

[37] These correspond to the range in which Flannery and Rangan places the speed of adjustment.

Since foreign empirical studies suggest that leverage is very firm specific we discuss how this should be handled in estimation on firm level. We discuss some new problems that arise when aggregating individual firms to sectors and discuss how these problems could be solved.
We make an important assumption concerning the speed of adjustment to an optimal leverage ratio. We assume a particular speed of adjustment and perform estimation, on the debt ratio of the non-financial corporate sector in Denmark, as though this is the true value. We make this assumption based on foreign empirical findings although the size of the speed of adjustment is not a settled issue. This assumption obviously creates a lot of uncertainty in estimation results, but the sample size does not allow proper estimation of the speed of adjustment. Proper estimation in this context means instrumental variables or GMM on large samples of data so as to give reasonably narrow confidence bounds.
Our estimation results do not lend much support to predictions of the pecking order theory. The trade-off theory is not as much tested as assumed since we select a specific non-zero speed of adjustment. A zero speed of adjustment contradicts a steady state leverage ratio as predicted by the trade-off theory. Foreign empirical evidence suggests that a non-zero speed of adjustment is not controversial.
We find that the market-to-book ratio seems to be very important for sector level leverage. There are a number of possible explanations for this in the literature. A lot of them are presented in F&G 2007Dec. One which is not is that a firm's capital structure could be the outcome of equity owners' attempts to time the market. This would be the case if owners issue new equity when they believe equity to be overvalued and vice versa[38]. The negative estimate of the coefficient to the market-to-book ratio we find in the final model is supportive of such ideas. Another variable which seem to be important is the above average change in GDP. As we have argued this is likely to be a proxy for firm entry and exit. One possibility is that above average states of the economy cause firms to enter the market. These new firms are not unlikely to be smaller business. As they will probably most commonly be debt financed this will mean that better states of the economy will cause an increase in the aggregate leverage ratio. The positive coefficient we find to the proxy for the state of the economy is supportive of such a causal chain.
We believe this paper describes models of the Danish non-financial corporate sector which are superior to the current model in ADAM apr08.

[38] This line of thought is similar to what is called market timing in the literature.

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Appendix

Appendix 1 - Comparative static:

The debt target depends negative on the fraction of end-of-period value that is lost if the firm defaults.

$$\frac{\partial^2 V}{\partial D \partial k} = -\left(\frac{1-T_D}{1+r_f}\right) Df(D) < 0$$

The debt target depends negative on the total after-tax value of non-debt tax shields.

$$\frac{\partial^2 V}{\partial D \partial \phi} = -\frac{(1-T_p)}{1+r_f}\left[f\left(D+\frac{\phi}{T_C}\right)\right] < 0$$

The debt target depends positively on the tax rate on investor equity income

$$\frac{\partial^2 V}{\partial D \partial T_E} = \left(\frac{1-T_D}{1+r_f}\right)\left[(1-F(D))\left[1-\frac{(1-T_C)}{(1-T_D)}\right] - \frac{T_C}{(1-T_D)}\left[F\left(D+\frac{\phi}{T_C}\right)-F(D)\right]\right] =$$

$$\frac{1}{1+r_f}\left[(1-F(D)) - T_C\left[1-F\left(D+\frac{\phi}{T_C}\right)\right]\right]$$

Due to $\frac{\phi}{T_C} > 0 \Rightarrow F(D) < F\left(D+\frac{\phi}{T_C}\right) \Rightarrow \frac{\partial^2 V}{\partial D \partial T_E} > 0$

The debt target depends on the tax rate on investor bond income as follows:

$$\frac{\partial^2 V}{\partial D \partial T_D} = \left(\frac{1}{1+r_f}\right)\left[kDf(D) - (1-F(D))\right]$$

The equation is unambiguously negative at the firm's optimal capital structure.

$$\frac{\partial V}{\partial D} = \left(\frac{1-T_D}{1+r_f}\right)\left[\begin{array}{l}(1-F(D))\left[1-\frac{(1-T_C)(1-T_p)}{(1-T_D)}\right] \\ -\frac{T_C(1-T_p)}{(1-T_D)}\left[F\left(D+\frac{\phi}{T_C}\right)-F(D)\right] - kDf(D)\end{array}\right] = 0 \Leftrightarrow$$

$$D = \frac{1}{[kf(D)]}\left\{\left[(1-F(D))\left[1-\frac{(1-T_C)(1-T_p)}{(1-T_D)}\right] - \frac{T_C(1-T_p)}{(1-T_D)}\left[F\left(D+\frac{\phi}{T_C}\right)-F(D)\right]\right]\right\}.$$

Substituting the optimality condition in to the equation yields

the cross partial at the optimal capital structure.

$$\frac{\partial^2 V}{\partial D \partial T_D} = \left(\frac{1}{1+r_f}\right)\left[kDf(D) - (1-F(D))\right] \Leftrightarrow$$

$$\frac{\partial^2 V}{\partial D \partial T_D} = -\left(\frac{1}{1+r_f}\right)\left[\begin{array}{l}\left[\frac{(1-T_C)(1-T_p)}{(1-T_D)}\right](1-F(D)) \\ +\frac{T_C(1-T_p)}{(1-T_D)}\left[F\left(D+\frac{\phi}{T_C}\right)-F(D)\right]\end{array}\right] < 0$$

Appendix 2 – a possible assumption

Assuming the data generating process is (1.7):

$$\Delta D_{it} = (1-\lambda)\,\Delta D_{it-1} + \sum_{k=1}^{N}\phi_k \Delta x_{kit} + \sum_{k=1}^{N}\varphi_k \Delta x_{kit-1} + \xi_1 DEF_{it} + (\xi_2 - \xi_1) DEF_{it}\cdot SPF_{it} + \Delta v_{it}$$

The pure time series equivalent becomes:

$$\sum_i \Delta D_{it} = \sum_i \left((1-\lambda)\,\Delta D_{it-1} + \sum_{k=1}^{N}\phi_k \Delta x_{kit} + \sum_{k=1}^{N}\varphi_k \Delta x_{kit-1} \right) + \xi_1 \sum_i DEF_{it} + (\xi_2 - \xi_1)\sum_i \left(DEF_{it}\cdot SPF_{it} \right) + \sum_i \Delta v_{it}$$

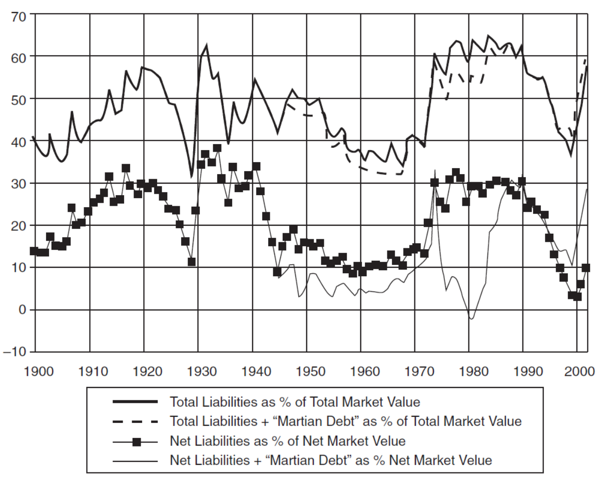
Assuming: $\alpha A_t \sum_i DEF_{it} \equiv \alpha \sum_i SPF_{it} \left(\sum_i 1 \right)^{-1} \sum_i DEF_{it} = \sum_i DEF_{it} SPF_{it}$. Then substituting into the time series equivalent we get:

$$\sum_i \Delta D_{it} = \sum_i \left((1-\lambda)\,\Delta D_{it-1} + \sum_{k=1}^{N}\phi_k \Delta x_{kit} + \sum_{k=1}^{N}\varphi_k \Delta x_{kit-1} \right) + \xi_1 \sum_i DEF_{it} + \alpha(\xi_2 - \xi_1) A_t \sum_i \left(DEF_{it} \right) + \sum_i \Delta v_{it}$$

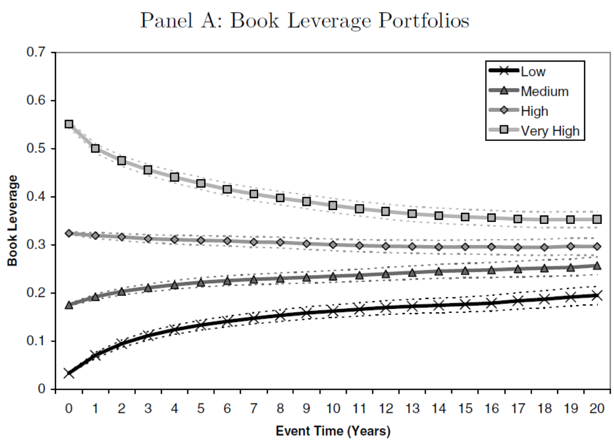
From which can be seen that the data generating process is mimicked with only a change of parameters. The assumption on the time series regression thus conceals the true firm level parameter, but retains the consistency of the estimators.

Enclosure

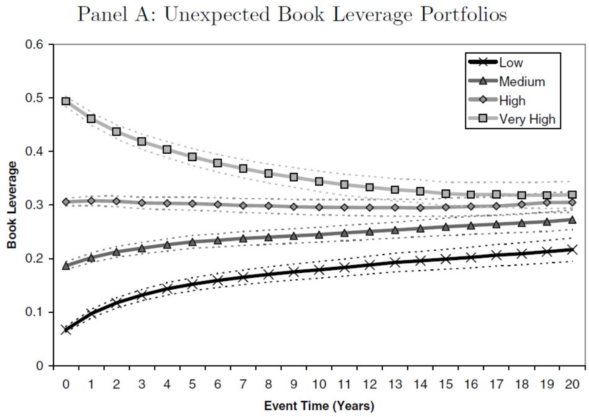
Enclosure 1. Wright (2004) figure 7



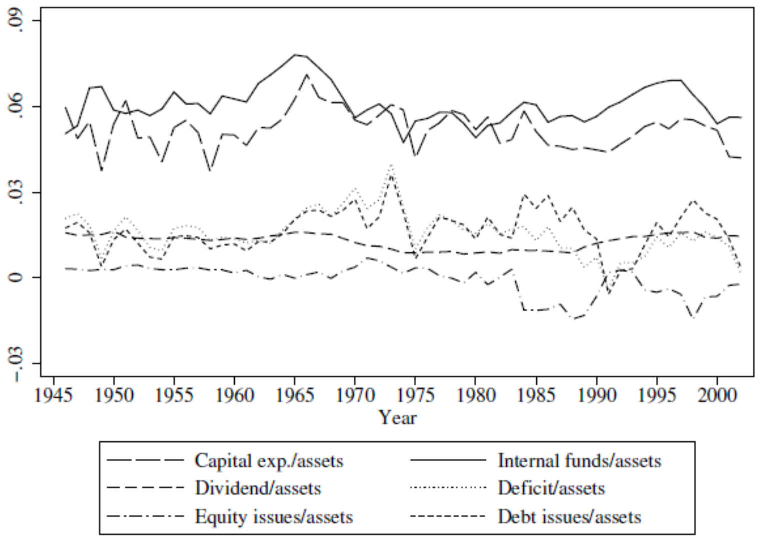
Enclosure 2. Copy of figure 1, panel A from Lemmon et Al. (2007)



Enclosure 3, Copy of figure 2, panel A from Lemmon et Al. (2007)

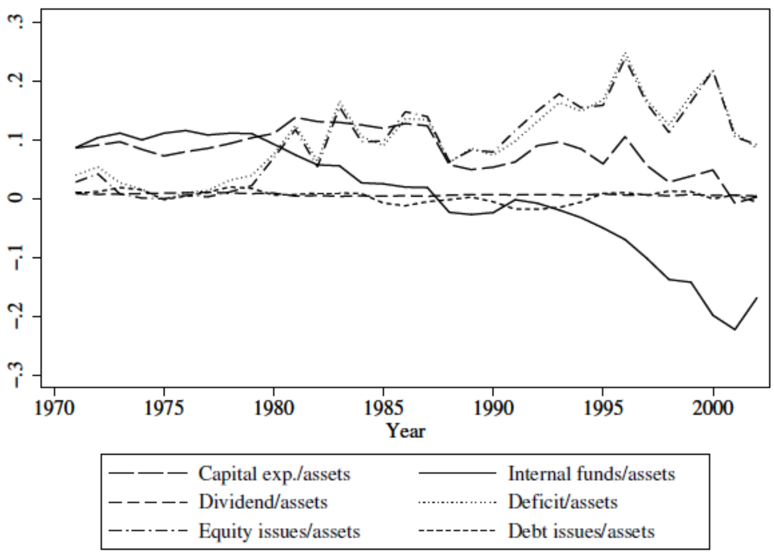


Enclosure 4, Non-farm non-financial corporate sector



Source: The data is from the Federal Reserve System, flow of funds Accounts of United States, March 2003, the figure is from Frank and Goyal (2007)

Enclosure 5, Small Public Firms from Compustat



Source: The data is from the Compustat Funds-Flow Statements, The sample comprises small publicly traded U.S. firms on the Compustat files (in the bottom one-third by book assts each year). The figure is from Frank and Goyal (2007)

Enclosure 6, copy of table 1 from Arellano and Bover (1995) p. 47.

Means and standard deviations of the estimators, 1000 replications

	$\alpha = 0.2$		$\alpha = 0.5$		$\alpha = 0.8$	
	AH	*LI*	*AH*	*LI*	*AH*	*LI*
$N = 500$						
$\sigma_\eta^2 = 0$						
Mean	0.2056	0.2038	0.5097	0.5031	0.8248	0.7976
S.d.	0.0768	0.0635	0.1093	0.0765	0.1949	0.0900
$\sigma_\eta^2 = 0.2$						
Mean	0.2059	0.2041	0.5120	0.5022	0.8596	0.7887
S.d.	0.0856	0.0695	0.1356	0.0864	0.3660	0.1105
$\sigma_\eta^2 = 1$						
Mean	0.2089	0.2040	0.5262	0.4963	1.8560	0.7597
S.d.	0.1189	0.0906	0.2262	0.1155	21.1516	0.1775

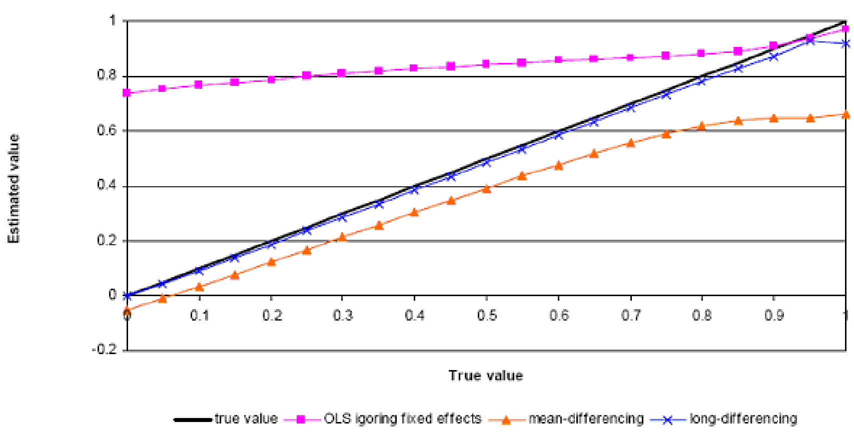
Each sample consists of N independent observations of (y_{i0}, y_{i1}, y_{i2}) generated from the process:

$$y_{i0} = (1-\alpha)^{-1}\eta_i + (1-\alpha^2)^{-1/2}v_{i0}, \qquad y_{i1} = \alpha y_{i0} + \eta_i + v_{i1}, \qquad y_{i2} = \alpha y_{i1} + \eta_i + v_{i2},$$

with $v_i = (v_{i0}, v_{i1}, v_{i2})' \sim N(0, I)$ and $\eta_i \sim N(0, \sigma_\eta^2)$ independent of v_i.

Enclosure 7, copy of figure from Huang and Ritter (2007) p. 47.

The estimated speed of adjustment as a function of the true speed



Simulations for the estimation speed of adjustment with i) OLS and no firm fixed effects ii) the firm fixed effects mean-differencing estimator and iii) the long-differencing estimator. The values plotted are the first-order autoregressive coefficient, so subtracting this from 1.0 gives the speed of adjustment. the data generating process is given by $L_{it} = (1-\gamma)L_{it-1} + \gamma TL_i + \tilde{\varepsilon}_{it}$, where $L_{i0} \sim N(0.25, 0.25)$, $TL_i \sim N(0.25, 0.25)$, and $\varepsilon_{i0} \sim N(0, 0.01)$. L is leverage and TL is target leverage. The simulations are repeated 10000 times, each time using 1000 firms and 10 years of data (K=8) for each firm.

Enclosure 8, part of table 1 from Hahn, Hausman and Kuersteiner.

Table 1: Monte Carlo Comparison of Estimators

Estimator	$\widehat{b}_{BB}$	$\widehat{b}_{LDGMM}$	$\widehat{b}_{AS}$	$\widehat{b}_{LD-AB}$	$\widehat{b}_{LD1}$	$\widehat{b}_{LD2}$	$\widehat{b}_{LD3}$
$\beta = 0.9, T = 5, n = 100$							
Mean	0.664	0.826	0.709	0.816	0.853	0.880	0.902
RMSE	0.388	0.221	0.317	0.249	0.240	0.234	0.264
Median	0.693	0.798	0.697	0.762	0.814	0.838	0.844

Enclosure 9, LR-test on model reduction:

Loglikehood Ratio Test	Loglikelihood H0	Loglikelihood HA	Test	Fraktilsandsynlighed
PAM1 -> PAM2	24.97	23.47	2.99	0.08
PAM2 -> PAM3	23.47	21.22	4.51	0.21
PAM3 -> PAM4	21.22	21.12	0.19	0.98
PAM1 -> PAM3	24.97	21.22	7.50	0.11
PAM1 -> PAM4	24.97	21.12	7.69	0.36
PAM2 -> PAM4	23.47	21.12	4.70	0.58
LRE1 -> LRE2	28.15	27.88	0.54	0.46
LRE2 -> LRE3	27.88	27.05	1.66	0.20
LRE3 -> LRE4	27.05	25.37	3.38	0.07
LRE4 -> LRE5	25.37	24.34	2.06	0.36
LRE5 -> LRE6	24.34	22.40	3.87	0.14
LRE6 -> LRE7	22.40	20.86	3.09	0.08
LRE1 -> LRE3	28.15	27.05	2.19	0.33
LRE1 -> LRE4	28.15	25.37	5.57	0.13
LRE1 -> LRE5	28.15	24.34	7.63	0.11
LRE1 -> LRE6	28.15	22.40	11.50	0.07
LRE1 -> LRE7	28.15	20.86	14.59	*0.04*
LRE2 -> LRE4	27.88	25.37	5.03	0.08
LRE2 -> LRE5	27.88	24.34	7.10	0.07
LRE2 -> LRE6	27.88	22.40	10.96	0.05
LRE2 -> LRE7	27.88	20.86	14.05	*0.03*
LRE3 -> LRE5	27.05	24.34	5.44	0.07
LRE3 -> LRE6	27.05	22.40	9.30	0.05
LRE3 -> LRE7	27.05	20.86	12.40	*0.03*
LRE4 -> LRE6	25.37	22.40	5.93	0.05
LRE4 -> LRE7	25.37	20.86	9.02	0.06
LRE5 -> LRE7	24.34	20.86	6.96	0.07

Enclosure 10, estimated final models for different values of lambda

Model 1	lambda = 0.1	lambda = 0.15	**lambda = 0.17**	lambda = 0.2	lambda = 0.25	lambda = 0.3	lambda = 0.35
dl_fy-mean(dl_fy)	2.81	2.64	**2.56**	2.46	2.28	2.10	1.93
	2.75	*2.62*	***2.56***	*2.48*	*2.33*	*2.17*	*2.00*
Residual from regression of dl_fy on MtBk	-0.67	-0.67	**-0.67**	-0.67	-0.66	-0.66	-0.66
	-3.04	*-3.07*	***-3.08***	*-3.10*	*-3.12*	*-3.14*	*-3.15*
Model 2							
d_MtBk	-0.40	-0.41	**-0.41**	-0.42	-0.43	-0.44	-0.45
	-2.27	*-2.40*	***-2.45***	*-2.53*	*-2.67*	*-2.82*	*-2.97*
lag(d_MtBk)	0.64	0.62	**0.61**	0.60	0.58	0.56	0.54
	3.66	*3.65*	***3.65***	*3.64*	*3.63*	*3.61*	*3.58*

Enclosure 11, Data description - Variables for estimation purposes:

Variable	ADAM name / calculations	Description
BVE_t	*wsi_cr_z*	Book value of equity in period *t* - Inner value of stock
MVE_t	*ws_cr_z*	Market value of equity in period *t* - Stocks and other share certificates issued by the non-financial corporate sector, market value
MCS_t	*Wlm_cr_cf*	Mortgage in non-financial corporate sector in period t
NSC_t	*Wnq1_cr*	Net stock of other claims for the non-financial corporate sector in period t - market value
MVD_t	$MCS_t - NSC_t$	market value of debt in period *t*
D_t	$\frac{MVD_t}{MVE_t + MVD_t}$	Fraction of Debt in period *t*
$NDTS_t$	*bivmu*	Proxy for Non-Debt Tax Shields in period *t* - Discounted value of expected tax-deductible write-offs from investment in machinery.
$Mtbk_t$	$\frac{MVE_t}{BVE_t}$	Market- to book value of equity in period t
A_Fixed	*knmp + knbp - knmqf - knbqf*	Real capital for the non-financial corporate sector - The Net Capital Value of machinery, transport equipment, furniture and buildings in the private sector subtracted the Net Capital Value of machinery, transport equipment, furniture and buildings in the financial sector.
A_Total	$A\_Fixed + wn\_cr$	Total assets for the non-financial corporate sector - Real capital plus market capitalization of the net worth for the non-financial corporate sector
$EBIT$	$\frac{(yr1 - yrqf1)}{yr1 + yw1 - (yrqf1 + ywqf1)}$	Earnings before interest and tax for the non-financial corporate sector - the non-financial corporate sectors Gross residual income divide by the non-financial corporate sectors gross residual income plus wages.
$RPCPNE$	$0.8\, RPCPNE.1 + 0.2\, \frac{(P\_CPN - P\_CPN.1)}{P\_CPN.1}$	Expected inflation - a weighted average between the last period inflation and changes in prices
$TANG$	$\frac{A\_FIXED}{A\_TOTAL}$	The Tangibility
DEF	$\frac{Tfn\_cr}{A\_Total}$	The financial deficit - the net lending for the non-financial corporate sector divide by the total assets for the non-financial corporate sector