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Patterns of Capital Structure Adjustment by Listing Type: Evidence from European Firms

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Abstract

This study analyzed the questions of whether capital structure adjustment in European firms differed by listing type and by current debt ratio. Major issues are concerned with (1) the adjustment speed toward target debt ratio and (2) the length of the adjustment period required toward the ratios. Results showed that (1) the speed of adjustment of firms with lower debt ratios were faster; (2) the adjustment speeds of listed firms were faster than those of delisted and unlisted firms; and (3) the length of the half-life adjustment time toward target ratio was shorter for listed firms than for delisted and unlisted firms. This paper contributed to the development of capital structure issues in that the adjustment speed could be different depending on firms' current debt ratios and listing types, unlike previous results in the literature.

Keywords*: Capital Structure Adjustment, Listing Types, Quantile Regression, European Firms*

JEL Code Classifications: *G32, G15, C21*

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1. Introduction

If finance scholars are asked about the one most important topic in capital structure, it is very unlikely that they would exclude Modigliani and Miller's 1958 seminal theory. The theory states that under the assumption of a perfect capital market, the capital structure is irrelevant to the corporate market values. However, their debt irrelevance theorem is known to be valid on the unrealistic assumption of perfect capital market and will not hold in realities where market imperfections exist. This consensus has led to development of many theories on capital structure. One theory, called the partial adjustment model, recently stands out for its importance. This theory, which claims both the existence of target debt ratio and the subsequent lagged adjustment toward the target, has in fact attracted attention from finance academics for more than thirty years. This theory in which firms target debt ratios has been supported by two types of claims, according to Chang and Dasgupta (2009). One is the notion of weighted average cost of capital, which presupposes the existence of target capital structure. The other claim is from the tradeoff model that implies the existence of an optimal debt ratio. When reviewing past research about partial adjustment theory toward target debt ratio, I find that the studies by Taggart (1977) and Jalilvand and Harris (1984) constitute the earliest related research on this model. The economic importance of the theory can be confirmed by the voluminous recent research, including Flannery and Rangan (2006), Serrasquerio and Nunes (2008), Lemmon, Roberts, and Zender (2008), Byoun (2008), and Huang and Ritter (2009). Among others, Huang and Ritter (2009) emphasize the importance of this theory by stating that "This is the most important issue in capital structure research today."

Two research aspects are worth mentioning from these previous studies: One aspect is the difference in estimation results on the adjustment speeds toward targets, and the other aspect is about the use of appropriate econometric methodology. First, in the previous research, one single speed of adjustment toward targets has been reported for its own sample firms, but the problem is that different research on different samples in different countries reports different speeds of adjustment (Driffield and Pal, 2008). For example, in studies on US firms, Fama and French (2002) reported 7%-18%, Lemmon, Roberts, and Zender (2008), 25%, and Flannery and Rangan (2006), 33.5%-34.2%. In contrast, in studies on European firms, 57% was reported for UK firms (Ozkan, 2001), 53% for German firms (Friderichs, Gerdesmeier, Kremp, Paranque, Sauve, Scheuer, and Stoss, 1999), 28% for French firms (Friderichs et al., 1999), 79% for Spanish firms (Miguel and Pindado, 2001), 14%-38.7% for Swiss firms (Gaud, Jani, Hoesli, and Bender, 2005), 33%-34% for Portuguese firms (Serrasquerio and Nunes, 2008), 41.9%-44.4% for Bulgarian firms (Nivorozhkin, 2003), 11.8%-18% for Czech firms (Nivorozhkin, 2003), and 52.1%-57.3% for Norwegian firms (Aksel, 2008). In contrast, Driffield and Pal (2008) reported much higher speeds of adjustment in their study on Asian countries: 80.96% for Korea, 90.45% for Indonesia, 86.78% for Malaysia, 88.16% for

Thailand, 86.48% for Hong Kong, and 80.53% for Singapore. These results of different adjustment speeds can be partly supported by the remark of Frank and Goyal (2007): "The speed at which it happens is not a settled issue." Second, the most popular methodology of the previous research has been the fixed-effect panel estimation method, mainly because the data used has been constructed in the panel form. For example, such studies as Flannery and Rangan (2006), Serrasquerio and Nunes (2008), Hovakimian and Li (2008), Antoniou, Guney, and Pauydal (2008) and Huang and Ritter (2009) have used this method. In addition, the dynamic partial adjustment model which incorporates time difference into the model has been used in the studies by Drobetz, Pensa, and Wanzenried (2006) and Cook and Tang (2009). Another type of the methodology found in the literature is the ordinary least squares method, which ignores fixed-effect in the data (Fama and French, 2002).

In this paper, the topic of the partial adjustment model will be analyzed with the data of the European firms from different perspectives. First, the possible non-linear relations between debt ratio and its determinants will be incorporated in the analysis by using quantile regressions. One representative study in which the quantile regression was used for capital structure issue is the study by Fattouh, Scaramozzino, and Harris (2008) on UK firms. Second, unlike previous studies, the differences in adjustment speeds among firms will be assumed to exist in the analysis. Most previous studies have assumed one single adjustment speed, with the exception of Jalivand and Harris (1984) and Driffield and Pal (2008). Quantile regression is believed to be one possible solution for this issue of different adjustment speeds because changes in the entire distribution can be analyzed. Third, the effect of listing types on adjustment speed will be also covered in the present analysis. It is partly because firms of different listing types have different access to capital markets, and partly because not much previous research on capital structure has included delisted or unlisted firms in its analysis (Farooqi-Lind, 2006; Bartholdy and Mateus, 2011). My concern here is "Will it be necessary to build a new theory on adjustment speed for unlisted and delisted firms?"

The following results were obtained from this analysis. First, the adjustment speeds were found to be different depending on firms' debt ratios. The adjustment speeds of firms with lower debt ratios turned out to be faster than those of firms with higher debt ratios. Accordingly, firms with higher debt ratios turned out to have the shortest half-life adjustment time. Second, the adjustment speed of listed firms was estimated to be faster than that of delisted or unlisted firms. Accordingly, the length of the half-life adjustment was the shortest for listed firms, then for delisted firms, and finally for unlisted firms.

The rest of the paper proceeds as follows. In Section 2, methodology will be explained, together with possible effects of listing types from the finance perspective. Data and empirical results will be explained in Section 3, and the paper will conclude in Section 4.

2. Model

2.1. Speed of Adjustment Model

In this study, two-stage estimation method was used in order to measure the speed of adjustment. This way of estimating the partial adjustment model through two stages was also adopted in the previous studies, including Serrasquerio and Nunes (2008), Hovakimian and Li (2008), Huang and Ritter (2009), Cook and Tang (2009), and Bartholdy and Mateus (2011). Compared to this research, the difference in this paper is that quantile regression was used when carrying out two stage estimation. In the first stage, we estimate target debt ratio at time ($t+1$) by using information at time t as in (1).

$$DR^*_{i,t+1} = \sum_{j=1}^{k} \hat{\beta}_j X_{i,t} \quad (1)$$

where $DR^*_{i,t+1}$ is the target debt ratio at time ($t+1$), and $X_{i,t}$ is the capital structure determinants for firm i at time t, such as tangibility, non-debt tax-shield, profitability, and firm size. Then, as in (2), we measure how much the actual adjustment was made against the target debt ratio in the second stage. This means that a firm’s financing choice at any point in time is a function of its current debt ratio and a “target” debt ratio, and it is assumed in this model that firms make financing choices that minimize the cost of deviation from this optimal debt ratio.

$$DR_{i,t+1} - DR_{i,t} = \alpha + \delta_{i,t}(DR^*_{i,t+1} - DR_{i,t}) + \varepsilon_{i,t+1} \quad (2)$$

where $\delta_{i,t}$ is called the speed of adjustment. If we substitute (1) into (2), we obtain the following relationship (3).

$$DR_{i,t+1} = \alpha + (1-\delta_{i,t})DR_{i,t} + \delta_{i,t}DR^*_{i,t+1} + \varepsilon_{i,t+1} \quad (3)$$

This can be interpreted as follows: (1) when $\delta_{i,t}$ equals 1, it means that the actual adjustment is the same as the amount that should be adjusted or 100% perfect adjustment is made in just one period; (2) when $\delta_{i,t}$ equals 0, it means that no actual adjustment is made compared to the target debt ratio; (3) when the absolute value $\delta_{i,t}$ is smaller than 1, the actual debt ratio approaches the target ratio as time passes, and (4) when $\delta_{i,t}$ is greater than 1 or less than -1, the actual debt ratio will be adjusted in the opposite way to the direction of target ratio. Flannery and Rangan (2006) interpret the speed of adjustment in relation with the adjustment costs such as legal fees and issue costs of securities. They claim that the estimated speed of adjustment one indicates the absence of adjustment costs. In contrast, the adjustment speed zero indicates the high adjustment costs, leading to no adjustment toward the target ratio at all.

2.2. Listing Types and Financial Characteristics

In this study, the terminology “listed firms” refers to firms which maintained listing from 1991 through 2007 or firms that were first listed on the stock exchange during the period and maintained listing at the time of 2007. “Delisted firms” refers to firms that stopped listing on the stock exchange during the data period because of bankruptcies and other reasons. For example, US firms begin delisting procedures when they do not meet the continued listing criteria such as share distribution criteria, market value criteria, and price criteria. And finally, “unlisted firms” refers to firms that are not registered as listed firm on the exchange due to lack of listing requirements such as asset size. For example, in the UK, some of the required conditions for initial listing include market value of more than £700,000, and the minimum 25% distribution of stocks held by general public.

The following characteristics are worth mentioning from a comparison of listed firms with unlisted firms. Above all, unlisted firms tend to be smaller in firm size. And, the information about these firms is relatively not opaque because of less concern from the public press, although the firms provide annual reports. Compared to listed firms, different corporate governance systems exist in this type of unlisted firms. And it is expected that agency problems are less severe in unlisted firms and they are expected to have relatively lower costs of agency problems. Debt ratios of these unlisted firms can be similar to those of listed firms, but the sources of debt financing tend to be different from listed firms. Unlisted firms are more likely to depend more on non-traded debts such as bank loans and trade credit for lower costs of capital because they do not have easy access to financial market as listed firms do. In contrast, listed firms are more strictly monitored by the general public because they have to provide annual reports to stock exchanges. Public bond, syndicated bank loans, and commercial papers are major debt financing instruments for these firms. Unlisted firms have incentives to become listed firms for many reasons (Loderer and Waelchli, 2010). The benefits include (1) trading of stocks through more liquid stock market, (2) higher diversification ability on the part of stockholders, (3) gains from market timing, (4) lower costs of capital, (5) tapping of new financing sources, (6) enhanced reputation effect, and (7) increased flexibility in designing performance-based compensation. In contrast, when going listing, the marginal costs incur such as (1) giving up of private control effect and (2) costs involved in the listing process.

3. Data and Empirical Results

3.1. Data and Descriptive Statistics

This study depended on the OSIRIS of Bureau van Dijk from WRDS (Wharton Research Data Services) for its database. The sample countries selected for this analysis included 25 countries in Europe: Austria (OSIRIS country code: AT), Belgium (BE), Switzerland (CH), Czech Republic (CZ), Germany (DE), Denmark (DE), Estonia (EE), Spain (ES), Finland (FI), France (FR), United Kingdom (GB), Greece (GR), Hungary (HU), Ireland (IE), Italy (IT), Lithuania (LT), Luxembourg (LU), Latvia (LV), the Netherlands (NL), Norway (NO), Poland (PL), Portugal (PT), Sweden (SE), Slovenia (SI), and the Slovak Republic (SK). The data period covered 17 years from 1991 through 2007, and the total number of firm-year data points reached 80,720.

Table 1: Structure of Panel Data: Number of Firm-Year Observations by Country, Year, and Listing Type

Year	AT	BE	CH	CZ	DE	DK	EE	ES	FI	FR	GB	GR	HU	IE	IT	LT	LU	LV	NL	NO	PL	PT	SE	SI	SK
	17	25	58		143	34		38	22	158	327	0	0	12	27		2		55	21		1	28		
1991	(15)	(16)	(31)	NA	(98)	(33)	NA	(29)	(13)	(157)	(474)	(18)	(2)	(19)	(23)	NA	(1)	NA	(52)	(15)	NA	(3)	(32)	NA	NA
	[17]	[16]	[34]		[69]	[9]		[27]	[12]	[167]	[307]	[0]	[0]	[8]	[27]		[4]		[26]	[11]		[1]	[19]		
	20	31	66		152	39		38	24	168	377	0	0	14	25		3		57	26		5	41		
1992	(17)	(32)	(34)	NA	(108)	(42)	NA	(28)	(12)	(159)	(502)	(18)	(3)	(20)	(19)	NA	(2)	NA	(52)	(18)	NA	(3)	(37)	NA	NA
	[16]	[15]	[30]		[62]	[11]		[20]	[11]	[131]	291	[0]	[0]	[12]	[23]		[3]		[22]	[12]		[3]	[22]		
	25	38	70	1	169	51		39	28	173	438	0	0	16	27		6		61	34		8	54		
1993	(20)	(38)	(35)	(5)	(112)	(50)	NA	(26)	(16)	(162)	(579)	(35)	(3)	(20)	(22)	NA	(2)	NA	(55)	(33)	NA	(7)	(43)	NA	NA
	[16]	[18]	[28]	[2]	[63]	[13]		[16]	[10]	[118]	[310]	[1]	[0]	[10]	[22]		[4]		[20]	[13]		[5]	[25]		
	29	39	78	2	178	56		36	25	197	533	0	0	20	28		7	0	71	38		14	76		
1994	(21)	(43)	(35)	(18)	(121)	(56)	NA	(24)	(16)	(186)	(704)	(69)	(5)	(21)	(20)	NA	(3)	(0)	(56)	(42)	NA	(11)	(34)	NA	NA
	[15]	[17]	[28]	[14]	[63]	[14]		[11]	[7]	[93]	[313]	[3]	[0]	[10]	[12]		[3]	[1]	[23]	[16]		[3]	[51]		
	28	44	97	6	188	58		39	26	219	624	0	0	23	43		7	2	80	41	3	14	92	1	0
1995	(27)	(42)	(46)	(40)	(119)	(61)	NA	(29)	(17)	(198)	(824)	(81)	(8)	(20)	(28)	NA	(3)	(2)	(69)	(47)	(1)	(14)	(77)	(0)	(1)
	[9]	[8]	[17]	[41]	[59]	[14]		[11]	[7]	[67]	[268]	[3]	[0]	[5]	[15]		[2]	[2]	[21]	[19]	[0]	[2]	[43]	[0]	[0]
	30	56	107	9	236	64		45	33	252	674	0	0	29	53		10	9	96	46	6	16	114	1	0
1996	(30)	(44)	(52)	(54)	(139)	(66)	NA	(33)	(22)	(207)	(868)	(101)	(11)	(24)	(39)	NA	(4)	(2)	(81)	(55)	(3)	(14	(101)	(0)	(1)
	[8]	[9]	[10]	[80]	[55]	[9]		[9]	[5]	[50]	[205]	[1]	[0]	[2]	[13]		[2]	(31)	[16]	[22]	[0]	[2]	[55]	[0]	[0]
Year	AT	BE	CH	CZ	DE	DK	EE	ES	FI	FR	GB	GR	HU	IE	IT	LT	LU	LV	NL	NO	PL	PT	SE	SI	SK
	40	71	119	14	318	69	1	49	45	296	804	0	0	34	65	2	12	10	110	56	10	18	133	2	0
1997	(31)	(49)	(52)	(70)	(149)	(66)	(0)	(36)	(23)	(223)	(956)	(110)	(9)	(26)	(42)	(0)	(8)	(1)	(94)	(70)	(5)	(19)	(113)	(0)	(3)
	[9]	[5]	[8]	[90]	[45]	[7]	[0]	[9]	[7]	[37]	[132]	[1]	[0]	[1]	[11]	[0]	[1]	[12]	[13]	[18]	[0]	[1]	[49]	[0]	[0]
	47	82	136	15	463	74	1	64	67	395	889	0	0	37	64	3	13	5	129	66	26	23	169	2	0
1998	(38)	(55)	(53)	(71)	(180)	(65)	(0)	(36)	(28)	(237)	(984)	(110)	(16)	(28)	(44)	(0)	(10)	(1)	(101)	(71)	(9)	(17)	(118)	(3)	(7)
	[4]	[4]	[11]	[69]	[53]	[6]	[0]	[4]	[6]	[18]	[57]	[0]	[2]	[1]	[6]	[0]	[1]	[4]	[14]	[13]	[1]	[1]	[48]	[0]	[0]
	52	100	149	17	569	78	2	71	100	514	968	1	0	42	96	4	14	5	147	75	31	32	179	4	0
1999	(36)	(61)	(53)	(66)	(211)	(65)	(0)	(34)	(30)	(271)	(908)	(133)	(27)	(31)	(45)	(0)	(8)	(1)	(103)	(60)	(11)	(22	(104)	(3)	(9)
	[4]	[5]	[9]	[63]	[56]	[6]	[0]	[4]	[6]	[13]	[33]	[1]	[2]	[1]	[4]	[0]	[2]	[3]	[15]	[13]	[1]	[0]	[42]	[0]	[0]
	60	102	159	17	596	87	8	93	109	532	1079	1	0	48	129	6	20	9	146	88	34	36	183	7	1
2000	(35)	(55)	(57)	(76)	(191)	(52)	(2)	(55)	(29)	(258)	(852)	(160)	(25)	(29)	(50)	(1)	(6)	(0)	(79)	(53)	(15)	(20)	(75)	(3)	(8)
	[6]	[4]	[11]	[70]	[54]	[6]	[0]	[5]	[7]	[10]	[20]	[1]	[1]	[1]	[1]	[0]	[3]	[2]	[11]	[10]	[0]	[1]	[41]	[0]	[0]
	65	104	164	20	580	100	9	92	112	535	1256	1	0	53	148	6	22	24	146	94	39	44	204	10	2
2001	(29)	(39)	(51)	(57)	(148)	(38)	(2)	(53)	(28)	(206)	(836)	(177)	(24)	(30)	(46)	(1)	(3)	(3)	(61)	(50)	(11)	(16)	(63)	(3)	(8)
	[4]	[1]	[9]	[26]	[46]	[5]	[0]	[2]	[6]	[8]	[14]	[0]	[1]	[1]	[0]	[0]	[3]	[2]	[10]	[8]	[0]	[0]	[36]	[0]	[0]
	67	122	169	13	591	102	12	100	111	593	1371	0	0	51	153	19	25	16	145	103	46	43	208	11	2
2002	(18)	(32)	(43)	(24)	(115)	(37)	(2)	(40)	(23)	(148)	(738)	(128)	(24)	(28)	(40)	(1)	(5)	(2)	(53)	(47)	(7)	(20)	(56)	(3)	(9)
	[3]	[2]	[9]	[18]	[36]	[5]	[1]	[2]	[6]	[8]	[14]	[0]	[1]	[1]	[0]	[0]	[2]	[1]	[11]	[7]	[0]	[7]	[32]	[0]	[0]
	70	136	172	14	605	107	13	106	114	641	1465	0	0	55	176	30	27	20	147	115	61	44	242	12	3
2003	(10)	(28)	(27)	(26)	(83)	(22)	(3)	(30)	(16)	(117)	(597)	(127)	(24)	(16)	(29)	(1)	(5)	(3)	(43)	(38)	(6)	(17)	(42)	(2)	(10)
	[3]	[2]	[6]	[16]	[33]	[5]	[1]	[1]	[6]	[9]	[12]	[0]	[1]	[1]	[1]	[0]	[2]	[1]	[12]	[9]	[0]	[13]	[32]	[0]	[0]
	77	147	180	13	651	130	14	134	120	670	1659	0	0	58	223	38	28	30	147	145	65	44	309	12	3
2004	(7)	(21)	(20)	(12)	(56)	(15)	(2)	(52)	(9)	(82)	(477)	(165)	(24)	(16)	(27)	(2)	(5)	(3)	(36)	(37)	(4)	(13)	(35)	(2)	(10)
	[3]	[2]	[6]	[14]	[29]	[5]	[1]	[11]	[6]	[10]	[13]	[0]	[1]	[1]	[1]	[0]	[2]	[2]	[12]	[9]	[0]	[13]	[30]	[0]	[0]
	81	142	187	12	670	142	16	158	128	666	1922	0	0	69	242	30	27	35	138	164	72	44	383	12	3
2005	(4)	(17)	(13)	(7)	(36)	(9)	(2)	(42)	(7)	(49)	(355)	(210)	(21)	(14)	(20)	(1)	(4)	(3)	(18)	(27)	(3)	(10)	(29)	(2)	(9)
	[3]	[2]	[8]	[12]	[31]	[6]	[1]	[10]	[6]	[7]	[12]	[0]	[1]	[1]	[1]	[0]	[2]	[2]	[3]	[7]	[0]	[10]	[28]	[0]	[0]
	82	117	185	8	645	146	16	153	122	660	2110	1	0	70	237	36	18	35	128	163	38	42	410	12	3
2006	(1)	(4)	(7)	(2)	(20)	(6)	(0)	(32)	(1)	(18)	(186)	(207)	(15)	(5)	(10)	(1)	(0)	(1)	(7)	(13)	(0)	(4)	(10)	(2)	(6)
	[3]	[1]	[5]	[10]	[28]	[4]	[0]	[10]	[4]	[4]	[9]	[0]	[0]	[1]	[1]	[0]	[1]	[2]	[2]	[6]	[0]	[7]	[26]	[0]	[0]
	12	4	19		30	27	0	2	0	19	1032	0	0	23	7		1		3				16		
2007	(0)	(0)	(0)	NA	(1)	(0)	(0)	(1)	(0)	(0)	(23)	(7)	(1)	(0)	(0)	NA	(0)	NA	(1)	NA	NA	NA	(0)	NA	NA
	[0]	[0]	[0]		[1]	[0]	[0]	[1]	[0]	[0]	[2]	[0]	[0]	[0]	[0]		[1]		[0]				[0]		
	804	1350	210	161	6782	1364	92	1257	1186	6672	17528	5	0	654	1743	183	242	200	1806	1275	431	428	2842	86	17
Total	339	591	609	528	1887	683	13	580	290	2678	10863	1885	242	347	504	9	69	22	961	676	75	210	989	25	81
	123	109	225	525	783	125	4	153	112	750	2012	13	10	57	138	0	37	85	231	193	2	69	559	0	0

Numbers in each cell are number of firms for analysis for listed, (delisted), and [unlisted] firms.

In the previous literature, such as Frank and Goyal (2007), many factors are known to affect firms' debt ratios: profitability, firm size, growth, industry classification, nature of assets, taxes, risk, supply-side factors, stock market conditions, debt market conditions, and macroeconomic conditions. In this analysis, I used four independent variables, tangibility, NDTS (non-debt tax shield), profitability, and firm size, together with the dependent variable, long-term debt ratio, by following Fattouh, Scaramozzino, and Harris (2005, 2008). Asset tangibility was computed as (fixed asset/total asset)*100, NDTS, (depreciation and amortization expenses/total asset)*100, profitability, (earning after tax/total asset)*100, and firm size, log (sales). Table 1 provides frequency distributions for the entire data by country, by listing types, and by year. Let us first take the 1995 data of the Netherlands for explanation. In 1995, the respective numbers of listed, delisted, and unlisted firms in the Netherlands were 80, 69, and 21. And the total numbers of listed, delisted, and unlisted firms in Denmark for analysis reached 1,364, 683, and 125, respectively. Table 2 reports median values as representative statistic for independent variables by listing type and by year. For example, the medians for the debt ratio variable ltd_ratio are 12.71%, 12.78%, and 18.72% for listed, delisted, and unlisted firms, respectively, in 2003.

Table 2: Descriptive Statistics (%)

Varia	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Ltd_ ratio	13.12 (12.93) [12.99]	12.65 (13.16) [11.99]	13.24 (13.13) [10.83]	12.62 (11.77) [11.10]	12.17 (11.85) [10.15]	12.21 (11.83) [10.15]	11.91 (11.59) [9.34]	12.28 (11.81) [10.67]	12.09 (12.08) [12.77]	11.60 (12.28) [11.46]	12.34 (12.14) [15.01]	13.04 (12.82) [15.44]	12.71 (12.78) [18.72]	11.86 (13.63) [16.83]	11.52 (14.11) [15.48]	11.43 (15.54) [12.76]	10.87 (11.84) [6.96]
Tangi bility	43.11 (44.04) [43.85]	43.54 (45.00) [44.19]	43.89 (44.45) [46.76]	42.96 (43.79) [45.52]	42.96 (43.79) [45.52]	42.74 (42.93) [47.10]	42.80 (45.14) [48.71]	42.69 (44.48) [53.87]	44.19 (45.99) [52.70]	45.55 (48.37) [53.33]	47.53 (50.40) [54.65]	48.11 (51.53) [59.90]	47.55 (51.85) [60.36]	48.47 (53.07) [58.37]	49.31 (53.69) [58.09]	50.00 (53.44) [54.67]	52.59 (62.08) [38.17]
NDTS	4.32 (3.85) [3.99]	4.41 (4.12) [4.03]	4.35 (4.24) [4.11]	4.20 (4.08) [4.05]	4.08 (3.94) [3.96]	4.10 (3.89) [3.95]	4.02 (3.82) [4.14]	4.05 (3.78) [4.58]	3.94 (3.75) [4.57]	3.62 (3.44) [4.38]	3.80 (3.68) [4.22]	3.81 (3.84) [4.13]	3.73 (3.94) [4.29]	3.21 (3.48) [4.00]	2.75 (2.91) [3.27]	2.51 (2.41) [3.23]	2.24 (2.51) [2.98]
ROA	3.02 (2.68) [2.49]	2.68 (2.06) [2.17]	2.99 (2.56) [2.34]	3.79 (3.53) [3.10]	4.31 (3.96) [3.27]	4.12 (3.96) [2.67]	4.46 (4.37) [2.38]	4.37 (3.89) [2.46]	3.88 (3.61) [1.63]	3.42 (2.84) [2.53]	2.11 (1.89) [2.83]	1.69 (1.48) [2.01]	1.98 (2.16) [1.87]	3.09 (2.68) [3.05]	3.67 (2.99) [3.80]	3.93 (3.06) [4.35]	4.27 (4.40) `[58.09]
Firm Size	12.48 (12.09) [12.32]	12.49 (12.16) [12.25]	12.47 (12.07) [12.26]	12.49 (11.99) [12.46]	12.50 (11.99) [12.47]	12.43 (12.03) [12.65]	12.40 (11.98) [13.07]	12.15 (11.91) [13.88]	12.03 (11.86) [13.89]	12.04 (11.84) [14.14]	12.06 (11.87) [14.71]	11.99 (11.95) [14.49]	11.92 (12.00) [14.26]	11.81 (11.87) [14.19]	11.82 (11.81) [14.53]	11.90 (11.91) [14.67]	11.31 (12.74) [14.74]

Ltd_ratio, NDTS, ROA, and firm size respectively stand for long-term debt ratio, non-debt tax shield, return on asset, and size of a firm. The figures in each cell represent median values (%) for listed, (delisted), and [unlisted] firms.

Table 3: Correlation Coefficients

	Ltd_ratio	Tangibility	ROA	Firm size	NDTS
Ltd_ratio	1.000000				
Tangibility	0.284503	1.000000			
ROA	-0.136713	0.026080	1.000000		
Firm size	0.009110	0.069696	0.231027	1.000000	
NDTS	0.053470	0.056326	-0.276968	0.035036	1.000000

Note: Ltd_ratio, NDTS, ROA, and firm size respectively stand for long-term debt ratio, non-debt tax shield, return on asset, and size of a firm.

Table 3 reports correlation coefficients among variables employed in this study. We find in this table that the correlations among the variables are not so high. The correlation coefficients between debt ratio (ltd_ratio) and profitability (ROA), and

NDTS and ROA turned out to be negative whereas those between other variables turned out to be positive.

3.2 Empirical Results

3.2.1. Estimation of the Base Quantile Regression Model

We estimated (1) for the entire data set first and then each respective data set by listing types. Regression results for the entire data set are presented in Table 4. We find in Table 4 significant coefficient estimates at almost all quantiles, except for the coefficients of NDTS and ROA at 20% and 10% quantiles, respectively.

The estimated coefficients of (1) for each respective data set are plotted in Figure 1 by firms' listing types. Overall results showed that the coefficient signs turned out to be consistent with the claims of theories at almost all quantiles. At the same time, the results showed the usefulness of quantile regression because different coefficients were found for different quantiles and by listing types.

Table 4: Quantile Regression Estimates

	Constant	Tangibility	NDTS	ROA	Firm Size	Adjusted R-Squared
Q10	-2.905 (-22.19)	0.029 (25.25)	0.008 (2.08)	-0.000 (-0.71)	0.224 (22.09)	0.0153
Q20	-6.04 (-29.52)	0.094 (42.95)	0.006 (0.86)	-0.002 (-1.89)	0.463 (27.21)	0.0466
Q30	-6.85 (-28.87)	0.160 (62.39)	-0.027 (-3.34)	-0.005 (-2.88)	0.536 (25.58)	0.0742
Q40	-6.71 (-25.17)	0.224 (78.42)	-0.074 (-4.25)	-0.012 (-3.78)	0.543 (22.44)	0.0959
Q50	-5.83 (-19.71)	0.282 (91.53)	-0.125 (-6.05)	-0.024 (-4.38)	0.519 (18.82)	0.1130
Q60	-4.44 (-13.91)	0.340 (102.16)	-0.163 (-5.63)	-0.044 (-9.98)	0.469 (15.77)	0.1266
Q70	-1.54 (-3.26)	0.388 (103.54)	-0.192 (-5.37)	-0.088 (-5.77)	0.376 (9.86)	0.1377
Q80	5.68 (8.74)	0.431 (99.85)	-0.294 (-14.14)	-0.155 (-13.53)	0.077 (1.57)	0.1458
Q90	21.29 (21.48)	0.456 (82.99)	-0.337 (-4.92)	-0.299 (-9.01)	-0.597 (-8.33)	0.1464

Note: Ltd_ratio, NDTS, ROA, and firm size respectively stand for long-term debt ratio, non-debt tax shield, return on asset, and size of a firm. Figures in parentheses indicate t-statistics.

First, as the variable tangibility increases, the debt ratio also increases because of the role of tangible assets as collateral. When we look at the coefficient estimates at higher levels than that at the 50% quantile by listing types, we find lower coefficient estimates of delisted firms than those of listed and unlisted firms. This means that although the unit increase in asset tangibility can invite more use of debt because of increasing capacity as collateral at relatively high levels of debt ratios, the increasing degree of debt capacity is lower than those of the listed and unlisted firms.

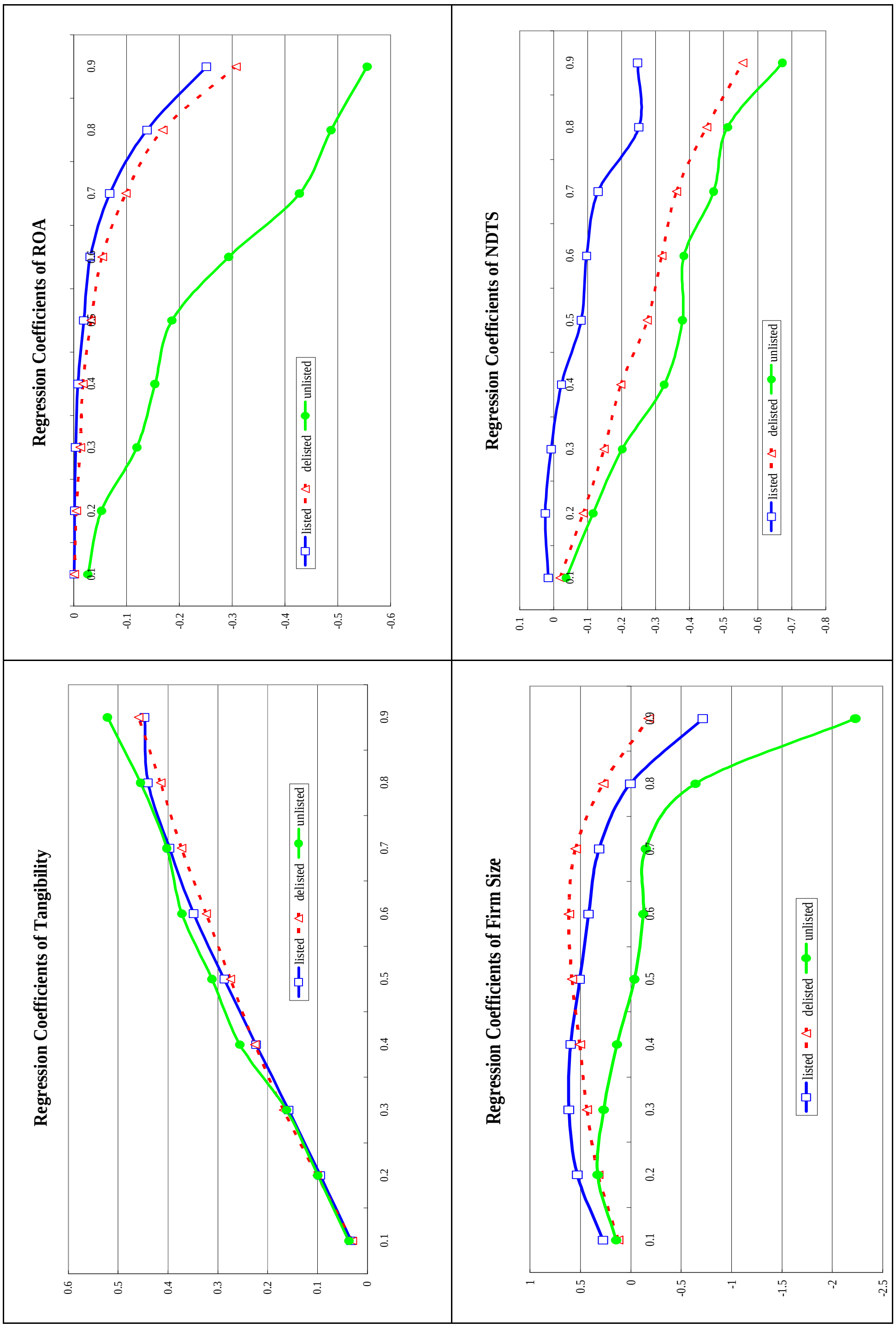

Figure 1: Quantile Regression Estimates by Listing Types

This also implies that investors are less likely to provide more debts to delisted firms because of their higher default risk. Second, the profitability coefficients were estimated to be negative at all quantiles as the theory predicts that the more profitable a firm becomes, the less likely it will use debts. We find that as debt ratio increases, the absolute value of negative coefficient for ROA becomes greater, irrespective of their listing types. This means that at higher debt levels, firms will depend less on debts or redeem debts. Third, the coefficients of the variable firm size were estimated to be positive at low and middle debt levels, whereas at high levels such as the 90% quantile, the coefficient was estimated to be negative for all listing types of firms. Negative signs were found for unlisted, listed, and delisted firms at quantiles after 50%, 80%, and 90% quantiles, respectively. This implies that despite the increase in firm size, unlisted firms with debt ratios higher than that at 50% quantile do not increase debt ratios; rather, they reduce them. This also implies that compared to increased debt capacity due to the increase in firm size, the effect from default risk may become greater from this debt level.The marginal debt level for coefficients to become negative turned out to be higher for listed and delisted firms than for unlisted firms: 80%, 90%, and 50% quantiles, respectively. The debt level from which default risk exceeds debt capacity is the highest for delisted firms. This is interpreted as follows. It becomes very difficult for delisted firms to borrow debt at very high debt levels despite their debt capacity stemming from firm size. Up to 80% and 90 % debt quantiles, we could confirm the firm size effect. In other words, the firm size effect existed up to the 50% quantile for unlisted firms. This may be partly attributed to their reputation effect. Unlisted firms, other things being equal, do not have easier access to financial markets and have less debt capacity than do listed firms. Fourth, we find lower coefficient estimates of NDTS at higher quantiles of debt ratios. This result is consistent with the claim that the incentive to use NDTS will be reduced at higher debt levels because of the overlapping effect from the tax shield of debt. The coefficient estimates of listed firms turned out to be the highest at all quantiles, followed by delisted firms, and then unlisted firms. This result was interpreted in the following way. The negative coefficient estimates could be observed because firms have incentives to reduce debt levels in the presence of NDTS. And, those effects to reduce debts turned out to be the greatest for unlisted firms, next for delisted firms, and finally for listed firms.

3.2.2. Estimation of the Speed of Adjustment

The speeds of adjustment were estimated by using (3), and the results are reported in Table 5. We find in the table that the estimated speeds of adjustment at 30% quantile are 0.2338, 0.2047, and 0.1456 for listed, delisted, and unlisted firms, respectively. The speeds of adjustment for all listing types and quantiles were estimated to be positive between zero and one except for just one case. This means that debt adjustment has been made partially every period for all types of firms. For example, the speed of adjustment for all firms was estimated to be

0.0743 at the 70% quantile, suggesting that 7.43% of the difference between current debt ratio and target ratio has been adjusted every year.

Table 5: Regression Estimates of Adjustment Speed by Quantiles

	All		Listed		Delisted		Unlisted	
	Coefficient	S.E.	Coefficient	S.E.	Coefficient	S.E.	Coefficient	S.E.
Q10	0.5536	0.0107	0.5825	0.0122	0.5368	0.0134	0.4193	0.0388
Q20	0.3234	0.0057	0.3472	0.0079	0.3058	0.0091	0.2332	0.0149
Q30	0.2173	0.0037	0.2338	0.0048	0.2047	0.0065	0.1456	0.0119
Q40	0.1505	0.0036	0.1643	0.0044	0.1411	0.0062	0.0903	0.0078
Q50	0.1061	0.0038	0.1181	0.0051	0.1010	0.0047	0.0473	0.0081
Q60	0.0798	0.0039	0.0945	0.0060	0.0776	0.0068	0.0201	0.0050
Q70	0.0743	0.0039	0.0866	0.0067	0.0758	0.0079	0.0151	0.0062
Q80	0.0836	0.0059	0.0970	0.0081	0.0864	0.0094	0.0058	0.0137
Q90	0.1103	0.0104	0.1334	0.0102	0.1128	0.0158	**a** -0.0144	0.0294

S.E. stands for standard errors for the coefficient. These results are based on the regression (3). Notation **a** indicates a special case, where the regression estimate turned out to be negative.

The results in Table 5 are illustrated in Figure 2a and Figure 2b. We see in Figure 2a that the speed of adjustment depended on the current levels of debt ratios for all firms. When the debt ratios were in the lower (higher) quantiles, the adjustment speeds were estimated to be higher (lower). For example, the speed of adjustment was estimated to be 0.5536 at the 10% quantile, and it decreased to the minimum level of 0.0743 at the 70% quantile. The estimates of speeds were slightly higher at the higher levels of quantiles such as 80% and 90%. The general pattern is that the speed of adjustment was higher at lower quantile levels, and it tended to decrease as the current debt level increased.

The graphs in Figure 2b illustrate the reported results in Table 5. I find the following characteristics. First, the speeds of adjustment were estimated to be fastest for listed firms, followed by delisted firms, and then for unlisted firms at all quantiles of debt ratios. The reason is probably because listed firms are more likely to have enjoyed relatively easier access to financial markets and institutions, which makes it possible to have issued securities in the financial market and to borrow loans from banks. And, compared to delisted and unlisted firms, listed firms might have more cash holdings and be more profitable, which also makes it possible to redeem debts. This will lead to faster speed of adjustment on the part of listed firms. In contrast, unlisted firms do not have easier access to financial markets, which will result in the slowest speed of adjustment. Second, the speeds of adjustment at relatively lower quantile levels were higher than those at higher quantile levels. Let us take one example from Table 5. The speed of adjustment for listed firms at the 10% quantile was estimated as 0.5825. It decreased to be the minimum level of 0.0866 at the 70% quantile, and slightly increased to 0.0970 at the 80% quantile. This phenomenon can be interpreted in the way that if firms with lower debt ratios increase debt by the same amount as firms with higher debt ratios, the relative change in the speed of adjustment will be greater for the firms with lower debt ratios. Similar patterns can be observed for delisted and unlisted firms. Third, one particular case is the result for the negative speed of adjustment -0.0144 for unlisted firms at the 90% quantile. This can be interpreted in such a way that firms at very high levels of debt ratio might have adjusted the debt ratios in the opposite direction. When the current debt ratio is very high, firms are very likely to set the lower ratio as a target at the next period. That is, the term $(DR^{*}_{i,t+1} - DR_{i,t})$ will be negative. In actuality, however, the firms might have increased their debt ratios to the contrary of their expectation. That is, $(DR_{i,t+1} - DR_{i,t})$ can be positive. Thus, the negative coefficient of $\delta_{i,t}$ is possible.

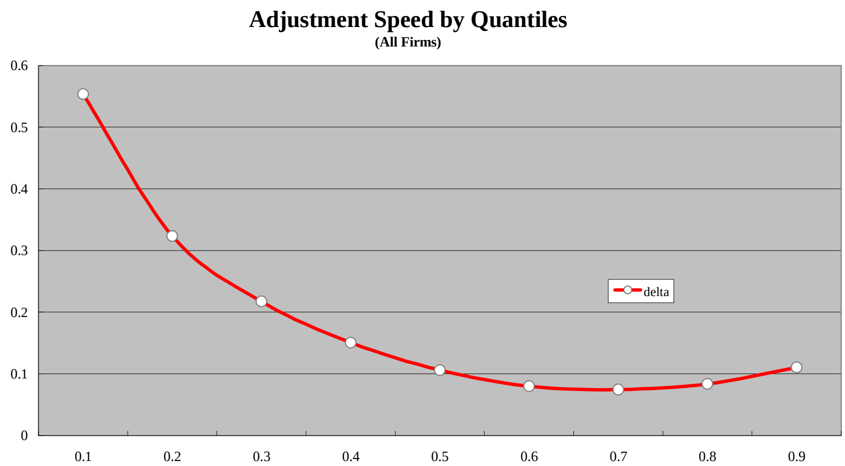

Figure 2a: Speed of Adjustment, (a) Speed of Adjustment by Quantiles for All Firms

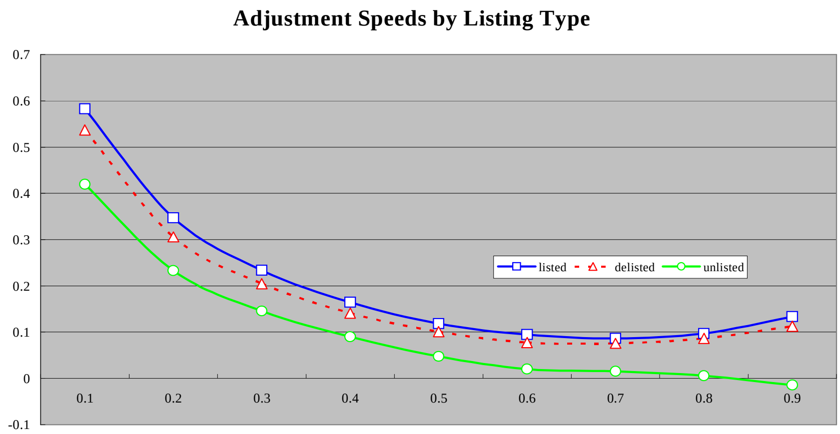

Figure 2b: (b) Speed of Adjustment by Quantiles for Three Listing Types of Firms

3.2.3. Time Required for Half-life Adjustment

The questions of how long it takes firms to reach their target debt ratios are analyzed and their results are reported in Table 6. The time periods of half-life adjustment required to the target ratio were computed, assuming the difference to the target ratio to be 100 %. Let us take one example for explanation. The speed of adjustment and the expected time to the target ratio for listed firms were, respectively, 0.0866 and 7.6522 years at the 70% quantile. This number of expected time for half-life adjustment was obtained from $\log 0.5/\log(1-0.0866)$, according to suggestion by Elsas and Florysiak (2010). This means that the annual adjustment will be 8.66% on average, which will result in 7.6522 years in reaching the target debt ratio. Similarly, the speed of adjustment for all pooled firms at the 20% quantile was 0.3234, which will result in 1.7742 years for half-life adjustment to the target. All numbers given in the table are computed this way. One exceptional case is the long time periods of more than 10 years for half-life adjustment. At the 50%, 60%, 70%, and 80% quantiles, the expected half-life adjustment periods were estimated to be, respectively, around 14, 34, 46, and 119 years for unlisted firms. At an extreme case of the 90% quantile for unlisted firms, the estimated time for half-life adjustment turned out to be negative. It was around -48 years. This means those firms' efforts to reduce debt ratios were not successful, which brought about the opposite result. Thus, it seems to be impossible for these firms at this 90% quantile to reach the target debt ratio during their lifetimes.

Table 6: Expected Time for Half-life Adjustment by Quantile (in Years)

Quantile	All	Listed	Delisted	Unlisted
Q10	0.8594	0.7936	0.9007	1.2753
Q20	1.7742	1.6253	1.8991	2.6104
Q30	2.8291	2.6028	3.0264	4.4049
Q40	4.2496	3.8619	4.5571	7.3240
Q50	6.1799	5.5153	6.5101	14.305
Q60	8.3347	6.9826	8.5811	34.137
Q70	8.9780	7.6522	8.7933	45.556
Q80	7.9396	6.7934	7.6707	119.16
Q90	5.9309	4.8412	5.7914	**b** -48.481

The expected times of half-life adjustment to the target ratio for firms were based on the speed of adjustment in Table 3. The speed of adjustment for delisted firms at 30% quantile was 0.2047, and the expected time for half-life adjustment was computed as $\log 0.5/\log(1-0.2047)$. Notation **b** indicates a special case, where the expected period of half-life adjustment turned out to be negative. The adjustment time was calculated from $\log 0.5/\log(1+0.0144)$. This means that at this current adjustment rate, it is impossible for these firms to adjust to the target ratio.

4. Concluding Remarks

The major findings from this analysis are as follows. First, the speeds of adjustment of firms with lower debt ratios turned out to be higher than those of firms with higher debt ratios. Second, the adjustment speed depended on listing types. That is, the speed of listed firms was the fastest, followed by delisted firms, and then unlisted firms. Consequently, the expected time of half-life adjustment to the target debt ratios was shortest for listed firms, next for delisted firms, and finally for unlisted firms. Firms' accessibility to financial markets might be the reason for this difference.

The noteworthy contributions of this paper are two-fold. One is that this study analyzed the firms' behavior toward target debt ratio by listing types, such as listed vs. delisted vs. unlisted firms. Considering the relative scarcity of research on delisted and unlisted firms compared to that on listed firms, this study contributed to the existing literature by including such firms. The other contribution is that unlike previous studies, the speed of adjustment can be different depending on firms' debt ratios and listing types, which resulted in different periods of half-life adjustment to target ratios.

One of the limitations in this study is that additional variables such as the cost of borrowing should have been included. Such a cost could be significantly different for firms in different countries and be significantly different for the same firm in different time periods because of market conditions.

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