

Trade-off theory vs. the pecking order hypothesis: Japanese evidence on capital structure under financial constraints

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ABSTRACT

This paper investigates the explanatory power of the two predominant theories of capital structure, the trade-off theory and the pecking order hypothesis, in accounting for financial policy decisions of Japanese corporations. We conduct a “horse race” test similar to the one utilized in the seminal papers of Shyam-Sunder and Myers (1999) and Frank and Goyal (2009). This is the first paper to take into consideration the effect of monetary conditions and financial constraints on the performance of these two theories. The data set used includes 1528 public and 2143 private companies and covers the period of 1980–2007, thus employing 60,037 observations. We show that economic conditions affect the performance of the two models. The pecking order hypothesis works best during the high growth period of the 1980s, while the trade-off theory is the best performer during the stagnant growth period of the 1990s and the subsequent credit crunch. Our results also indicate that the explanatory power of these two theories varies for different groups of firms. The trade-off theory works best for companies with low levels of leverage while the pecking order hypothesis performs best for private companies and companies with high levels of leverage.

1. Introduction

Miller and Modigliani (1958) presented the case for the irrelevance of capital structure – based on a stylised model defined by many restrictive assumptions. This can also be interpreted to mean that in our world, as opposed to the highly stylised theoretical world defined by these assumptions, capital structure is *not* irrelevant. This realisation has led to competition between different theories attempting to explain and predict the financial policy decisions of firms. Nevertheless findings from studies examining the two predominant theories, the trade-off and the pecking order hypotheses, have so far been mixed. It seems that the conventional examination of the factors that influence firms’ levels of leverage are not well suited to identify which of the main two competing models is superior.

Shyam-Sunder and Myers (1999) constructed a “horse race” test in their seminal paper to directly pit the pecking order and trade-off models against each other, using US data. They found the pecking

order hypothesis the winner. This result was disputed a few years later by Frank and Goyal (2009) who used a much larger US data set. They reported that the pecking order hypothesis was not able to adequately explain capital structure decisions of smaller firms, especially during the 1990s.

Thus the evidence that has so far been produced by the “horse race” tests is inconclusive. There is ample scope for new research, especially since the two main studies have focused only on the US market and monetary conditions have not been taken into consideration.

In their recent study of a large number of companies from 52 countries, Botta and Colombo (2022) found that capital structure decisions are complex and non-linear, with firm, macroeconomic and institutional factors interacting, and producing significant heterogeneity of the target leverage, and speed of adjustment towards the optimal capital structure.

Among the possible factors, we focus on the role of monetary conditions. The US studies of Kisen (2006) and Faulkender and Petersen

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(2006) found that credit ratings significantly influence financial policy decisions, whereby companies with high credit ratings or companies that have had a credit rating upgrade have easier access to external finance than other firms. Bougheas et al. (2006) found that economic downturns affect the capital structure of UK companies.

In his seminal paper Leary (2009), examining the US, found that fluctuations in the supply of credit significantly affect capital structure and have a disproportionate effect on different types of firms. He also showed that smaller sized companies that face greater financial constraints are more affected by either an economic expansion or an economic contraction. Voutsinas and Werner (2011), examining Japan, confirmed this.

Sardo et al. (2020) found evidence that venture capital affects the capital structure and thus confirmed that the provision of finance is relevant.

There is little doubt that country studies can further the research agenda on capital structure (Granado-Peiró and López-Gracia, 2017, on Spain). Since authors such as Lööf (2004) argue that different archetypes of economies affect the capital structure (stock market-based vs. bank-based) and our interest lies in the competing pecking order vs. trade off theory performance, we focus on one large bank-based economy, namely Japan, and we examine especially the role of credit constraints. We also examine the role of different parts of the business cycle and a country's long-term economic development (high growth phase vs. low growth or credit crunch phase).

Before further analysing the impact of financial constraints and monetary conditions on the trade-off and pecking order hypotheses, the theoretical framework and current empirical findings for the two theories should be discussed. The trade-off theory (Miller, 1977; Miller and Modigliani, 1963; Myers 2001) predicts that there is an optimal level of capital structure for each firm derived from the tax benefits of debt and the financial distress costs that it creates. On the other hand, the pecking order hypothesis (Myers, 1984; Myers and Majluf, 1984) stipulates that firms will always prefer to use internal rather than external finance due to the fact that internal finance does not suffer from informational asymmetry problems. If the use of internal finance is not possible then financial managers will decide to first issue debt (again following a pecking order, with the safest kind of debt coming first), and then equity (due to the negative signalling effect of equity issuance to markets). Summarizing, the trade-off theory states that firms with safe, tangible assets and plenty of profits to shield should be the ones with the highest leverage levels. The pecking order hypothesis predicts the opposite; companies with high profits should be the ones having the lowest leverage ratios.

The majority of previous capital structure studies deployed numerous factors to investigate the driving forces behind observed capital structure. The findings coming from the analysis of these factors provided evidence on the validity of these two theories. The most popular factors in capital structure studies are size, profitability, collateral values, non-debt tax shields, financial distress and the internal cash deficit.

As far as size and the collateral value factors are concerned results coming from the US (Bradley et al., 1984; Taub, 1975; Titman and Wessels, 1988; Hovakimian et al., 2004) and internationally (Bhabra et al., 2008; Chen, 2004; Chen and Strange, 2005; de Jong et al., 2008; Gaud et al., 2005; Hirota, 1999; Huang and Song, 2006; Kayo and Kimura, 2011; Rajan and Zingales, 1995) unanimously agree that these two factors have a positive relationship with external finance, in accordance with the trade-off theory. Furthermore, the theoretical study of Flor (2008) also predicts that firms with asset values with high growth rates are expected to have higher levels of debt. Also in line with the predictions of the trade-off theory are the results coming from the examination of financial distress costs that are proven to have an inverse relationship with leverage (Hovakimian et al., 2001; Colombo, 2001; Nunes and Serrasqueiro, 2007).

Nevertheless results on the role of non-debt tax shields are mixed:

Taub (1975), Bradley et al. (1984), Booth et al. (2001) find that non-debt tax shields are positively related with external debt while Allen and Mizuno (1989), Hirota (1999) present opposite findings. Therefore one of the most important predictions of the trade-off theory, i.e. that firms stockpile debt in order to use it as a tax shield, cannot be confirmed. Results coming from the profitability factor are also not in favor of the trade-off theory. It is shown that in every single study on capital structure, and in accordance with the pecking order hypothesis, profitable companies are those with the lowest leverage levels (e.g. Gaud et al., 2005; Chui et al., 2002). Furthermore, the empirical findings of Dewaelheyns and Hulle (2010) show that the affiliate companies of private business groups prefer to use internal debt first over bank debt. Finally, the examination of the internal cash deficit factor fails to provide clear support for the pecking order hypothesis. The studies of Minton and Wruck (2001), Lemmon and Zender (2001) show that companies do not fully exhaust their internally generated cash before they receive external financing while Helwege and Liang (1996) find that companies do not necessarily follow a pecking order when they decide to use external finance.

The results from a classical examination of capital structure have not been able to provide a clear answer as to which of the two theories is the predominant model for explaining financial policy decisions. Recent work has widened the scope of factors potentially affecting external finance decisions: Vivian and Xu (2017) examined the impact of managerial confidence on pecking order preference in the Shyam-Sunder and Myers (1999) model and found that overconfident managers tend to use more equity than debt, reversing the pecking order preferences, especially for small firms with volatile earnings. Earlier, Sanchez-Vidal and Martin-Ugedo (2005) tested the pecking order theory using Spanish panel data from 1994 to 2000 and found support for the pecking order theory.

Our study aims to shed more light in this area of capital structure by conducting a “horse race” test between the trade-off theory and the pecking order hypothesis, by making a significant contribution to the literature in the following respects: It is the first time that monetary conditions and financial constraints in general will be taken into consideration while directly comparing the explanatory power of these two theories. Furthermore we examine both public and private firms, and use a large data set. This will provide valuable findings since public and private firms face different financial constraints and thus their capital structure may be influenced by different factors. Finally, the role of the business cycle is examined.

The country of Japan was selected not only because during the observation period of 30 years it boasted the second largest capital market in the world. The Japanese economy has also experienced severe fluctuations in its monetary and macroeconomic conditions during this time. In the 1980s, Japan witnessed a period of unprecedented economic prosperity and credit expansion; a prolonged stock market rally alongside one of the largest property booms on record, while Japanese foreign investment seemed to “flood” the world, with Japanese investors purchasing landmarks throughout the globe. This economic euphoria came to an end with the close of the decade as bank lending growth was restricted by the central bank (Werner, 2005) and subsequently remained depressed for two decades. The stock market bubble burst in 1990 and the land price bubble a year or two later, with these assets recording a drop in their price of almost 80% from the peak. During the 1990s, GDP growth slowed down dramatically, ending in years of GDP contraction, stagnation and deflation. To make matters worse for the beleaguered Japanese economy, in 1997 the accumulation of non-performing real estate loans triggered the collapse of Yamaichi Securities, one of the four biggest securities houses in Japan. In conjunction with the East-Asian crisis that year and the Russian sovereign default the following year, pressure mounted on the banking system, culminating in significant amounts of public money being injected into banks by 2003. Year on year bank lending growth, already close to zero for a number of years, dropped to contraction in 1999 and subsequent years, remaining

depressed until 2013, despite early warnings that no economic recovery would happen without a recovery in bank credit growth (Werner, 1995). Indeed, the long recession only ended when a more aggressive form of “quantitative easing” was adopted that resulted in a recovery of bank credit growth. Japanese data thus yield information during periods of boom, recession, and credit crunch.

This study aims to investigate in what way these three different monetary periods have affected the explanatory power of the trade-off the pecking order hypotheses, a novelty for “horse race” tests. It is for this reason that the empirical analysis will be conducted for the entire time period of 1980–2007 but also for the sub-periods of 1980–1989, 1990–1998 and 1999–2007 thus covering the land value bubble credit expansion, the stagnant growth period of the 1990s and the more recent credit crunch.

The methodology used in the empirical analysis follows that of Shyam-Sunder and Myers (1999), Frank and Goyal’s (2009) paper and will be discussed in detail in Section 2. Section 3 will contain a description of the data set used in this study. Section 4 will include the empirical findings alongside with critical commentary, and finally, in Section 5, the concluding remarks will be presented.

2. Methodology

One of the main research areas of capital structure for the last 30 years has been whether the tax-driven trade-off theory or the informational asymmetry-based pecking order hypothesis is better able to explain and predict firms’ decisions to issue or retire debt. In order to shed more light on this topic this paper will use a methodology inspired by that of Shyam-Sunder and Myers (1999). Two theoretical models, one for each theory, will be derived and through their application we will be able to deduct which theory outperforms the other.

In the next few sections we are going to analyze the derivation of these two models but before that we would like to state that this paper is going to conduct a panel data analysis. As Baltagi (1995) has pointed out, panel data are superior to time-series or cross-section analysis due to the fact that they are better able to study the dynamics of adjustment, are more informative and control for individual heterogeneity. The regression models that are going to be created will be of the following form:

$$y_{it} = \alpha z'_i + \beta x'_{it} + \varepsilon_{it} \quad (1)$$

where x_{it} is the explanatory variable, in other words the driving force behind each examined theory, and β the evaluated parameter. z_i is the individual heterogeneity effect which contains a constant term and a set of individual or group specific characteristics that are either observed or unobserved. If z_i contains only a constant term and no unobserved effects then OLS estimators are consistent and efficient. In the case that z_i contains unobserved effects and at the same time is correlated with x_{it} fixed effects estimators should be used. If the individual heterogeneity effect can be assumed to be uncorrelated with the dependent variables then random effects estimators can be deployed.

In order to select the appropriate estimators for our analysis two post-estimation tests will be deployed. The Breusch and Pagan (1980) (BP) test will enable us to detect the potential presence of unobserved effects and thus reject or accept the OLS estimators. If the use of OLS is found to be inappropriate then the Hausman (1978) test will be run to assist us in selecting either the fixed or random effects estimators.

2.1. Dependent variable

Following in the footsteps of the vast majority of existing studies in the area of capital structure, including those that conduct “Horse Race” tests, we define leverage as the ratio of debt to assets. Since we want to investigate how well each theory is able to predict the firms’ financial policy decisions the dependent variable we will use will be the annual

change of total debt divided by total assets. As a robustness test we will also investigate the explanatory power of each model on the annual change of leverage, that this entire total debt to total assets ratio.

2.2. Trade-off model

The trade-off theory stipulates that firms have an optimum level of capital structure in which they maximize their values. This optimal capital structure is determined by the tax advantages of borrowed money and by the financial distress and agency conflicts costs that arise. Therefore, financial managers will strive to reach and maintain their target leverage ratios. Nevertheless this is a feat difficult to achieve since economic events and market conditions are likely to force companies to deviate from their target levels. In other words the trade-off theory postulates that every firm has a target level of debt to which it wants to revert.

The major problem in formulating a model that directly tests this theory is that the target debt level for each company is not observable. The only way of circumventing around this issue is to create a proxy for the firms’ desired leverage levels. Shyam-Sunder and Myers (1999) accomplished this through the use of a historical average, a 3-year and a 5-year moving average of leverage for the examined period, even though results from the 3-year and 5-year moving averages were not reported as they were described as statistically insignificant.

This approach has also been followed in this paper. For every company included in our sample a historical average of its leverage levels was calculated. Due to the fact though that our data set covers a time period spanning from 1980 to 2007 it is likely that economic conditions, and therefore the companies’ leverage targets, have changed over time. It is for this reason that 3 additional means of leverage were calculated: One covering the land bubble period of 1980–1989, one covering the stagnant growth period of 1990–1998 and one for credit crunch period of 1999–2007. This selection was made due to the fact that, as discussed in Section 1 of this paper, during these periods severe fluctuations in monetary conditions took place. Furthermore as an alternative proxy for the firms’ desired capital structure, a rolling target based on a 5 years moving average of each firm’s book debt ratio was calculated.

Summing up the model that was constructed to test the validity of the trade-off theory is shown below.

$$\frac{\Delta D_{it}}{Totalassets_{it}} = \alpha + b_{TA} \frac{(D_{it}^* - D_{it-1})}{Totalassets_{it}} + u_i + \varepsilon_t \quad (2)$$

ΔD_{it} depicts the first difference of total debt and D_{it}^* is the target debt level for firm i and time t . The trade-off theory dictates that $b_{TA} > 0$ because companies should be moving towards their desired target but also $b_{TA} < 1$ implying positive adjustment costs. As was mentioned earlier in this section the $\Delta D_{it}/Totalassets_{it}$ term was replaced with $\Delta Leverage_{it}$ in order to run robustness tests and different definitions of the target debt levels were used.

2.3. Pecking order model

The pecking order hypothesis states that a company will always prefer to use internal finance to meet its financial needs and only if it has to it will rely on external forms of finance. Even when external finance is used firms will always prefer to issue the safest form of debt first and equity will be used as a measure of last resort.

Based on the predictions of the pecking order hypothesis, and in accordance with Shyam-Sunder and Myers (1999), Frank and Goyal (2003), we select the funds flow deficit as the explanatory variable in our model. The reasoning behind this is that if the funds flow deficit is positive then a firm will issue debt of an amount equal to that of its deficit. On the other hand if the company’s deficit is negative then the firm will decide to retire debt. The issuance of equity is not taken into consideration since the pecking order hypothesis predicts that it should

Table 1
Descriptive statistics, original sample, public firms.

	1980	1983	1986	1989	1992	1995	1998	2001	2004	2007
Total Assets	93959	105333	115396	125949	152851	156620	160009	165102	160059	187833
Total Debt	34464	37735	38516	35868	45172	45586	44380	40420	36614	34829
Leverage	0.282	0.289	0.282	0.261	0.264	0.272	0.26	0.24	0.21	0.168
Equity	5745	6180	7684	10080	12858	13642	14456	15339	16291	18089
Debt Issues	-0.003	0.011	0.014	0.012	0.026	-0.009	-0.003	-0.022	-0.057	-0.004
Equity Issues	0.003	0.004	0.007	0.013	0.005	0.004	0.003	0.004	0.003	0.003
Deficit	-0.012	-0.011	-0.014	-0.006	0.003	-0.033	-0.016	-0.029	-0.006	-0.029
EBIT	0.089	0.073	0.068	0.071	0.064	0.041	0.04	0.043	0.04	0.049
Observations	740	782	819	1181	1318	1376	1423	1415	1333	1272

This table presents the mean of several key factors of this study for a significant number of representative years of Stock Exchange Listed firms. Debt and equity issues as well as the deficit and EBIT have been scaled with total assets. The values have been rounded up to the third decimal point.

seldom occur.

Our definition for the funds flow deficit is shown below:

$$DEF_{it} = DIV_{it} + X_{it} + \Delta W_{it} - C_{it} \tag{3}$$

Where:

C_{it} =Operating cash flows, after interest and taxes.

DIV_{it} =Dividend payments.

X_{it} =Capital expenditures.

ΔW_{it} =Net increase in working capital.

The model for the pecking order hypothesis is therefore the following:

$$\frac{\Delta D_{it}}{Totalassets_{it}} = \alpha + b_{PO} \frac{DEF_{it}}{Totalassets_{it}} + u_i + \varepsilon_{it} \tag{4}$$

The pecking order hypothesis predicts that the results of this model should be $\alpha = 0$ and $b_{PO} = 1$. In other words the results should show that the only variable affecting a company’s issuance of debt is its funds flow deficit and that the amount of debt issued (or retired) will be equal to the positive (or negative) value of its deficit. Of course as in the case of the trade-off model the $\Delta D_{it}/Totalassets_{it}$ term will be replaced with $\Delta Leverage_{it}$ in order to run robustness tests.

2.4. Other comments

One of the aims of this paper is to test the explanatory power of both theories when different groups of firms are examined. As discussed in Section 1 of this article, size is an important factor in the area of capital structure therefore it makes sense to further investigate whether one of the two theories is better able to explain and predict the financial policy decisions of smaller/larger firms. Moreover several researchers (Atanasova and Wilson, 2004; Ogawa and Suzuki, 1999; D’espallier et al., 2008) have shown that companies face financial constraints. This could also be an important factor in the performance of the two theories. For example it could be the case that the pecking order hypothesis, in accordance with its theoretical background, works better for smaller companies that face more significant informational asymmetry

problems and hence financial constraints.

It is for these reasons that we will apply both regression models on different groups of firms. The first distinction we make is to examine public and private Japanese firms separately. Private firms are much smaller in size and much more informationally opaque than their public counterparts since information for publicly listed companies is freely available due to stock exchange requirements. At the time of writing, it was the first time that such a distinction is made as far as “Horse Race” tests are concerned. Some studies focus on small firms, but do not directly compare private and public firms (e.g. Bartholdy et al., 2012; Adair and Adaskou, 2015).

The second categorization of the firms is based on their size and leverage levels. Following a similar practise to that of Frank and Goyal (2003) we classify firms as “small”, “medium” and “large” in size according to their total asset values. More specifically for every year of our sample firms are ranked with the lowest 30% labelled as “small” and the highest 30% as “large”; the rest of the sample is classified as “medium”. The same classification takes place as far as leverage is concerned. Therefore our regression analysis is conducted for all public and private firms in the data sample, but also for their size and leverage sub-samples.

Finally, as was discussed in Section 1, one of this study’s contributions to the literature is the investigation of the effect of monetary conditions on the performance of the two examined theories. It is for this reason that our empirical analysis will examine the entire time period of 1980-2007 but also further investigate the following time periods: the land bubble period of 1980-1989 (monetary expansion), the years of stagnant growth from 1990-1998 and the period of credit crunch during 1999-2007 (quantitative monetary contraction). For detailed definitions on all variables used, please refer to Tables 1 and 2.

The dimensions of public vs. private and size are postulated to be potentially of relevance for the following theoretical reasons: Public firms, due to listing requirements concerning information disclosure, are much more transparent and thus closer to the theoretical ideal of perfect information than private firms. The latter only need to publish basic financial statements annually. Thus the large literature on information imperfection or asymmetry applies. Moreover, there is a substantial body of literature evidencing financing constraints experienced by small

Table 2
Descriptive statistics, original sample, private firms.

	1980	1983	1986	1989	1992	1995	1998	2001	2004	2007
Total Assets	12137	10856	9465	9114	11379	14717	15322	14999	13339	14995
Total Debt	5429	4620	3826	3046	3620	4841	4637	4578	3657	3698
Leverage	0.324	0.337	0.325	0.304	0.292	0.313	0.30	0.292	0.267	0.217
Equity	763	730	580	504	550	766	756	751	706	716
Debt Issues	-0.006	0.013	0.016	0.010	0.008	-0.004	0.006	-0.014	-0.038	-0.011
Equity Issues	0.002	0.002	0.001	0.001	0.002	0.001	0.001	0.001	0	0
Deficit	-0.039	-0.03	-0.025	-0.042	-0.033	-0.04	-0.025	-0.018	-0.026	-0.019
EBIT	0.08	0.066	0.071	0.072	0.072	0.042	0.035	0.04	0.042	0.051
Observations	553	739	871	1244	1408	1013	1033	1050	979	605

This table presents the mean of several key factors of this study for a significant number of representative years of non Stock Exchange Listed firms. Debt and equity issues as well as the deficit and EBIT have been scaled with total assets. The values have been rounded up to the third decimal point.

firms (for a brief survey, see [Mkhaiber and Werner, 2021](#)), which is likely to affect their behaviour, including capital structure decisions. This is due to the fact that capital markets have a minimum issuance threshold in order to generate the minimum fees required by the respective capital market service providers. Leverage is the determinant of capital structure.

It will be examined whether different financial or economic conditions result in different outcomes. A theoretical reason for such result would be the greater degree of credit rationing during downturns, as postulated by some authors (e.g. the balance sheet channel of monetary policy transmission, [Gertler and Gilchrist, 1993](#)), and also affecting firms differently, depending on their size (see the literature on small firm finance). A more fundamental reason could be the special role of banks as creators of the money supply – a role that stands in contrast to capital market finance ([Werner, 2014; Werner, 2016](#)). The role and relationship of interest rates to economic growth has recently come into doubt empirically, based on the theoretical idea that without general equilibrium rationed markets may be a more relevant paradigm ([Lee and Werner, 2018](#)), positioning quantitative monetary policy as a more prominent measure of the monetary policy stance (see [Werner, 2013; Lyonnet and Werner, 2012](#)). Finally, the quantity theory of disaggregated credit ([Werner, 1997, Werner, 2005](#)) suggests that asset price levels, including equity markets, may be determined by bank credit, providing another theoretical justification for business cycles affecting availability and cost of capital and debt.

2.5. Tests of statistical power

As a robustness test, and following the methodology of [Shyam-Sunder and Myers \(1999\)](#), we will carry tests of statistical power. The notion behind these tests is to generate a hypothetical time series for each company in our sample based on either the pecking order hypothesis or the trade-off theory. Then we will examine how well these two models fit the data; if, for example, the trade-off theory model has statistical power it should not be able to explain the financing decisions that are purely generated by the pecking order hypothesis model and vice versa.

The creation of these hypothetical time series will start with the actual value of total debt for each firm. Since this study is using an unbalanced dataset the first observation for each firm will vary. The methodology on which the creation the hypothetical time series is based on will of course be different for each theory and will be shown in the next few paragraphs.

According to the pecking order hypothesis a firm will decide to issue debt if its deficit is positive and retire debt if its deficit is negative. The amount of the debt issued or retired is assumed to be equal to that of the deficit. Hence the funds flow deficit is added to the actual total debt value of the first observation for each company. This process will generate the simulated total debt value for the following year; that year's deficit will be added to the aforementioned simulated debt value thus generating the third year's simulated debt value and so on. By repeating this procedure the simulated total debt series for each company according to the pecking order hypothesis will be created.

For the trade-off theory the major problem in simulating total debt data for our firm sample rests on defining the firms' target level of debt. [Shyam-Sunder and Meyers \(1999\)](#) made the assumption that firms have exactly the same target throughout the entire examined time period. We believe that this is not a realistic assumption. Companies are likely to make alterations to their desired capital structure over time as economic conditions change. For this reason, the D_{it}^* term of [Eq. \(2\)](#) was calculated as each firm's the mean of its actual total debt value for each of three monetary periods of our sample; the land bubble period of 1980-1989, the second for the years of the stagnant growth from 1990 to 1998 and the third for the credit crunch during 1999-2007. In order for the simulated data series to be generated [Eq. \(2\)](#), which for convenience reasons is shown again below, will have to be applied.

$$\frac{\Delta D_{it}}{Totalassets_{it}} = \alpha + b_{TA} \frac{(D_{it}^* - D_{it-1})}{Totalassets_{it}} + u_i + \varepsilon_t$$

According to the trade-off theory $\alpha = 0$ and b_{TA} will receive the value that we estimated through our main empirical analysis. More specifically each company will start with its actual debt value of its first observation and the simulated debt level in its second observation will be equal to $b_{TA}(D_{it}^* - D_{it-1})$ plus D_{it-1} . D_{it}^* will be the firms' average value of their actual total debt for the specific sub-sample, b_{TA} will be the estimated coefficient from the initial empirical analysis (in other words it is obtained by the regression analysis of [Sections 4.1–4.3](#)) and D_{it-1} will be the previous total debt value, in this case the actual total debt of the company's first observation. The following years for each firm will be generated in the same manner.

2.6. Robustness Tests

The studies of [Chirinko and Singha \(2000\)](#) and more recently [Bartholdy et al. \(2012\)](#) have criticized the methodology that [Shyam-Sunder and Myers \(1999\)](#) used regarding the construction of the pecking order hypothesis model. More specifically, these studies argued that the [Shyam-Sunder and Meyers \(1999\)](#) model produces biased results due to the fact that it does not taken into consideration the ability of the firms' to issue external equity.

In order to circumvent this problem, while measuring the performance of the pecking order hypothesis and at the same time the validity of the original model, we include a number of robustness tests influenced by the study of [Seifert and Gonenc \(2008\)](#). [Seifert and Gonenc \(2008\)](#) utilised an alternative definition of the firms' funds flow deficit that was originally proposed by [Fama and French \(2005\)](#) and incorporates the issuance of equity, as can be seen below:

$$DEF2_{it} = dA_{it} - dRE_{it} = dL_{it} + dSB_{it}$$

$DEF2_{it}$ denotes the alternative definition of the firms' funds flow deficit, dA_{it} is the change of the firms' total assets between year t and $t-1$, dRE_{it} is the change of the firms' retained earnings between year t and year $t-1$, dL_{it} is the change of the firms' total liabilities between year t and year $t-1$ and dSB_{it} is the change in stockholders' equity in excess of the change in retained earnings between year t and year $t-1$. The predictions of the original pecking order model apply here as well, in other words if the hypothesis fits the data perfectly then $\alpha = 0$ and $b_{PO} = 1$. We will therefore re-run the specifications for the pecking order model for all time periods using this alternative definition of deficit and also compare its performance with the trade-off model for both public and private firms.

3. Data set

The data for the creation of this study's data set were extracted from Nikkei Needs Financial Quest, the premier source for financial and economic data for the country of Japan. More specifically our sample includes financial statement data from 1528 publicly listed and 2143 private Japanese companies. The number of public firms includes all companies that during the time period of our sample were listed in any of the major Japanese stock exchanges (Tokyo, Osaka, Nagoya, Sapporo and Jasdq). Even firms that are currently de-listed have been included in our data set thus allowing us to circumvent around the survivorship bias problem. This paper's sample spans from 1980 to 2007, a period that includes important structural developments of the Japanese economy, but excludes the most recent, far more turbulent period since the 2008 financial crisis and the 2011 major earthquake and ongoing nuclear meltdown. During the observation period, several firms entered but also exited the Japanese stock markets. Due to this reason this study is based on an unbalanced panel data set. For more information one the number of firm-observations per year the reader is advised to examine

Table 3
Horse race bubble period, public firms.

	Debt Issues / Total Assets	Debt Issues / Total Assets	Debt Issues / Total Assets	Change in Debt Ratio	Change in Debt Ratio	Change in Debt Ratio	Debt Issues / Total Assets	Change in Debt Ratio	Debt Issues / Total Assets	Change in Debt Ratio
Constant,	0.0260***	0.0068***	-0.0033***	0.0089***	-0.0037***	-0.0107***	0.0220***	0.0060***	0.0078***	-0.0038***
a										
b_{TAAV}		0.3063***			0.1713***		0.1973***	0.1312***		
b_{TAMAS5}			0.9130***			0.6075***			0.7720***	0.5293***
b_{PO}	0.4202***			0.2660***			0.3720***	0.2425***	0.2358***	0.1482***
R²	0.26	0.17	0.50	0.14	0.07	0.31	0.31	0.21	0.57	0.35
OBS	8104	7053	7053	8104	7053	7053	7053	7053	7053	8104
Woolridge	0.7	0.00	0.00	0.79	0.00	0.00	0.00	0.00	0.00	0.14
BP	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00
Hausman	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00
X	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

This is a panel data regression analysis based on data of Stock Exchange Listed firms for the time period of 1980-1989, labeled as “Bubble”. b_{TAAV} is the coefficient attributed to the $\frac{(D_{it}^* - D_{it})}{Totalassets_{it}}$ variable, when the firms’ debt target is assumed to be the average of their total debt values for the Bubble period; respectively b_{TAMAS5} is the coefficient attributed to $\frac{(D_{it}^* - D_{it})}{Totalassets_{it}}$ when the firms’ debt target is assumed to be a 5 year moving average of their total debt values for the Bubble period. b_{PO} is the coefficient of the $\frac{DEF_{it}}{Totalassets_{it}}$ factor, where $DEF_{it} = DIV_{it} + X_{it} + \Delta W_{it} - C_{it}$. If the Woolridge test has a value under 0.05 then first order autocorrelation is present and the Xtregar STATA command is utilized. If the BP test is run and has a value under 0.05 then OLS are rejected. If OLS are rejected then the Hausman test is run; if it has a value under 0.05 then fixed effects estimators are used; if not, then random effects are selected. The *test* command (X) was used to formally examine if coefficients are equal to unity ($X \geq 0.05$). *, **, *** denote significance at the 10%, 5% and 1% level respectively. Time dummies accounting for business cycles effects have been added.

Table 4
Horse race bubble period, private firms.

	Debt Issues / Total Assets	Debt Issues / Total Assets	Debt Issues / Total Assets	Change in Debt Ratio	Change in Debt Ratio	Change in Debt Ratio	Debt Issues / Total Assets	Change in Debt Ratio	Debt Issues / Total Assets	Change in Debt Ratio
Constant,	0.0380***	0.0057***	-0.0059***	-0.0164***	-0.0017*	-0.0048***	0.0345***	0.0139***	0.0158***	0.0071***
a										
b_{TAAV}		0.2026***			0.1151***		0.1563***	0.0745***		
b_{TAMAS5}			1.075***			0.5456***			0.7597***	0.2847***
b_{PO}	0.5250***			0.2937***			0.4951***	0.2801***	0.3275***	0.2131***
R²	0.47	0.09	0.57	0.23	0.05	0.26	0.51	0.25	0.73	0.30
OBS	7333	7033	6091	7333	7333	6091	6091	7333	6091	7333
Woolridge	0.06	0.00	0.00	0.148	0.00	0.00	0.00	0.00	0.00	0.00
BP	0.00	0.12	0.00	0.56	0.16	0.00	0.00	0.48	0.00	0.95
Hausman	0.00	N/A	0.00	N/A	N/A	0.00	0.00	N/A	0.00	N/A
X	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

This is a panel data regression analysis based on data of firms that are not listed in any Stock Exchange for the time period of 1980-1989, labeled as “Bubble”. b_{TAAV} is the coefficient attributed to the $\frac{(D_{it}^* - D_{it})}{Totalassets_{it}}$ variable, when the firms’ debt target is assumed to be the average of their total debt values for the Bubble period; respectively b_{TAMAS5} is the coefficient attributed to $\frac{(D_{it}^* - D_{it})}{Totalassets_{it}}$ when the firms’ debt target is assumed to be a 5 year moving average of their total debt values for the Bubble period. b_{PO} is the coefficient of the $\frac{DEF_{it}}{Totalassets_{it}}$ factor, where $DEF_{it} = DIV_{it} + X_{it} + \Delta W_{it} - C_{it}$. If the Woolridge test has a value under 0.05 then first order autocorrelation is present and the Xtregar STATA command is utilized. If the BP test is run and has a value under 0.05 then OLS are rejected. If OLS are rejected then the Hausman test is run; if it has a value under 0.05 then fixed effects estimators are used; if not, then random effects are selected. The *test* command (X) was used to formally examine if coefficients are equal to unity ($X \geq 0.05$). *, **, *** denote significance at the 10%, 5% and 1% level respectively. Time dummies accounting for business cycles effects have been added.

Tables 3 and 4.

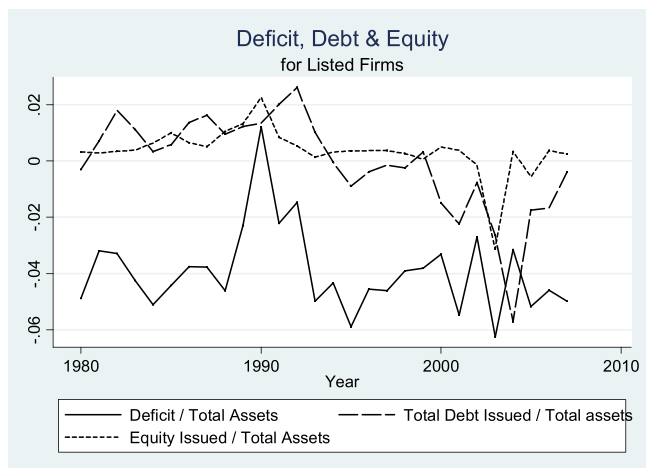
4. Results

In this part of the study we will discuss and comment on the results of the empirical analysis. In Section 4.1 we will report and examine the descriptive statistics for both the public and private firms’ data sets. Sections 4.2-4.5 contain the findings originating from the main regression analysis while Section 4.6 includes the results coming from the tests of statistical power. It should be stated that the empirical analysis was conducted with the use of the STATA statistical software program.

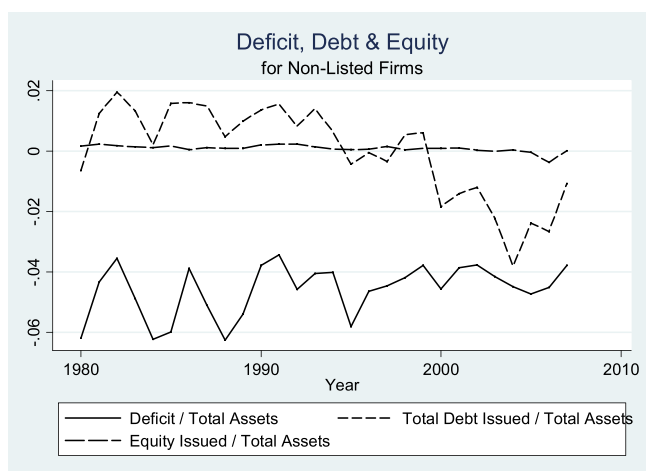
4.1. Descriptive statistics

In Tables 1 and 2 the reader can have a view of the mean values for some of the key factors used in the empirical analysis of this paper. In general the descriptive statistics tell the story of the Japanese economy during the last 30 years. Public and private companies during the 80s experienced high growth rates, profitability and leverage; this growth stalled during the 90s and by the end of that decade a gradual decline commenced. Equity is also shown to be affected from economic conditions; during the monetary expansions of the 80s firms, especially public ones, issue much more equity than the subsequent years.

Of particular interest for this study is the depiction of the funds flow deficit against total debt and equity issued since it will provide us an



Graph 1. Deficit, debt & equity for listed firms.



Graph 2. Deficit, debt & equity for non-listed firms.

initial indication of the effectiveness of the pecking order hypothesis. According to the pecking order hypothesis, and as discussed in Section 2.3, the issuance of total debt should closely follow the funds flow deficit. As is shown in Graphs 1 and 2 this clearly the case for private firms while the results from the public firms sample are also encouraging.

If the pecking order theory fits the data better, the co-efficient for the pecking order hypothesis should ideally be unity. The trade-off theory says that the firms’ debt/assets ratio tends to revert to an optimal level. This optimal level is different for each firm (i.e. each firm has calculated it depending on potential benefits it derives from tax efficiencies). This is simulated in our model by a rolling average. If the coefficient for the trade-off theory is equal to unity then each firm rigidly wants to stay/achieve its optimal capital structure and the trade-off theory is likely to be superior, as it implies that the firm strictly maintains its target debt ratio, as predicted by the trade-off theory. On the other hand, if the coefficient for the trade-off theory significantly differs from 1, it may suggest that the firm is either over-adjusting or under-adjusting its capital structure relative to its optimal target, possibly due to external factors or constraints. Then it would appear that the firm is not adhering to the model’s strict assumption of balancing debt and equity at an optimal level. This could indicate that the trade-off model doesn’t fully explain the firm’s financing behaviour in this instance, potentially indicating that the pecking order theory or other factors are playing a more important role.

4.2. Bubble period

The first sub-sample examined investigates the unprecedented growth period of 1980-1989 (Tables 3–6). The results for public firms are shown in Table 3. On the whole the winner is found to be the 5 year moving average trade-off model either by simply comparing coefficients (when the change of debt is examined: $b_{TAMA5}=0.913 > b_{PO}=0.4202 > b_{TAAV}=0.3063$) or by directly pitting against the pecking order hypothesis in a single regression model. On the other hand the pecking order model appears to be second best, consistently outperforming the trade-off model with the simple historical average.

The findings from the examination of private firms are similar to those reported by the public firms. On the whole the pecking order hypothesis seems to be a better fit for private rather than for public firms (for public firms $b_{PO}=0.4202$ and for private firms $b_{PO}=0.525$). This is in accordance with theory since private companies are expected to face higher informational asymmetry barriers and therefore follow more closely a pecking order as far as their financial policy decisions are concerned. It should also be stated that the 5 year moving average trade-off model breaks down since it reports a coefficient greater than unity while the explanatory power of the simple historical average trade-off model is diminished. Again this a likely result since private companies, that are likely to be financial constrained, are expected to face greater difficulties than their public counterparts in reaching their desired capital structure targets.

Next we will examine the results coming from the size and leverage sub-samples. The results for this regression analysis are shown in Tables 5 and 6. As a further note it should be mentioned that the 5 year moving average trade-off model was excluded from this analysis due to the fact that its estimated coefficients were frequently above unity and thus casting doubts on its validity; this will be discussed in further detail in coming sections of the empirical analysis.

In Table 5 the reader can see that both theories work best for the largest of public firms. The coefficients from small vs. large public companies are: $b_{PO}=0.4144 < b_{PO}=0.6081$ and $b_{TAAV}=0.2035 < b_{TAAV}=0.2291$. The findings for private firms, shown in Table 6, on the other hand show that both theories perform best the smallest of firms. The coefficients from small vs. large private companies are: $b_{PO}=0.5247 > b_{PO}=0.4336$ and $b_{TAAV}=0.8421 > b_{TAAV}=0.3455$. It appears that either the largest or the smallest of companies appear to follow a particular strategy as far as capital structure is concerned; either due to necessity or due to the luxury of being able to devise a strategy. In either case the results clearly show that size is an important factor that must be taken into consideration when “Horse Race” tests are conducted. This conclusion supports the findings of Frank and Goyal (2003).

When the leverage sub-samples are examined it is shown that firms with low leverage levels, public or private, follow the trade-off theory while those with high leverage level follow a pecking order. For example in the public companies data set the coefficients for High vs. Low leveraged firms are: $b_{PO}=0.5514 > b_{PO}=0.1101$ and $b_{TAAV}=0.4787 < b_{TAAV}=0.6829$. This means that the general adversity of a specific firm towards external debt is also another important factor to take into consideration while measuring the performance of capital structure theories.

In order to formally test whether any of the models have coefficients that are statistically equal to unity the *test* command in STATA was applied. The results rejected in every case the null hypothesis. This is not unexpected though since also in the papers of Shyam-Sunder and Myers (1999), Frank and Goyal (2003) none of the models tested ever had a coefficient that was statistically equal to unity. These findings only indicate that neither of the two theories perfectly describes reality, a very high benchmark for any theory.

On the whole the findings from the examination of the land value bubble period indicate that both models performed quite well. Constants are in every single case very close to zero and are statistically significant (in the majority of cases at the 5% level), R^2 reported values are encouraging regarding the efficiency of the models and the coefficient

Table 5
Horse race bubble period, sub-samples, public firms.

	Small Sized	Medium Sized	Large Sized	Low Leverage	Medium Leverage	High Leverage
Constant, a	-0.0016	0.0073***	0.0081***	-0.0146***	0.0106***	0.0210***
b_{TAAV}	0.2035***	0.1851***	0.2291***	0.6829***	0.6688***	0.4787***
R²	0.13	0.09	0.10	0.37	0.39	0.26
OBS	2388	3246	2470	1937	2558	1974
Woolridge	0.02	0.00	0.00	0.00	0.00	0.00
BP	0.45	0.26	0.18	0.02	0.01	0.00
Hausman	N/A	N/A	N/A	0.00	0.00	0.00
X	0.00	0.00	0.00	0.00	0.00	0.00
Constant, a	0.0245***	0.0220***	0.0339***	0.0011	0.0260***	0.0322***
b_{PO}	0.4144***	0.2921***	0.6081***	0.1101***	0.3579***	0.5514***
R²	0.21	N/A	0.45	0.04	0.29	0.37
OBS	2388	3246	2470	2420	3242	2442
Woolridge	0.15	0.33	0.79	0.02	0.93	0.75
BP	0.12	0.00	0.00	0.16	0.02	0.55
Hausman	N/A	0.64	0.00	N/A	0.00	N/A
X	0.00	0.00	0.00	0.00	0.00	0.00

This is a panel data regression analysis based on data for Stock Exchange listed firms for the time period of 1980-1989, labeled as “Bubble”. The dependent variable is issued debt scaled by total assets. b_{TAAV} is the coefficient attributed to the $\frac{(D_{it}^* - D_{it})}{Totalassets_{it}}$ variable, when the firms’ debt target is assumed to be the average of their total debt values for the Bubble period. b_{PO} is the coefficient of the $\frac{DEF_{it}}{Totalassets_{it}}$ factor, where $DEF_{it} = DIV_{it} + X_{it} + \Delta W_{it} - C_{it}$. If the Woolridge test has a value under 0.05 then first order autocorrelation is present and the Xtregar STATA command is utilized. If the BP test is run and has a value under 0.05 then OLS are rejected. If OLS are rejected then the Hausman test is run; if it has a value under 0.05 then fixed effects estimators are used; if not, then random effects are selected. The test command (X) was used to formally examine if coefficients are equal to unity ($X \geq 0.05$)*, **, *** denote significance at the 10%,5% and 1% level respectively. Time dummies accounting for business cycles effects have been added.

Table 6
Horse race bubble period, sub-samples, private firms.

	Small Sized	Medium Sized	Large Sized	Low Leverage	Medium Leverage	High Leverage
Constant, a	-0.0086***	0.0105***	0.0098***	-0.0247***	0.0081***	0.0182***
b_{TAAV}	0.8421***	0.4530***	0.3455***	0.9267***	0.7937***	0.1800***
R²	0.49	0.27	0.18	0.77	0.43	0.04
OBS	1559	2298	1896	1646	2212	1694
Woolridge	0.00	0.02	0.00	0.00	0.00	0.03
BP	0.00	0.00	0.00	0.00	0.00	0.00
Hausman	0.00	0.00	0.00	HF	0.00	0.00
X	0.00	0.00	0.00	0.00	0.00	0.00
Constant, a	0.0346***	0.0402***	0.0339***	0.0127***	0.0355***	0.0433***
b_{PO}	0.5247***	0.4911***	0.4336***	0.1780***	0.4418***	0.4909***
R²	0.47	0.44	N/A	0.214	0.38	0.43
OBS	2058	2946	2329	1646	2212	2230
Woolridge	0.92	0.45	0.63	0.01	0.02	0.26
BP	0.03	0.00	0.00	0.00	0.00	0.00
Hausman	0.00	0.02	0.35	0.00	0.00	0.05
X	0.00	0.00	0.00	0.00	0.00	0.00

This is a panel data regression analysis based on data for firms that are not listed in any Stock Exchange for the time period of 1980-1989, labeled as “Bubble”. The dependent variable is issued debt scaled by total assets. b_{TAAV} is the coefficient attributed to the $\frac{(D_{it}^* - D_{it})}{Totalassets_{it}}$ variable, when the firms’ debt target is assumed to be the average of their total debt values for the Bubble period. b_{PO} is the coefficient of the $\frac{DEF_{it}}{Totalassets_{it}}$ factor, where $DEF_{it} = DIV_{it} + X_{it} + \Delta W_{it} - C_{it}$. If the Woolridge test has a value under 0.05 then first order autocorrelation is present and the Xtregar STATA command is utilized. If the BP test is run and has a value under 0.05 then OLS are rejected. If OLS are rejected then the Hausman test is run; if it has a value under 0.05 then fixed effects estimators are used; if not, then random effects are selected. The test command (X) was used to formally examine if coefficients are equal to unity ($X \geq 0.05$)*, **, *** denote significance at the 10%,5% and 1% level respectively. Time dummies accounting for business cycles effects have been added.

values are within the accepted parameters. Moreover we should mention that in this section, as well as in the ones that will follow, the coefficient values we report are those from the examination of the debt issuance, since this was the dependent variable that was also used by [Shyam-Sunder and Myers \(1999\)](#). For convenience’s sake, coefficients from the examination of leverage are discussed, when it is deemed necessary, but not reported. The reader of course is welcome to visit the tables depicting the findings of this paper for more information.

4.3. Post-bubble period

The second sub-sample covers the 1990-1999 time period that followed after the burst of the land value bubble and was later named as the stagnant growth period. The results of the regression analysis are shown in [Tables 7–10](#).

As far as the results coming from the examination of public firms ([Table 7](#)) the pecking order hypothesis appears to be losing its explanatory power; on the contrary the trade-off models increase their performance. More specifically the reported coefficients have the following

Table 7
Horse race post bubble period, public firms.

	Debt Issues / Total Assets	Debt Issues / Total Assets	Debt Issues / Total Assets	Change in Debt Ratio	Change in Debt Ratio	Change in Debt Ratio	Debt Issues / Total Assets	Change in Debt Ratio	Debt Issues / Total Assets	Change in Debt Ratio
Constant,	0.0151***	0.0026***	0.0014***	0.0065***	0.0032***	0.0026***	0.0115***	0.0079***	0.0059***	0.0046***
a										
b_{TAAV}		0.4110***			0.2471***		0.3242***	0.2126***		
b_{TAMAS}			1.0420***			0.6564***			0.9716***	0.6287***
b_{PO}	0.2770***			0.1401***			0.2135***	0.1141***	0.1067***	0.0463***
R²	N/A	0.19	0.59	N/A	0.12	0.35	0.26	0.15	0.61	0.36
OBS	13272	11820	11820	13272	11820	11820	11820	11820	11820	11820
Woolridge	0.86	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00
BP	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Hausman	0.91	0.00	0.01	0.17	0.00	0.00	0.00	0.00	0.00	0.00
X	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

This is a panel data regression analysis based on data of Stock Exchange Listed firms for the time period of 1990-1998, labeled as “Post Bubble”. b_{TAAV} is the coefficient attributed to the $\frac{(D_{it}^* - D_{it})}{Totalassets_{it}}$ variable, when the firms’ debt target is assumed to be the average of their total debt values for the Post Bubble period; respectively b_{TAMAS} is the coefficient attributed to $\frac{(D_{it}^* - D_{it})}{Totalassets_{it}}$ when the firms’ debt target is assumed to be a 5 year moving average of their total debt values for the Post Bubble period. b_{PO} is the coefficient of the $\frac{DEF_{it}}{Totalassets_{it}}$ factor, where $DEF_{it} = DIV_{it} + X_{it} + \Delta W_{it} - C_{it}$. If the Woolridge test has a value under 0.05 then first order autocorrelation is present and the Xtregar STATA command is utilized. If the BP test is run and has a value under 0.05 then OLS are rejected. If OLS are rejected then the Hausman test is run; if it has a value under 0.05 then fixed effects estimators are used; if not, then random effects are selected. The *test* command (X) was used to formally examine if coefficients are equal to unity ($X \geq 0.05$)*, **, *** denote significance at the 10%,5% and 1% level respectively. Time dummies accounting for business cycles effects have been added.

Table 8
Horse race post bubble period, private firms.

	Debt Issues / Total Assets	Debt Issues / Total Assets	Debt Issues / Total Assets	Change in Debt Ratio	Change in Debt Ratio	Change in Debt Ratio	Debt Issues / Total Assets	Change in Debt Ratio	Debt Issues / Total Assets	Change in Debt Ratio
Constant,	0.0307***	0.0062***	0.0061**	0.0109***	0.0062***	0.0056***	0.0304***	0.0101***	0.0303***	0.0076***
a										
b_{TAAV}		0.0267			0.1212***		0.0084	0.0516***		
b_{TAMAS}			0.058			0.2664***			0.0176	0.2016***
b_{PO}	0.5641***			0.0965***			0.5618***	0.0813***	0.5591***	0.0369***
R²	0.74	0.01	0.03	0.08	0.05	0.12	0.74	0.09	0.74	0.15
OBS	10781	10780	10780	9043	9042	9042	10078	9042	10780	9042
Woolridge	0.62	0.98	0.78	0.01	0.00	0.00	0.58	0.01	0.49	0.01
BP	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Hausman	0.04	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.01	0.00
X	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

This is a panel data regression analysis based on data of firms that are not listed in any Stock Exchange for the time period of 1990-1998, labeled as “Post Bubble”. b_{TAAV} is the coefficient attributed to the $\frac{(D_{it}^* - D_{it})}{Totalassets_{it}}$ variable, when the firms’ debt target is assumed to be the average of their total debt values for the Post Bubble period; respectively b_{TAMAS} is the coefficient attributed to $\frac{(D_{it}^* - D_{it})}{Totalassets_{it}}$ when the firms’ debt target is assumed to be a 5 year moving average of their total debt values for the Post Bubble period. b_{PO} is the coefficient of the $\frac{DEF_{it}}{Totalassets_{it}}$ factor, where $DEF_{it} = DIV_{it} + X_{it} + \Delta W_{it} - C_{it}$. If the Woolridge test has a value under 0.05 then first order autocorrelation is present and the Xtregar STATA command is utilized. If the BP test is run and has a value under 0.05 then OLS are rejected. If OLS are rejected then the Hausman test is run; if it has a value under 0.05 then fixed effects estimators are used; if not, then random effects are selected. The *test* command (X) was used to formally examine if coefficients are equal to unity ($X \geq 0.05$)*, **, *** denote significance at the 10%,5% and 1% level respectively. Time dummies accounting for business cycles effects have been added.

values: $b_{TAMAS}=1.042 > b_{TAAV}=0.4110 > b_{PO}=0.277$. Even when the trade-off and the pecking order models are incorporated in a single regression equation this relationship still holds. The findings for the private companies’ sample (Table 8) though tell a different story. The pecking order hypothesis performs much better ($b_{PO}=0.5641$) and is declared the winner since both trade-off models produce statistically insignificant results.

The examination of the post-bubble period provides us with an early confirmation on the validity of our hypothesis. More specifically it shows that monetary conditions indeed affect the performance of capital structure theories. Furthermore it is also proves that the trade-off and pecking order hypothesis “fit” certain groups of firms better. As an

additional comment it appears that all three models continue to efficiently explain capital structure decisions. Constants are in every single case very close to zero, R^2 are also indicating that the models fit nicely the data at hand given the size, form of the sample and the field investigated. Moreover the coefficient values are within the accepted parameters with the exception of the target adjustment model with a moving average in Table 7 that is larger than unity and thus results in a failure of the model. It should also be stated that, as in the examination of the bubble period, all models are better able to explain the issuance of debt rather than changes in leverage. Finally, the results of the *test* command for once more failed to show that any of the models have coefficients that are statistically equal to unity.

Table 9
Horse race post bubble period, sub-samples, public firms.

	Small Sized	Medium Sized	Large Sized	Low Leverage	Medium Leverage	High Leverage
Constant, a	-0.0009	0.0024***	0.0078***	-0.0219***	-0.0139***	0.0197***
b_{TAAV}	0.3914***	0.5772***	0.5500***	0.8681***	0.9572***	0.3602***
R²	0.19	0.33	0.31	0.54	0.57	0.23
OBS	3376	4621	3542	3284	4329	3970
Woolridge	0.00	0.00	0.00	0.00	0.00	0.00
BP	0.00	0.00	0.00	0.01	0.03	0.14
Hausman	0.00	0.00	0.01	HF	0.00	N/A
X	0.00	0.00	0.00	0.00	0.00	0.00
Constant, a	0.0112***	0.0139***	0.0196***	-0.0014	0.0151***	0.0268***
b_{PO}	0.2369***	0.2871***	0.2777***	0.1938*	0.2443***	0.3049***
R²	0.13	0.18	0.15	0.06	0.14	0.18
OBS	3919	5332	4021	3979	4329	3970
Woolridge	0.25	0.37	0.96	0.00	0.01	0.08
BP	0.22	0.00	0.00	0.96	0.04	0.38
Hausman	N/A	0.00	0.01	N/A	0.00	N/A
X	0.00	0.00	0.00	0.00	0.00	0.00

This is a panel data regression analysis based on data for Stock Exchange listed firms for the time period of 1990-1998, labeled as “Post Bubble”. The dependent variable is issued debt scaled by total assets. b_{TAAV} is the coefficient attributed to the $\frac{(D_{it}^* - D_{it})}{Totalassets_{it}}$ variable, when the firms’ debt target is assumed to be the average of their total debt values for the Post Bubble period. b_{PO} is the coefficient of the $\frac{DEF_{it}}{Totalassets_{it}}$ factor, where $DEF_{it} = DIV_{it} + X_{it} + \Delta W_{it} - C_{it}$. If the Woolridge test has a value under 0.05 then first order autocorrelation is present and the Xtregar STATA command is utilized. If the BP test is run and has a value under 0.05 then OLS are rejected. If OLS are rejected then the Hausman test is run; if it has a value under 0.05 then fixed effects estimators are used; if not, then random effects are selected. The *test* command (X) was used to formally examine if coefficients are equal to unity ($X \geq 0.05$)*, **, *** denote significance at the 10%,5% and 1% level respectively. Time dummies accounting for business cycles effects have been added.

Table 10
Horse race post bubble, sub-samples, private firms.

	Small Sized	Medium Sized	Large Sized	Low Leverage	Medium Leverage	High Leverage
Constant, a	-0.0018	0.0043***	0.0107***	-0.0084***	0.0050***	0.0208***
b_{TAAV}	0.0259	0.3244***	0.5735***	0.0013	0.8585***	1.038***
R²	0.02	0.21	0.30	0.27	0.51	0.60
OBS	3227	4296	2674	3238	3314	3217
Woolridge	0.00	0.00	0.00	0.00	0.00	0.00
BP	0.75	0.36	0.00	0.77	0.00	0.31
Hausman	N/A	N/A	0.00	N/A	0.00	N/A
X	0.00	0.00	0.00	0.00	0.00	0.00
Constant, a	0.0325***	0.0246***	0.0252***	0.0006	0.0276***	0.0413***
b_{PO}	0.6089***	0.3812***	0.3939***	0.1606***	0.4692***	0.6165***
R²	0.87	N/A	N/A	0.14	N/A	N/A
OBS	3227	4296	3258	3238	4326	3217
Woolridge	0.05	0.38	0.01	0.00	0.00	0.48
BP	0.23	0.00	0.00	0.82	0.00	0.01
Hausman	N/A	0.72	0.82	N/A	0.13	0.29
X	0.00	0.00	0.00	0.00	0.00	0.00

This is a panel data regression analysis based on data for firms that are not listed in any Stock Exchange for the time period of 1990-1998, labeled as “Post Bubble”. The dependent variable is issued debt scaled by total assets. b_{TAAV} is the coefficient attributed to the $\frac{(D_{it}^* - D_{it})}{Totalassets_{it}}$ variable, when the firms’ debt target is assumed to be the average of their total debt values for the Post Bubble period. b_{PO} is the coefficient of the $\frac{DEF_{it}}{Totalassets_{it}}$ factor, where $DEF_{it} = DIV_{it} + X_{it} + \Delta W_{it} - C_{it}$. If the Woolridge test has a value under 0.05 then first order autocorrelation is present and the Xtregar STATA command is utilized. If the BP test is run and has a value under 0.05 then OLS are rejected. If OLS are rejected then the Hausman test is run; if it has a value under 0.05 then fixed effects estimators are used; if not, then random effects are selected. The *test* command (X) was used to formally examine if coefficients are equal to unity ($X \geq 0.05$)*, **, *** denote significance at the 10%,5% and 1% level respectively. Time dummies accounting for business cycles effects have been added.

When the factor of size is examined (Tables 9 and 10) the conclusions drawn by the investigation of the post bubble period are different from those drawn from the bubble one. For public companies both theories seem to work best for medium-size firms ($b_{TAAV}=0.5772$, $b_{PO}=0.2871$). For private companies it appears that the trade-off theory works for the largest in size (small firms, $b_{TAAV}=0.0259$; medium firms, $b_{TAAV}=0.3244$; large firms, $b_{TAAV}=0.5735$) while the pecking order hypothesis works best for the smallest ones (small firms, $b_{PO}=0.6089$; medium firms, $b_{PO}=0.3812$; large firms, $b_{PO} =0.3939$). Despite the conflicting data coming from the examination of public companies we can conclude that

so far the pecking order hypothesis consistently performs better for the smaller firms. This is in accordance with its theoretical predictions since smaller firms face more severe information asymmetry barriers.

Contrary to size, the leverage factor (Tables 9 and 10) produces much more consistent results with the bubble period. The pecking order hypothesis fits much better the groups of firms that have high leverage values while it performs the worst for the groups that have the lowest values of leverage. These conclusions are valid for listed and non-listed firms. The coefficients for public companies are: low leverage firms, $b_{PO}=0.1938$; medium leverage firms, $b_{PO}=0.2443$; high leverage firms,

Table 11
Horse race crunch period, public firms.

	Debt Issues / Total Assets	Debt Issues / Total Assets	Debt Issues / Total Assets	Change in Debt Ratio	Change in Debt Ratio	Change in Debt Ratio	Debt Issues / Total Assets	Change in Debt Ratio	Debt Issues / Total Assets	Change in Debt Ratio
Constant,	-0.045***	-0.0342***	-0.0066	-0.0224***	-0.0109*	-0.0029	-0.0602***	-0.0365***	-0.0283***	-0.0317***
a										
b_{TAAV}		0.8301***			0.3344***		0.8105***	00893		
b_{TAMAS}			1.2144***			0.5128***			1.1598***	0.3044
b_{PO}	-0.533***			-0.6365***			-0.4542***	-0.5695*	-0.3451***	-0.5320*
R²	N/A	0.51	0.60	0.39	N/A	0.27	0.64	0.36	0.79	0.45
OBS	10741	9250	10741	9250	10741	9250	9250	10741	9250	10741
Woolridge	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.48	0.01	0.40
BP	0.00	0.00	0.34	0.00	0.00	0.00	0.00	0.00	0.02	0.00
Hausman	0.22	HF	N/A	0.00	0.54	0.00	HF	0.00	HF	0.00
X	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

This is a panel data regression analysis based on data of Stock Exchange Listed firms for the time period of 1999–2007, labeled as “Crunch”. b_{TAAV} is the coefficient attributed to the $\frac{(D_{it}^* - D_{it})}{Totalassets_{it}}$ variable, when the firms’ debt target is assumed to be the average of their total debt values for the Crunch period; respectively b_{TAMAS} is the coefficient attributed to $\frac{(D_{it}^* - D_{it})}{Totalassets_{it}}$ when the firms’ debt target is assumed to be a 5 year moving average of their total debt values for the Crunch period. b_{PO} is the coefficient of the $\frac{DEF_{it}}{Totalassets_{it}}$ factor, where $DEF_{it} = DIV_{it} + X_{it} + \Delta W_{it} - C_{it}$. If the Woolridge test has a value under 0.05 then first order autocorrelation is present and the Xtregar STATA command is utilized. If the BP test is run and has a value under 0.05 then OLS are rejected. If OLS are rejected then the Hausman test is run; if it has a value under 0.05 then fixed effects estimators are used; if not, then random effects are selected. The *test* command (X) was used to formally examine if coefficients are equal to unity ($X \geq 0.05$)*, **, *** denote significance at the 10%,5% and 1% level respectively. Time dummies accounting for business cycles effects have been added.

Table 12
Horse race crunch period, private firms.

	Debt Issues / Total Assets	Debt Issues / Total Assets	Debt Issues / Total Assets	Change in Debt Ratio	Change in Debt Ratio	Change in Debt Ratio	Debt Issues / Total Assets	Change in Debt Ratio	Debt Issues / Total Assets	Change in Debt Ratio
Constant,	-0.0050***	-0.0228***	-0.0078***	-0.0057***	-0.0104***	-0.0051***	-0.0068***	-0.0050***	-0.0010	-0.0030***
a										
b_{TAAV}		0.4662***			0.1668***		0.2955***	0.1320***		
b_{TAMAS}			1.2296***			0.5137***			1.066***	0.4616***
b_{PO}	0.3773***			0.1266***			0.3374***	0.1320***	0.1959***	0.0649***
R²	0.24	0.13	0.55	0.05	0.05	0.22	0.30	0.11	0.61	0.23
OBS	7101	5763	5763	7101	5763	5763	5763	5763	5763	5763
Woolridge	0.34	0.00	0.00	0.60	0.00	0.00	0.00	0.00	0.00	0.00
BP	0.04	0.00	0.00	0.04	0.00	0.00	0.00	0.00	0.00	0.00
Hausman	HF	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
X	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

This is a panel data regression analysis based on data of firms that are not listed in any Stock Exchange for the time period of 1999–2007, labeled as “Crunch”. b_{TAAV} is the coefficient attributed to the $\frac{(D_{it}^* - D_{it})}{Totalassets_{it}}$ variable, when the firms’ debt target is assumed to be the average of their total debt values for the Crunch period; respectively b_{TAMAS} is the coefficient attributed to $\frac{(D_{it}^* - D_{it})}{Totalassets_{it}}$ when the firms’ debt target is assumed to be a 5 year moving average of their total debt values for the Crunch period. b_{PO} is the coefficient of the $\frac{DEF_{it}}{Totalassets_{it}}$ factor, where $DEF_{it} = DIV_{it} + X_{it} + \Delta W_{it} - C_{it}$. If the Woolridge test has a value under 0.05 then first order autocorrelation is present and the Xtregar STATA command is utilized. If the BP test is run and has a value under 0.05 then OLS are rejected. If OLS are rejected then the Hausman test is run; if it has a value under 0.05 then fixed effects estimators are used; if not, then random effects are selected. The *test* command (X) was used to formally examine if coefficients are equal to unity ($X \geq 0.05$)*, **, *** denote significance at the 10%,5% and 1% level respectively. Time dummies accounting for business cycles effects have been added.

$b_{PO} = 0.3049$. The coefficients for private companies are: low leverage firms, $b_{PO} = 0.1606$; medium leverage firms, $b_{PO} = 0.4692$; high leverage firms, $b_{PO} = 0.6165$.

When public companies are examined the trade-off theory model performs best for companies with medium leverage levels. Nevertheless, as in the bubble period sample, it provides much better results for low leverage firms than for high leverage ones.. More specifically the reported coefficients are: low leverage firms, $b_{TAAV} = 0.8681$; medium leverage firms, $b_{TAAV} = 0.9572$; high leverage firms, $b_{TAAV} = 0.3602$. The findings coming from the examination of private firms do not allow us to draw any conclusions since the trade-off model either provides statistically insignificant results or reports a coefficient great than unity. If the coefficient is significantly different from 1, it is not easy to directly

interpret it as a win for the trade-off theory.

4.4. Credit crunch period

The third and final sub-sample examined will be the one covering the 1999–2007 time period during which a credit crunch took place in Japan. The reader can witness the empirical results of this analysis in Tables 11–14.

One of the most important conclusions to be drawn by Table 11 (public companies) is that the pecking order model fails in every single regression since it produces coefficients with negative signs. After a very good performance during the growth period of the 80s and consistent results during the 90s, it appears that the pecking order hypothesis has

Table 13
Horse race crunch period, sub-samples, public firms.

	Small Sized	Medium Sized	Large Sized	Low Leverage	Medium Leverage	High Leverage
Constant, a	-0.0067***	-0.0183***	-0.0185***	-0.0148***	-0.0137***	-0.0043
b_{TAAV}	0.8401***	0.6385***	1.028***	0.6960***	0.0108	0.3015***
R²	0.52	0.33	0.49	0.53	0.01	N/A
OBS	2672	3594	2740	2585	4313	3221
Woolridge	0.00	0.00	0.00	0.00	0.00	0.00
BP	0.00	0.00	0.01	0.00	0.24	0.00
Hausman	HF	0.00	0.03	HF	N/A	0.07
X	0.00	0.00	0.00	0.00	0.00	0.00
Constant, a	-0.0594*	-0.0093***	-0.0032	-0.0017***	-0.0085***	-0.0149***
b_{PO}	-0.6118	0.0851*	0.1641***	0.0250***	0.1094***	0.0753***
R²	0.13	0.02	0.04	0.01	0.03	0.03
OBS	3206	4309	3226	2585	4313	3221
Woolridge	0.02	0.07	0.30	0.00	0.07	0.76
BP	0.10	0.00	0.06	0.00	0.17	0.00
Hausman	N/A	0.00	N/A	HF	N/A	0.00
X	0.00	0.00	0.00	0.00	0.00	0.00

This is a panel data regression analysis based on data for Stock Exchange listed firms for the time period of 1999-2007, labeled as “Crunch”. The dependent variable is issued debt scaled by total assets. b_{TAAV} is the coefficient attributed to the $\frac{(D_{it}^* - D_{it})}{Totalassets_{it}}$ variable, when the firms’ debt target is assumed to be the average of their total debt values for the Crunch period. b_{PO} is the coefficient of the $\frac{DEF_{it}}{Totalassets_{it}}$ factor, where $DEF_{it} = DIV_{it} + X_{it} + \Delta W_{it} - C_{it}$. If the Woolridge test has a value under 0.05 then first order autocorrelation is present and the Xtregar STATA command is utilized. If the BP test is run and has a value under 0.05 then OLS are rejected. If OLS are rejected then the Hausman test is run; if it has a value under 0.05 then fixed effects estimators are used; if not, then random effects are selected. The *test* command (X) was used to formally examine if coefficients are equal to unity ($X \geq 0.05$)*, **, *** denote significance at the 10%,5% and 1% level respectively. Time dummies accounting for business cycles effects have been added.

Table 14
Horse race crunch period, sub-samples, private firms.

	Small Sized	Medium Sized	Large Sized	Low Leverage	Medium Leverage	High Leverage
Constant, a	-0.0357***	-0.0106***	-0.0115***	-0.0224***	-0.0198***	-0.0027
b_{TAAV}	0.6757***	0.4708***	0.5121***	0.9588***	0.1858	0.5976***
R²	0.34	0.24	0.25	0.67	0.03	0.37
OBS	1562	2847	1726	1607	2849	2118
Woolridge	0.00	0.00	0.00	0.00	0.00	0.00
BP	0.00	0.74	0.00	0.00	0.40	0.37
Hausman	0.00	N/A	0.00	0.00	N/A	N/A
X	0.00	0.00	0.00	0.00	0.00	0.00
Constant, a	0.0043	-0.0029	-0.0021	0.0012	-0.0013	0.0034
b_{PO}	0.7814***	0.3087***	0.2907***	0.6686***	0.4270***	0.5107***
R²	0.36	0.15	0.17	0.23	0.25	0.35
OBS	2087	2847	2167	2134	2849	2118
Woolridge	0.59	0.42	0.21	0.00	0.06	0.85
BP	0.94	0.73	0.07	0.85	0.00	0.05
Hausman	N/A	N/A	N/A	N/A	0.00	N/A
X	0.00	0.00	0.00	0.00	0.00	0.00

This is a panel data regression analysis based on data for firms that are not listed in any Stock Exchange for the time period of 1999-2007, labeled as “Crunch”. The dependent variable is issued debt scaled by total assets. b_{TAAV} is the coefficient attributed to the $\frac{(D_{it}^* - D_{it})}{Totalassets_{it}}$ variable, when the firms’ debt target is assumed to be the average of their total debt values for the Crunch period. b_{PO} is the coefficient of the $\frac{DEF_{it}}{Totalassets_{it}}$ factor, where $DEF_{it} = DIV_{it} + X_{it} + \Delta W_{it} - C_{it}$. If the Woolridge test has a value under 0.05 then first order autocorrelation is present and the Xtregar STATA command is utilized. If the BP test is run and has a value under 0.05 then OLS are rejected. If OLS are rejected then the Hausman test is run; if it has a value under 0.05 then fixed effects estimators are used; if not, then random effects are selected. The *test* command (X) was used to formally examine if coefficients are equal to unity ($X \geq 0.05$)*, **, *** denote significance at the 10%,5% and 1% level respectively. Time dummies accounting for business cycles effects have been added.

no explanatory power during the credit crunch. On the other hand, the target adjustment model with a fixed target seems to perform its best when compared with the other two time periods ($b_{TAAV}=0.8301$). The same cannot be said though about the trade-off theory based model with the 5 year rolling target since it consistently fails (coefficient greater than unity) when the dependent variable is issued debt.

Nevertheless the results coming from the examination of the private companies sample are completely different. The pecking order model, despite having significantly decreased coefficients and R^2 than the other two periods still performs quite well ($b_{PO}=0.3773$). The target

adjustment model with a fixed target appears to be performing better than the pecking order model ($b_{TAAV}=0.4662$). Though if both are used simultaneously in an equation, then pecking order is revealed to have slightly more explanatory value ($b_{PO}=0.3374 > b_{TAAV}=0.2955$). The trade-off theory based model with a moving average again breaks down when issued debt is examined.

The findings arising from the examination of the size factor (Tables 13 and 14) are more in line with those reported in Section 4.2. It appears that the pecking order hypothesis works best for either the largest of public companies or the smallest of private firms. The

Table 15
Horse race entire period, public firms.

	Debt Issues / Total Assets	Debt Issues / Total Assets	Debt Issues / Total Assets	Change in Debt Ratio	Change in Debt Ratio	Change in Debt Ratio	Debt Issues / Total Assets	Change in Debt Ratio	Debt Issues / Total Assets	Change in Debt Ratio
Constant,	-0.016	-0.0036**	-0.0051***	-0.012***	-0.0025**	-0.0022***	-0.0290***	-0.0210*	-0.0156*	-0.0202***
a										
b_{TAAV}		0.0380			0.1962***		0.4321***	0.0196		
b_{TAMAS}			1.1796***			0.5011***			1.1597***	0.3519
b_{PO}	-0.3464			-0.4737***			-0.4031***	-0.4052	-0.2679	-0.3795*
R^2	0.06	0.00	0.60	0.25	0.08	0.26	0.29	0.20	0.63	0.34
OBS	32117	32117	32117	30563	30563	30563	30563	32117	32117	32117
Woolridge	0.001	0.00	0.00	0.00	0.00	0.00	0.00	0.34	0.00	0.14
BP	0.35	0.06	0.32	0.00	0.00	0.00	0.00	0.00	0.46	0.00
Hausman	N/A	N/A	N/A	0.00	0.3	0.00	0.00	0.00	N/A	0.00
X	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

This is a panel data regression analysis based on data of Stock Exchange Listed firms for the time period of 1980-2007. b_{TAAV} is the coefficient attributed to the $\frac{(D_{it}^* - D_{it})}{Totalassets_{it}}$ variable, when the firms' debt target is assumed to be the average of their total debt values for the entire period; respectively b_{TAMAS} is the coefficient attributed to $\frac{(D_{it}^* - D_{it})}{Totalassets_{it}}$ when the firms' debt target is assumed to be a 5 year moving average of their total debt values for the entire period. b_{PO} is the coefficient of the $\frac{DEF_{it}}{Totalassets_{it}}$ factor, where $DEF_{it} = DIV_{it} + X_{it} + \Delta W_{it} - C_{it}$. If the Woolridge test has a value under 0.05 then first order autocorrelation is present and the Xtregar STATA command is utilized. If the BP test is run and has a value under 0.05 then OLS are rejected. If OLS are rejected then the Hausman test is run; if it has a value under 0.05 then fixed effects estimators are used; if not, then random effects are selected. The *test* command (X) was used to formally examine if coefficients are equal to unity ($X \geq 0.05$)*, **, *** denote significance at the 10%,5% and 1% level respectively. Time dummies accounting for business cycles effects have been added.

Table 16
Horse race entire period, private firms.

	Debt Issues / Total Assets	Debt Issues / Total Assets	Debt Issues / Total Assets	Change in Debt Ratio	Change in Debt Ratio	Change in Debt Ratio	Debt Issues / Total Assets	Change in Debt Ratio	Debt Issues / Total Assets	Change in Debt Ratio
Constant,	0.0255***	-0.008	-0.0089	0.0058***	-0.0010	-0.0006	0.0250***	0.0051***	0.0238***	0.0025***
a										
b_{TAAV}		0.0295			0.0613***		0.0124	0.0232***		
b_{TAMAS}			0.1475			0.2661***			0.0817	0.2005***
b_{PO}	0.5623***			0.1274***			0.5584***	0.1195***	0.5363***	0.0634***
R^2	0.53	0.02	0.10	0.09	0.02	0.13	0.53	0.12	0.56	0.15
OBS	25215	25214	25214	22878	22877	22877	25214	22877	25214	22877
Woolridge	0.10	0.54	0.31	0.01	0.00	0.00	0.23	0.01	0.98	0.01
BP	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Hausman	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
X	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

This is a panel data regression analysis based on data of firms that are not listed in any Stock Exchange for the time period of 1980-2007. b_{TAAV} is the coefficient attributed to the $\frac{(D_{it}^* - D_{it})}{Totalassets_{it}}$ variable, when the firms' debt target is assumed to be the average of their total debt values for the entire period; respectively b_{TAMAS} is the coefficient attributed to $\frac{(D_{it}^* - D_{it})}{Totalassets_{it}}$ when the firms' debt target is assumed to be a 5 year moving average of their total debt values for the entire period. b_{PO} is the coefficient of the $\frac{DEF_{it}}{Totalassets_{it}}$ factor, where $DEF_{it} = DIV_{it} + X_{it} + \Delta W_{it} - C_{it}$. If the Woolridge test has a value under 0.05 then first order autocorrelation is present and the Xtregar STATA command is utilized. If the BP test is run and has a value under 0.05 then OLS are rejected. If OLS are rejected then the Hausman test is run; if it has a value under 0.05 then fixed effects estimators are used; if not, then random effects are selected. The *test* command (X) was used to formally examine if coefficients are equal to unity ($X \geq 0.05$)*, **, *** denote significance at the 10%,5% and 1% level respectively. Time dummies accounting for business cycles effects have been added.

coefficients for public companies are: small firms, $b_{PO} = -0.6118$; medium firms, $b_{PO} = 0.0851$; large firms, $b_{PO} = 0.1641$. The coefficients for private companies are: small firms, $b_{PO} = 0.7814$; medium firms, $b_{PO} = 0.3087$; large firms, $b_{PO} = 0.2907$. The same applies for the trade-off model when the private companies' sample is examined; it works best for the smallest of companies (small firms, $b_{TAAV} = 0.6757$; medium firms, $b_{TAAV} = 0.4708$; large firms, $b_{TAAV} = 0.5121$). No safe conclusions can be drawn from the results coming from the public companies' sample due to the fact that for one specification the trade-off model exhibits a coefficient greater than unity.

Results relevant to leverage are not as definitive as those reported in previous periods but generally are as expected. In Table 12 it can be seen that the pecking order equation performs best for medium leverage

firms. At the same time though, high leverage firms have a coefficient that is three times that of low leverage ones. More specifically the reported coefficients are: low leverage firms, $b_{PO} = 0.025$; medium leverage firms, $b_{PO} = 0.1094$; high leverage firms, $b_{PO} = 0.0753$. Moreover it should be taken into consideration that the pecking order hypothesis has failed to explain financial policy decisions during the credit crunch for public firms. In the private companies sample the pecking order model once again performs best for those corporations belonging to the high leverage group (low leverage firms, $b_{PO} = 0.6686$; medium leverage firms, $b_{PO} = 0.427$; high leverage firms, $b_{PO} = 0.5107$). As reported in Section 4.2 the explanatory power of the trade-off model is higher for firms, either public or private, with low levels of leverage. For public companies and private companies respectively the results are the

Table 17
Horse race entire period, sub-samples, public firms.

	Small Sized	Medium Sized	Large Sized	Low Leverage	Medium Leverage	High Leverage
Constant, a	-0.0122***	-0.0019***	0.0001*	-0.0245***	0.0001	0.0145***
b_{TAAV}	0.0283	0.0651***	0.2059***	0.3057	0.0148	0.2342***
R²	0.01	0.03	N/A	0.02	0.02	N/A
OBS	9513	12877	9717	9606	12878	9633
Woolridge	0.00	0.00	0.00	0.00	0.00	0.00
BP	0.20	0.13	0.00	0.70	0.91	0.00
Hausman	N/A	N/A	0.24	N/A	N/A	0.79
X	0.00	0.00	0.00	0.00	0.00	0.00
Constant, a	-0.0293	0.0078***	0.0148***	0.4019***	0.0087***	0.0114***
b_{PO}	-0.5193	0.1994***	0.2833***	-0.1150***	0.2031***	0.1508***
R²	0.10	0.09	0.13	0.01	0.10	0.07
OBS	9513	12877	9717	8680	11621	9633
Woolridge	0.00	0.03	0.15	0.00	0.00	0.51
BP	0.32	0.44	0.06	0.02	0.00	0.74
Hausman	N/A	N/A	N/A	0.00	0.03	N/A
X	0.00	0.00	0.00	0.00	0.00	0.00

This is a panel data regression analysis based on data for Stock Exchange listed firms for the time period of 1980-2007. The dependent variable is issued debt scaled by total assets. b_{TAAV} is the coefficient attributed to the $\frac{(D_{it}^* - D_{it})}{Totalassets_{it}}$ variable, when the firms' debt target is assumed to be the average of their total debt values for the entire period. b_{PO} is the coefficient of the $\frac{DEF_{it}}{Totalassets_{it}}$ factor, where $DEF_{it} = DIV_{it} + X_{it} + \Delta W_{it} - C_{it}$. If the Woolridge test has a value under 0.05 then first order autocorrelation is present and the Xtregar STATA command is utilized. If the BP test is run and has a value under 0.05 then OLS are rejected. If OLS are rejected then the Hausman test is run; if it has a value under 0.05 then fixed effects estimators are used; if not, then random effects are selected. The test command (X) was used to formally examine if coefficients are equal to unity ($X \geq 0.05$)*, **, *** denote significance at the 10%,5% and 1% level respectively. Time dummies accounting for business cycles effects have been added.

Table 18
Horse race entire period, sub-samples, private firms.

	Small Sized	Medium Sized	Large Sized	Low Leverage	Medium Leverage	High Leverage
Constant, a	-0.0120***	-0.0013*	0.0035***	-0.0136***	-0.0138***	0.0517***
b_{TAAV}	0.0234	0.2776***	0.1485***	0.0037	0.6867***	0.9834***
R²	0.02	0.16	0.09	0.01	0.32	0.61
OBS	6246	8774	7753	7530	8593	6408
Woolridge	0.00	0.00	0.00	0.00	0.00	0.00
BP	0.19	0.02	0.40	0.55	0.00	0.00
Hausman	N/A	0.00	N/A	N/A	0.00	0.00
X	0.00	0.00	0.00	0.00	0.00	0.00
Constant, a	0.0225***	0.0210***	0.0204***	0.0027***	0.0203***	0.0356***
b_{PO}	0.5836***	0.3912***	0.3779***	0.1019***	0.4728***	0.5959***
R²	0.73	0.30	N/A	0.07	0.36	N/A
OBS	7372	10089	7754	6458	8594	7565
Woolridge	0.20	0.20	0.79	0.00	0.00	0.51
BP	0.00	0.00	0.00	0.00	0.00	0.00
Hausman	0.03	0.00	0.38	HF	0.00	0.08
X	0.00	0.00	0.00	0.00	0.00	0.00

This is a panel data regression analysis based on data for firms that are not listed in any Stock Exchange for the time period of 1980-2007. The dependent variable is issued debt scaled by total assets. b_{TAAV} is the coefficient attributed to the $\frac{(D_{it}^* - D_{it})}{Totalassets_{it}}$ variable, when the firms' debt target is assumed to be the average of their total debt values for the entire period. b_{PO} is the coefficient of the $\frac{DEF_{it}}{Totalassets_{it}}$ factor, where $DEF_{it} = DIV_{it} + X_{it} + \Delta W_{it} - C_{it}$. If the Woolridge test has a value under 0.05 then first order autocorrelation is present and the Xtregar STATA command is utilized. If the BP test is run and has a value under 0.05 then OLS are rejected. If OLS are rejected then the Hausman test is run; if it has a value under 0.05 then fixed effects estimators are used; if not, then random effects are selected. The test command (X) was used to formally examine if coefficients are equal to unity ($X \geq 0.05$)*, **, *** denote significance at the 10%,5% and 1% level respectively. Time dummies accounting for business cycles effects have been added.

following (High vs. Low leverage firms): $b_{TAAV} = -0.3015 < b_{TAAV} = 0.696$ and $b_{TAAV} = 0.5976 < b_{TAAV} = 0.9588$.

4.5. Total SAMPLE

Having analyzed Each of the three sub-samples in the previous sections, this part of the regression analysis will end with the examination of the sample covering the 1980-2007 time period. The reader can view the results of this analysis in Tables 15–18.

For the public firms sample our findings show that the pecking order

hypothesis model fails to interpret the firms' capital structure decisions by reporting coefficients with a negative sign. If a thorough analysis of periods of different monetary conditions had not been made the reader would have immediately rejected the pecking order hypothesis. This would have resulted in a serious loss of information. As it seems, the results reported in Table 15 are severely influenced by the credit crunch period of 1999-2007. The pecking order hypothesis appears not to work when a monetary tightening takes place. This should not be puzzling; during a credit crunch even if a firm has a positive deficit, it could simply not be able to receive credit or be forced to issue equity. During an

Table 19
Tests of statistical power, public firms.

	Bubble Period Pecking Order Simulated Data	Bubble Period Target Adjustment Simulated Data	Post Bubble Period Pecking Order Simulated Data	Post Bubble Period Target Adjustment Simulated Data	Crunch Period Pecking Order Simulated Data	Crunch Period Target Adjustment Simulated Data
Constant,	-0.0414***		-0.0380***		-0.0446***	
a						
b_{TAAV}	0.0943***		0.2114***		-0.0354	
R^2	0.02		0.05		0.00	
OBS	8104		13272		10741	
Woolridge	0.84		0.31		0.13	
BP	0.00		0.79		0.00	
Hausman	0.00		N/A		0.00	
X	0.00		0.00		0.00	
Constant,		-0.0092***		-0.0068***		0.0032***
a						
b_{PO}		-0.0003		-0.0049***		0.0095***
R^2		0.00		0.00		0.03
OBS		7053		11820		10741
Woolridge		0.02		0.00		0.00
BP		0.02		0.00		0.00
Hausman		0.00		0.00		0.00
X		0.00		0.00		0.00
F	Bubble Period	Post-Bubble Period	Crunch Period	Entire Period		
	0.00	0.00	0.00	0.00		

This is a panel data regression analysis based on data of Stock Exchange Listed firms. The dependent variable is issued debt scaled by total assets. b_{TAAV} is the coefficient attributed to the $\frac{(D_{it}^* - D_{it})}{Totalassets_{it}}$ variable, when the firms' debt target is assumed to be the average of their total debt values for the Bubble, Post Bubble, or Crunch period. b_{PO} is the coefficient of the $\frac{DEF_{it}}{Totalassets_{it}}$ factor, where $DEF_{it} = DIV_{it} + X_{it} + \Delta W_{it} - C_{it}$. Two sets of simulated panel data for total debt values were created based on the pecking order hypothesis and the target adjustment model with a fixed target for each of the Bubble, Post bubble and Crunch Period. If the Woolridge test has a value under 0.05 then first order autocorrelation is present and the Xtregar STATA command is utilized. If the BP test is run and has a value under 0.05 then OLS are rejected. If OLS are rejected then the Hausman test is run; if it has a value under 0.05 then fixed effects estimators are used; if not, then random effects are selected. The *test* command (X) was used to formally examine if coefficients are equal to unity ($X \geq 0.05$)*, **, *** denote significance at the 10%,5% and 1% level respectively. Time dummies accounting for business cycles effects have been added. The Fisher type test (F) was used to examine if the real total debt values exhibit mean reversion; if it has a value under 0.05 then the null hypothesis of a unit root is rejected and the series is stationary.

economic expansion firms generally have an easier time of obtaining leverage and therefore financial managers are free to follow a pecking order.

As far as the trade-off theory is concerned the best choice seems to be the trade-off model with a fixed target. The reason for this is that the 5-year rolling target model throughout our analysis has outperformed its fixed target equivalent as many times as it has reported coefficients greater than unity and has thus broke down. This is also the case for this section since when the issuance of debt is examined again the rolling target model contradicts the theoretical predictions of the pecking order theory. Therefore the fixed target model is a much more reliable option despite having lower coefficients and R^2 values. It performs adequately when leverage changes are examined ($b_{TAAV}=0.1962$) but it produces statistically insignificant results when the issuance of debt is the dependent variable.

Our overall results from the entire time period examined but also from the sub-periods indicate that generally the trade-off theory, with the exception of when an economic boom, and hence credit expansion, is taking place, is better able to explain the capital structure decisions of public companies than the pecking order hypothesis. From a theoretical point view this can be justified since public companies have the resources to actually set debt targets and move towards them. Moreover due to the fact that their listing requirements force them to publish a large volume of information public companies face significantly lower informational asymmetry barrier thus rendering the pecking order hypothesis less relevant for them.

On the other hand when private companies are examined the results are more in favor of the pecking order hypothesis. In consistency with the findings shown in the previous sections the pecking order model generally performs much better for private companies ($b_{PO}=0.5623$). In Table 16 it is shown that in almost every single specification the pecking

order model outperforms either of the trade-off models. Moreover when the issuance of debt is examined both trade-off models report statistically insignificant results. As we discussed earlier this was to be expected since due to informational asymmetries, private firms have much fewer options of obtaining external finance than their listed counterparts.

The results reported from the analysis of the entire sample are generally in accordance with those depicted in Sections 4.2–4.4. It is clear from the results reported in Tables 17 and 18 that both size and leverage are factors that should be taken into consideration when either of the two theories of capital structure is examined.

Generally the pecking order hypothesis for once more is shown to perform best for the largest of public companies and the smallest of private companies. The coefficients for public companies are: small firms, $b_{PO}=-0.5193$; medium firms, $b_{PO}=0.1994$; large firms, $b_{PO} =-0.2833$. The coefficients for private companies are: small firms, $b_{PO}=0.5836$; medium firms, $b_{PO}=0.3912$; large firms, $b_{PO} =-0.3779$. The trade-off model is proven to work best for the largest of companies despite them being public or private; this should be taken with a pinch of salt since some findings are statistically insignificant. The coefficients for public companies are: small firms, $b_{TAAV}=0.0283$; medium firms, $b_{TAAV}=0.0651$; large firms, $b_{TAAV}=0.2059$. The coefficients for private companies are: small firms, $b_{TAAV}=0.0234$; medium firms, $b_{TAAV}=0.2776$; large firms, $b_{TAAV}=0.1485$. Overall the results coming from the examination of public companies, from all sections, show that the trade-off theory is best able to explain the financial policy decisions of large firms. The findings from the private firms sample are rather inconclusive but this is not surprising given the fact that the trade-off theory has a diminished explanatory power for this group of firms.

On the whole, the examination of leverage produced clear results for the pecking order model. Whether public or private companies are examined the pecking order hypothesis works better for firms that have

Table 20
Tests of statistical power, private firms.

	Bubble Period Pecking Order Simulated Data	Bubble Period Target Adjustment Simulated Data	Post Bubble Period Pecking Order Simulated Data	Post Bubble Period Target Adjustment Simulated Data	Crunch Period Pecking Order Simulated Data	Crunch Period Target Adjustment Simulated Data
Constant,	-0.05400***		-0.0432***		-0.0406***	
a						
b_{TAAV}	0.1910***		0.0390***		0.1736***	
R^2	0.02		0.01		0.02	
OBS	6091		10780		7101	
Woolridge	0.00		0.32		0.73	
BP	0.00		0.59		0.04	
Hausman	0.00		N/A		0.00	
X	0.00		0.00		0.00	
Constant,		-0.0087***		-0.0015***		0.0009***
a						
b_{PO}		-0.0034***		-0.0041***		-0.0033***
R^2		0.00		0.02		0.01
OBS		6091		9042		5763
Woolridge		0.00		0.00		0.00
BP		0.00		0.00		0.00
Hausman		0.00		0.02		HF
X		0.00		0.00		0.00
	Bubble Period	Post-Bubble Period	Crunch Period	Entire Period		
F	0.00	0.00	0.00	0.00		

This is a panel data regression analysis based on data of non Stock Exchange Listed firms. The dependent variable is issued debt scaled by total assets. b_{TAAV} is the coefficient attributed to the $\frac{(D_{it}^* - D_{it})}{Totalassets_{it}}$ variable, when the firms' debt target is assumed to be the average of their total debt values for the Bubble, Post Bubble, or Crunch period. b_{PO} is the coefficient of the $\frac{DEF_{it}}{Totalassets_{it}}$ factor, where $DEF_{it} = DIV_{it} + X_{it} + \Delta W_{it} - C_{it}$. Two sets of simulated panel data for total debt values were created based on the pecking order hypothesis and the target adjustment model with a fixed target for each of the Bubble, Post bubble and Crunch Period. If the Woolridge test has a value under 0.05 then first order autocorrelation is present and the Xtregar STATA command is utilized. If the BP test is run and has a value under 0.05 then OLS are rejected. If OLS are rejected then the Hausman test is run; if it has a value under 0.05 then fixed effects estimators are used; if not, then random effects are selected. The test command (X) was used to formally examine if coefficients are equal to unity ($X \geq 0.05$); *, **, *** denote significance at the 10%, 5% and 1% level respectively. Time dummies accounting for business cycles effects have been added. The Fisher type test (F) was used to examine if the real total debt values exhibit mean reversion; if it has a value under 0.05 then the null hypothesis of a unit root is rejected and the series is stationary.

high leverage rather than for those that have low leverage. For public companies and private companies respectively the results are the following (High vs. Low leverage firms): $b_{PO}=0.1508 > b_{PO}=-0.115$ and $b_{PO}=0.5959 > b_{PO}=0.1019$. For the trade-off model our findings show that, contrary to the pecking order hypothesis, it performs better for low leverage companies; this is in accordance with the results shown in previous sections. For the public firms sample for High vs. Low leverage companies the results are: $b_{TAAV}=0.2342 < b_{TAAV}=0.3057$. Nevertheless the results coming from the private firm sample contradict the previous sub-sample findings since they show that the trade-off model performs best for high leverage companies (High vs. Low leverage firms; $b_{TAAV}=0.9834 > b_{TAAV}=0.0037$).

Even though the findings on size or leverage factors do not provide us with a definitive conclusion, they clearly show that both of them must be taken into account when capital structure theory is examined. At the very least though it is safe to conclude that the pecking order hypothesis generally performs better for high leverage companies and for either the largest or the smallest sized firms. These findings have theoretical appeal. High leverage firms could not have been able, for various reasons, to issue equity and thus are only able to rely on internal finance and debt; the smallest of firms are likely to be severely financially constrained and thus forced to follow a pecking order. For the trade-off model it is more or less safe to conclude that financially conservative firms with low levels of leverage, probably due to an internal stringent managerial protocol common in some Japanese firms, prefer to set specific debt targets. Finally it can also be concluded that the trade-off model performs better for the largest of firms; this was an outcome to be expected since the largest of firms can achieve their desired capital structure more easily.

4.6. Tests of statistical power

Here we examine the statistical power of the models examined in the previous sections of the empirical analysis. The methodology that was followed for the applications of these tests was described in Section 2.5 and the results are shown in Tables 19 and 20. Since the 5 year moving average trade-off model reported failures for a large number of specifications it was the fixed target model was pitted against the pecking order model. Furthermore to ensure the robustness of our results all sub-periods as well as the entire 1980-2007 were examined.

Our findings are in accordance with those of Shyam-Sunder and Myers (1999). More specifically it is shown that for either the public or private companies sample the target-adjustment model was able to explain the data set was simulated according to the pecking order hypothesis by reporting positive and significant coefficients albeit its low R^2 values. This indicated that the positive and significant coefficients reported by the target-adjustment model were due to the fact that debt ratios exhibit mean reversion. This of course meant that companies were not issuing or retiring debt according to the trade-off theory. The mean reverting nature of debt ratios led the target-adjustment model to generate spuriously good fits without this to have anything to do with targets of optimal capital structure.

In order to formally examine this the Fisher type (Choi, 2001), a unit root test, based on the augmented Dickey-Fuller test, was run through the use of the *xtunitroot* STATA command. The Fisher type test was selected over the Levin-Lin-Chu (2002) and Harris-Tzavalis (1999) tests because the latter require a balanced panel data-set. The results showed that indeed debt ratios, for either public or private firms, are stationary since the null hypothesis of a unit root is rejected in every case. This only confirmed the suspicious failures of the target-adjustment models (larger than unity coefficients) throughout the examined periods.

On the other hand in every single examined period the pecking order equation is rejected by the trade-off data set while the target-adjustment model is able to provide a good fit for the pecking order data set. These findings re-affirm the validity of the pecking order model.

Further robustness tests are reported in the Appendix.

5. Conclusion

Botta and Colombo's (2022) study has clarified that the dynamics of capital structure determination are complex and non-linear. This calls for careful consideration of different aspects of this complex process. Our approach is to examine the case of an important industrialised nation with a large and diverse number of companies, over a long time period, to highlight in particular the role of the economic growth environment (two decades of very high economic growth vs. stagnation, vs. credit crunch), including the monetary policy environment, and also the dimension of low vs. high leverage companies/industries in an attempt to gather further relevant data that may help in highlighting particular aspects of Botta and Colombo's complex tapestry of corporate finance.

We are able to conduct a horse race test between the two main theories of capital structure, the trade-off and the pecking order hypothesis, for the country of Japan. This paper makes a contribution to science by being the first study of its kind to take into consideration how monetary conditions and a number of other factors affect the performance of the two theories.

It was for this reason that the country of Japan was selected due to its severe fluctuations of its economy during the last 30 years. In order to study these changes more closely our empirical analysis was run for the entire 1980-2007 time period but was also further divided into three sub-categories each covering a period of different monetary conditions. The three periods were: the land value bubble of the 80s, a period of unprecedented economic growth; the stagnant growth period of the 90s, and the credit crunch of the 00s.

This study also examines how these two aforementioned theories "fit" different groups of firms. In order to achieve this, a large panel dataset, containing both public and private Japanese companies, was constructed. Firms were initially divided into public and private since it is generally accepted that these two groups in terms of size but also more importantly according to the informational asymmetry barriers they face. These two main data-sets were also further divided into further sub-samples according to leverage and size.

The methodology this paper followed was inspired by the seminal studies of Shyam-Sunder and Myers (1999) and Frank and Goyal (2009). The findings of the main empirical analysis show that during periods of economic growth there is an increase of performance for the pecking order model and a decrease of performance for the trade-off model while the opposite holds for periods of stagnation and monetary contraction. Based on the theoretical background of these two theories these results are not surprising. During periods of rapid expansion the firms' capital structure targets change at a rapid pace thus rendering the trade-off theory ineffective. Nevertheless when the economy stagnates or slightly contracts then, on the whole, the firms' debt targets remain for the most part unaffected and thus companies move towards them. On the other hand the pecking order hypothesis is also expected to work better during periods of economic boom when credit flows freely and thus companies are less likely to be credit rationed and thus obtain external finance and vice versa during the bust phase of the economic cycle.

The other major finding of this study is the fact that the trade-off theory appears to work best for public companies while the pecking order hypothesis works best for private companies. This is again in accordance with the theoretical prediction of the two theories. The information asymmetry-based pecking order hypothesis is expected to work better for private, smaller companies that face more restrictions than their public counterparts. Public firms are likely to have an easier time in setting specific capital structure goals and be able to move

towards them as the trade-off theory predicts. Nevertheless when an alternative definition of the pecking order hypothesis, taking the issuance of external equity into consideration, is used the pecking order hypothesis outperforms its competitor. Therefore even in the scenario of bad economic conditions the dominance of the trade-off theory, as far as public firms are concerned, is under dispute.

Nevertheless the statistical power robustness tests of this study cast serious doubts on the validity of the trade-off model's results. The trade-off theory model was able to explain a simulated data set in which the financial policy decisions were solely based on the pecking order hypothesis. Its provision of a good fit for the data showed that its results were a false positive. This leads us to believe that the mean reverting nature of debt ratios led the target-adjustment model to generate spuriously good fits. Capital structure targets did not have anything to do with the good results provided by the trade-off model. Conversely the pecking order model failed to explain the simulated data set based on the trade-off theory and thus re-affirmed its validity.

Results from the examination of the size and leverage factors are not as definitive as those produced from our main empirical analysis but still indicate that these two factors must be taken into consideration when capital structure theories are examined. Generally it is shown that the pecking order hypothesis performs better for high leverage companies and for either the largest or the smallest sized of firms. Our understanding of these findings is that high leverage firms are not able, for various reasons, to issue equity and thus are only able to rely on internal finance and debt while the size factor results, as we discussed earlier, are one more indicator of financial constraints that are one of the driving forces behind the pecking order hypothesis. Trade-off theory is shown to work best for companies that have low leverage levels and are of large size. It could be the case that low leverage firms due to internal stringent managerial protocol prefer to set specific debt targets while, as we discussed earlier, one of the trade-off theory's predictions is that large sized companies should be the ones most able to move towards their optimal capital structure.

Concluding we would like to point out that the findings of this study have important policy implications for the research area of capital structure. More specifically this paper proves that monetary conditions, the informational asymmetry barriers and financial constraints that different groups of firms face must be taken into consideration before either of the two main theories of capital structure are applied. Moreover it could also be the case that the current stalemate between the trade-off and the pecking order hypothesis is due to the fact that the majority of capital structure studies have not taken these aforementioned factors into account. Finally, we believe that further research on this topic is necessary, considering the relevance of monetary conditions, as well as other economic events, also in the case of other countries, in order to understand the explanatory power of capital structure theories and to enhance our understanding of financial policy decisions.

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The authors state that they have no conflict of interest.

CRediT authorship contribution statement

Konstantinos Voutsinas: Writing – original draft, Investigation, Formal analysis, Data curation. **Richard A. Werner:** Writing – review & editing, Validation, Supervision, Project administration, Methodology, Conceptualization.

Table 21
Robustness tests – alternative definition of deficit, public firms.

	Bubble Period	Bubble Period	Post Bubble Period	Post Bubble Period	Crunch Period	Crunch Period	Entire Period	Entire Period
	Debt Issues / Total Assets	Debt Issues / Total Assets	Debt Issues / Total Assets	Debt Issues / Total Assets	Debt Issues / Total Assets	Debt Issues / Total Assets	Debt Issues / Total Assets	Debt Issues / Total Assets
Constant, a	-0.0108***	-0.0085***	0.0017***	0.0015***	-0.0038	-0.0105***	-0.0030***	-0.0042***
b_{TAAV}		0.1632***		0.2143***		0.7464***		0.2007***
b_{PO}	0.4216***	0.3978***	0.4662***	0.4146***	0.4944***	0.1146***	0.4754***	0.4167***
R^2	N/A	0.41	0.44	0.49	0.42	0.56	0.44	0.47
OBS	8104	7053	11820	11820	9250	9250	30563	30563
Woolridge	0.08	0.00	0.00	0.00	0.00	0.00	0.00	0.00
BP	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Hausman	0.08	0.00	0.01	0.00	0.00	0.02	0.00	0.02
X	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

This is a panel data regression analysis based on data of Stock Exchange Listed firms for the time period of 1980-1989, labeled as “Bubble”. b_{TAAV} is the coefficient attributed to the $\frac{(D_{it}^* - D_{it})}{Totalassets_{it}}$ variable, when the firms’ debt target is assumed to be the average of their total debt values for the Bubble period; respectively b_{TAMA5} is the coefficient attributed to $\frac{(D_{it}^* - D_{it})}{Totalassets_{it}}$ when the firms’ debt target is assumed to be a 5 year moving average of their total debt values for the Bubble period. b_{PO} is the coefficient of the $\frac{DEF_{it}}{Totalassets_{it}}$ factor, where $DEF_{it} = DIV_{it} + X_{it} + \Delta W_{it} - C_{it}$. If the Woolridge test has a value under 0.05 then first order autocorrelation is present and the Xtregar STATA command is utilized. If the BP test is run and has a value under 0.05 then OLS are rejected. If OLS are rejected then the Hausman test is run; if it has a value under 0.05 then fixed effects estimators are used; if not, then random effects are selected. The *test* command (X) was used to formally examine if coefficients are equal to unity ($X \geq 0.05$). *, **, *** denote significance at the 10%,5% and 1% level respectively. Time dummies accounting for business cycles effects have been added.

Table 22
Robustness tests – alternative definition of deficit, private firms.

	Bubble Period	Bubble Period	Postbubble Period	Postbubble Period	Crunch Period	Crunch Period	Entire Period	Entire Period
	Debt Issues / Total Assets	Debt Issues / Total Assets	Debt Issues / Total Assets	Debt Issues / Total Assets	Debt Issues / Total Assets	Debt Issues / Total Assets	Debt Issues / Total Assets	Debt Issues / Total Assets
Constant, a	0.002	0.0003	0.0031***	0.0027*	-0.0116***	-0.0112***	-0.0022*	-0.0026*
b_{TAAV}		0.1731***		0.0186		0.2163***		0.0180
b_{TAMA5}								
b_{PO}	0.3567***	0.368***	0.4982***	0.4952***	0.3598***	0.3462***	0.4819***	0.4786***
R^2	0.32	0.39	0.48	0.49	0.42	0.45	N/A	N/A
OBS	7333	6091	10780	10780	7101	5763	25214	25214
Woolridge	0.733	0.00	0.34	0.60	0.08	0.00	0.20	0.16
BP	0.02	0.00	0.00	0.00	0.01	0.00	0.00	0.00
Hausman	0.00	0.00	0.00	0.00	0.00	0.00	0.71	0.53
X	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

This is a panel data regression analysis based on data of firms that are not listed in any Stock Exchange for the time period of 1980-2007. b_{TAAV} is the coefficient attributed to the $\frac{(D_{it}^* - D_{it})}{Totalassets_{it}}$ variable, when the firms’ debt target is assumed to be the average of their total debt values for the entire period; respectively b_{TAMA5} is the coefficient attributed to $\frac{(D_{it}^* - D_{it})}{Totalassets_{it}}$ when the firms’ debt target is assumed to be a 5 year moving average of their total debt values for the entire period. b_{PO} is the coefficient of the $\frac{DEF_{it}}{Totalassets_{it}}$ factor, where $DEF_{it} = DIV_{it} + X_{it} + \Delta W_{it} - C_{it}$. If the Woolridge test has a value under 0.05 then first order autocorrelation is present and the Xtregar STATA command is utilized. If the BP test is run and has a value under 0.05 then OLS are rejected. If OLS are rejected then the Hausman test is run; if it has a value under 0.05 then fixed effects estimators are used; if not, then random effects are selected. The *test* command (X) was used to formally examine if coefficients are equal to unity ($X \geq 0.05$). *, **, *** denote significance at the 10%,5% and 1% level respectively. Time dummies accounting for business cycles effects have been added.

Appendix

Robustness Tests

The results from the robustness tests shown in Table 21 shows that, in every single specification run for the public firm data set, the pecking order model using the alternative definition of the firms’ funds flow deficit performs just as good as, or better than the original model. Furthermore, with the exception of the credit crunch period, the pecking order model significantly outperforms the trade-off model. These findings are extremely important since they not only re-affirm the validity of the selected pecking order model used but also complement the results

coming from the examination of the post-bubble and the credit crunch periods where the pecking order model broke down. These results show that during these economic turbulent periods firms continue to follow a pecking order but, as predicted by the theory itself, are forced to rely (to the extent that it is possible) on external equity.

On the other hand results arising from the examination of the private firm sample, shown in Table 22, simply re-affirm the validity of the original findings. This is not unexpected since private firms are unlikely to use external equity for their financing needs in the first place.

Data availability

Data can be made available on request.

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