Pecking Order and Trade-off

Explanations of Capital Structure

and

The Maturity Structure of Corporate

Debt Obligations

by

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ABSTRACT

The aim of this thesis is to provide new solutions and outcomes to the over- and under-investment problems and the information asymmetry that motivates the pecking order theory. By extending the original models, it is shown that i) the under-investment problem is caused by the debt-equity mix of the financing rather than the investment itself and this problem can be resolved by a post-investment adjustment in capital structure – a simpler than reducing debt maturity (as in Myers (1977)) or gearing; ii) transfers in value from debt-holders to shareholders to promote over-investment are not sustainable since investors will seek to avoid being disadvantaged by demanding higher returns, greater restrictions on the company or both; iii) information asymmetry can be managed using bridge financing and other techniques in ways that remove the rationale for the pecking order theory; and iv) managers have incentives to engage in empire building which is facilitated by a capital structure that reflects the degree of concentration among the other companies in the sector: faced with a low (high) degree of concentration, companies have lower (higher) gearing.

These outcomes are empirically investigated using an extensive sample and robust estimating procedures providing strong support for the hypotheses tested.

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CONTENTS

TABLES

CHAPTER 1 INTRODUCTION

1.1 Research background

This thesis examines four situations in which conflicts between company stakeholders arise. These conflicts give rise to agency costs that can damage the interests of shareholders and/or debt-holders but at the same time benefit a different group of stakeholders. The circumstances in which these conflicts arise are related to changes in capital structure associated with an investment opportunity. Changes in capital structure can occur when an investment is financed depending on the mix of debt and equity and such changes can disadvantage existing shareholders (and benefit new shareholders) or benefit existing debt-holders at the expense of shareholders. Management need to manage capital structure ways that address the conflicts that arise with the objective of protecting existing shareholders. However, one of the conflicts that arise is between managers and shareholders, so the management of capital structure may not address all conflicts.

Changes in capital structure can cause transfers in value between debt-holders and shareholders as in the under-investment problem. However, traditional views of capital structure suggest long-run stability in gearing, but more recent research suggests that stability is not a comprehensive explanation and that there are dynamic aspects associated with capital structure.

DeAngelo and Roll (2015) suggest that capital structure is not stable, and that stability is the exception rather than the rule. They suggest that factors that affect gearing can vary over time and so make the process of explaining capital structure behaviour more difficult or that capital structure is of second-order importance and is determined as a residual. These results contrast with Lemmon, Roberts and Zender (2008) who report capital structures that are stable over long periods and that the major part of variation is time-invariant. Similarly, Frank & Goyal (2009) observe that gearing is stationary over the long-term. Graham, Leary and Roberts (2015) document a century of "relatively stable" capital structure in the US.

Baker and Wurgler (2002) examine market timing issues and present evidence that companies time issues of debt to minimise their borrowing costs concluding that capital structure at any point in time reflects the cumulative result of past attempts to exploit market levels and that such effects persist for a decade. The ability of managers to time market decisions is questioned by the efficient market hypothesis and by Berlin (2006). Butler, Grullon and Westen (2006) point out that after adjusting for a structural shift in US monetary and fiscal policy in the 1980s, there is no evidence that managers can time debt issues. Contrary to Baker and Wurgler (2002), Hovakimian (2006) found that while equity transactions may be timed to exploit favourable market conditions, such transactions did not have significant long-lasting effects on capital structure.

A different approach in capital structure research has been to recognise that firms may deviate from a target capital structure from time to time but then revert to the target. The speed of adjustment to the target has been examined in Leary and Roberts (2005). They included the idea of adjustment costs being a factor in the process of rebalancing capital structure and conclude that firms actively rebalance their gearing within an optimal range. However, Hovakimian and Li (2012) suggest that the speed of adjustment is not a meaningful measure of the importance of target gearing ratios.

The choice of capital structure is also influenced by the company's position in the sector in which it operates. Leary and Roberts (2011) show that firms make financing decisions by responding to the financing decisions of their peers. This thesis identifies a new factor that affects capital structure – the ambition of the firm to make acquisitions.

Graham and Leary (2011) analyse variations in gearing noting that approximately 60% of gearing variation is cross-sectional and that the majority is across firms within a given industry rather than between industries, consistent with MacKay and Phillips (2005). Intra-industry gearing variation is twice as large as inter-industry variation for market-based gearing and three times as large for book value-based gearing. They also suggest that there "likely" is no single theory to explain capital structure for all firms but that, given the wide range of factors that affect gearing, the challenge is to distinguish first-order importance from second-order importance. They also comment that there are factors which hold weakly in broad panels but strongly in narrow samples.

An example of such a factor is reported in Cooper and Lambertides (2016) which documents a positive relationship between gearing and dividend payouts (in a narrow sample) which contrasts with previously documented negative relationships (in broad panels). The theme in the narrower sample used by Cooper and Lambertides (2016) is that large dividend increases are being used as a signal and that an associated increase in gearing is a further signal of firm quality: the sample is restricted to the narrow sample of large dividend increases. They relate their results to DeAngelo and Roll (2015) who suggest that gearing variation can be caused by a time-varying capital structure target or by a wide range around a target.

These results suggest a context in which capital structure can vary over time, reflecting targets that are flexible and that there can be deviations from target from time to time. The ideas discussed in this thesis are consistent with this context in which dynamic adjustments to capital structure are contemplated.

1.2 Research problems

Four problem areas in which conflicts between stakeholders arise are considered in this thesis: the under-investment problem as described in Myers (1977); the over-investment problem (or asset substitution problem) as described in Jensen and Meckling (1976); the pecking order theory as described in Myers (1984) and Myers and Majluf (1984); and the agency costs associated with managers in relation to their preferred capital structure.

The first problem area, the under-investment problem, can arise when a company acquires an investment opportunity with a positive net present value which benefits both the shareholders and the debt-holders. Any benefit obtained by the debt-holders will be at the expense of the shareholders. If the transfer of value to the debt-holders is large, what remains for the shareholders may render the investment opportunity unattractive and the company management may be tempted to forego the investment – hence the label the under-investment problem.

The second problem area, the over-investment problem, is the converse of the under-investment problem. When a company acquires an investment opportunity that has a negative net present value there will be no benefit for the shareholders nor will it be good for debt-holders whose investments will reduce in value. The loss of value suffered by the debt-holders will benefit the shareholders. There will be a transfer of value from the debt-holders to the shareholders and, if it is large enough, it may render the net present value of the investment opportunity positive. This will enable the company to pursue a sub-optimal investment – hence the label the over-investment problem.

The third problem area gives rise to the pecking order theory of capital structure. The motivation is information asymmetry. When financing an investment, the company may be faced with issuing shares at a value that it considers would be highly beneficial to the new investors and hence detrimental to existing shareholders. Issuing shares at such a price will effectively transfer value to the new investors at the expense of the old or pre-investment shareholders. Faced with such a dilemma, managers prefer to finance the investment by raising debt. Hence, in this situation, there is an automatic preference for debt over equity capital and hence the pecking order theory.

The fourth problem area relates to the conflicting personal objectives of management. Management prefer a strong balance sheet. This has several important advantages that enable the company to operate and compete effectively against the competition in the sector in which it operates and to facilitate acquisitions. The strong balance sheet preference contrasts with the trade-off approach to capital structure as in Kraus and Litzenberger (1973) which balances tax shelter against the costs of financial distress: choosing less debt and hence lower tax shelter may be less beneficial for shareholders.

1.3 Aims and objectives

The aim of the work conducted in this thesis is to provide new insights into the circumstances in which the problems listed above can arise and to identify new methods of management of those problems with a view to identifying implications for capital structure decisions.

The objective is to extend the models underlying the existing explanatory theories of under-investment, over-investment and the pecking order by considering a wider range of the financing methods in those models.

A further objective is to develop alternative methods of addressing the problems described previously that differ from the current approach and provide insights into the management of capital structure.

The model in Myers (1977) can be extended with the addition of simple assumptions which link the value of debt to a gearing ratio. This enables changes in the value of existing debt and equity to be modelled in a wider range of situations including internal and external financing of the investment opportunity and where the net present value of the investment opportunity is either zero or positive. This analysis produces a wider range of possible outcomes. This enables alternative conclusions to be drawn from the analysis and facilitates the articulation of alternative methods of managing any under-investment problem which may include rebalancing capital structure back to its target: this process can recapture for shareholders any value transferred to debt-holders.

The extended model of the under-investment problem can be applied to the over-investment problem because these two problems are directly related in that they both envisage transfers of value between debt-holders and shareholders. This approach provides useful insights into the situation in which the over-investment problem can arise. The possible solution to recapture value transferred to debt-holders can provide the circumstances for the over-investment problem. This process of rebalancing can be taken further than simply recapturing value transferred to debt-holders by increasing gearing. This will disadvantage debt-holders and benefit shareholders. A further objective is to consider how debt investors might react to such a strategy.

The model in Myers and Majluf (1984) can be modified to include some alternative financing solutions that address the problem of information asymmetry in ways that do not provide an automatic preference of debt over equity (except in one narrow sense). The aim is to extend the model by including financing options that have two stages: an interim stage followed by a refinancing after the problem of information asymmetry has been resolved. The objective is to examine whether this can solve the problem of information asymmetry without generating an automatic preference for debt over equity.

In relation to the conflicts between mangers and shareholders, the aim is to examine the motives of management in relation to acquisitions and identify implications for capital structure that facilitate the purchase of other companies.

A further overarching objective is to provide empirical support for the solutions identified. This includes explaining existing empirical results that support existing solutions to the problems listed above.

1.4 Contributions

1.4.1 The under-investment problem

The incremental contributions achieved in relation to the under-investment problem show that:

- The model in Myers (1977) can be extended by the inclusion of some simple assumptions to address both internal and external financing and the mix of debt and equity in the external financing of the investment clarifying that transfers of value to debt-holders occur in only limited circumstances;

- In the case of internal financing, that there is no under-investment problem and hence that such a problem, if it does arise, can only arise in the external financing case;

- The external financing case makes clear that the under-investment problem is a consequence of the financing decision rather than the investment decision and that it arises only in limited circumstances;

- The circumstances of the under-investment problem can only arise where the existing debt-holders enjoy a transfer of value caused by a reduction in gearing following the financing of the investment;

- In the case of external financing where the investment opportunity represents a positive or zero net present value project, providing gearing is not reduced by the financing, there is no under-investment problem and, even if there is some benefit enjoyed by debt-holders, they cannot capture all the benefit of a positive net present value investment opportunity and so some benefit will accrue to shareholders, thus avoiding the under-investment problem;

- The under-investment problem can be avoided completely by i) ensuring that the company's gearing ratio is not reduced by the external financing; or ii) if gearing is reduced by the financing, then reversing any transfer of value from shareholders to debt-holders by a subsequent, marginal adjustment to capital structure: this solution is much simpler and less costly than those suggested in Myers (1977);

- The under-investment problem can arise in the case of financial distress but that there are incentives for management to pursue investment rather than to under-invest;

- The motivation for Myers' (1977) suggestion to reduce debt maturity (to put the investment decision in the hands of the lenders) is unnecessary since the management can always negotiate with lenders regardless of the maturity of debt if indeed that were necessary;

- The other solutions (mediation and adjustments to the loan contract) to the under-investment problem proposed in Myers (1977) are shown to be inappropriate and costly and that more efficient techniques to manage any under-investment problem are put forward;

- The empirical results that are cited in support of the solutions in Myers (1977) – essentially the negative relationship between gearing and debt maturity and the market to book value ratio – can be explained in other ways that do not support the solutions proposed in Myers (1977) for the under-investment problem. Two explanations are provided for this negative relationship: first the accounting treatment of investment expenditures; and secondly, the link between the market value of the enterprise in i) the gearing ratio; and ii) the market to book value: this suggests using a gearing ratio based on book values: this is tested empirically;
- The empirical results (using gearing and debt maturity based on book values) confirm that debt maturity is only weakly related to the market to book value ratio and, using gearing measured in terms of book values, a positive relationship between gearing and the market to book value ratio is established confirming the arguments above and providing no support for the solutions in Myers (1977).

1.4.2 The over-investment problem and the pecking order theory

The incremental contributions achieved in relation to the under-investment problem show that:

- the over-investment problem is the converse of the under-investment problem in that a transfer of value from debt-holders at the expense of shareholders is the underlying problem generating over-investment whereas in the under-investment scenario, it is a transfer of value from shareholder to debt-holders that can lead to the under-investment problem;

- the tools proposed in Chapter 2 to manage the under-investment problem can be used to achieve a transfer of value from debt-holders to shareholders as in the over-investment problem: this mechanism involves reducing the value of existing debt by reducing the credit quality which can be achieved quite simply by increasing overall gearing by using a suitable amount of debt in the financing mix of the new investment: at face value, this could be a source of value creation for shareholders (if debt-holders accepted such transfers of value);
- providers of debt finance will not be content to suffer transfers of value from their investments to shareholders (as postulated in the solution to the under-investment problem): this will make it difficult for a company to promote such a transfer and pursue sub-optimal investments;
- debt investors, aware of the behaviour of a company seeking to transfer value from debt-holders to shareholders, will seek a premium in the cost of debt that will compensate for the risk of a value transfer occurring: this is demonstrated using a simple experiment to model investor behaviour;
- a good strategy for the company to avoid this increased debt cost is to maintain a constant capital structure and so avoid debt investors seeking a premium (to compensate for the risk of a transfer in value) and thereby optimise the company's cost of capital;
- there is a stark contrast between Myers' (1977) solution to the under-investment problem (shortening debt maturity and/or reducing the debt amount) and the solution to the pecking order problem (increasing debt): both problems involve the risk of under-investment and yet the solutions proposed about debt are exactly opposite;

- in the case of the pecking order theory, there are several solutions that can be used to manage potential transfers of value between old and new shareholders in the presence of asymmetric information that enable sensible investment opportunities to be pursued without value being lost by shareholders: one technique that is proposed is the use of short-term bridging finance. This is pure debt financing and so in a certain narrow sense is consistent with the solution in the pecking order theory. However, the idea of the short-term finance is that it will be replaced with long-term finance which could include equity which can be issued at a time when the problem of information asymmetry has been resolved. In this way, a company can pursue a long-term capital structure strategy (for example, constant gearing) with temporary deviations (using bridge financing: a lending package offered by banks to enable companies to raise cash quickly for acquisitions or to finance gaps between bond issues and where the intention is that the loan will be repaid within a relatively short period – up to 12 months is common) when information asymmetry precludes an equity issue;
- the bridge financing technique is tested using the dataset described in Chapter 2 and shows that while there is support for the pecking order theory in common with tests reported in Shyam-Sunder and Myers (1999), that the data also support the idea that increases in gearing at the time of investment are subsequently reversed and that such temporary increases in gearing are suggestive of the use of short-term bridge financing which is one of the solutions proposed for problems of information asymmetry;
- these results suggest that problems of asymmetric information can be managed in a way that makes no predictions about capital structure and thus that there is

no basis for arguing that there is a natural preference for debt over equity (as proposed in the pecking order theory);

- if there is no motivation for the pecking order theory (since there are solutions to problems of information asymmetry) then the implication for capital structure theory is that companies should maintain reserve borrowing capacity to be able to use bridge financing should the need arise. This suggests a preference for a conservative capital structure – a gearing ratio that is below the maximum level that it could be.

1.4.3 Strategic approach to gearing

The term “strategic approach to gearing” describes a policy of managing capital structure that takes account of the level of concentration among other companies in the sector in which the company operates. A company’s capital structure is influenced by the level of concentration among other companies in the sector.

The incremental contributions achieved in relation to under-investment problem show that:

- management have an incentive to engage in empire building for two reasons: first, a bigger company leads to bigger remuneration; and secondly, growing larger reduces the risk of becoming a target for a competitor that grows faster (with the downside of management of the acquired company becoming a cost saving with obvious implications for personal welfare);

- to be successful in making acquisitions, buyers must compete with other potential purchasers: this process is facilitated by a balance sheet that can provide financing for acquisitions easily and quickly. Bridge financing (described in Chapter 3 as a tool to manage problems with asymmetric information) can be deployed quickly to finance acquisitions providing the balance sheet is sufficiently conservative to support the debt;

- company gearing will reflect a company's acquisition ambitions and the availability of opportunities in the sector in which it operates: so, in a highly fragmented sector, company gearing is likely to be low to provide the platform to launch acquisitions and vice versa;

- thus, company gearing is related to measures of concentration of other companies in the sector in which it operates. This is a factor that is external to the company but affects its decisions about capital structure. This provides an additional factor that explains capital structure decisions. A measure of concentration is developed to assess the ability of a company to finance acquisitions which combines size and balance sheet – the firepower index – derived from the Hirschman-Herfindahl index;

- the hypothesised relationship is tested empirically using firepower (and more conventional measures of concentration using market values and sales) and both gearing and relative gearing (gearing relative to the other companies in the sector). The results provide support for the hypothesised positive relationship between company gearing (and relative gearing) and the firepower measure of concentration in the sector in which the company operates.

1.5 Main findings and thesis structure

In Chapter 2, the model in Myers (1995) is extended to address both internal and external financing to show that the under-investment problem arises only in the external financing case and that the cause is the financing method – the mix of debt and equity. The external financing of the investment can change the overall capital structure and this change in capital structure can lead to a transfer in value from the shareholders to the debt-holders where overall gearing is reduced thereby making the existing debt less risky and so more valuable – hence the under-investment problem. Alternatively, by achieving an increase in gearing, value will be transferred from the debt-holders to the shareholders (since existing debt will become riskier): this is the solution to the under-investment problem.

The mechanism that links changes in capital structure and transfers in value between debt-holders and shareholders can be used to manage the under-investment problem. Value that is transferred to debt-holders resulting from a change in capital structure can be recaptured by making a subsequent adjustment in capital structure to restore the gearing that prevailed before the investment was made. This technique can be used to understand both the over-investment problem and the pecking order theory.

Hypotheses are developed and tested to provide an alternative explanation for the results reported in the existing empirical work which appears to support the proposed solutions to the under-investment problem in Myers (1977) of shortening debt maturity. These empirical results support the analysis and do not provide support for the traditional approach to under-investment – namely shortening debt maturity or reducing gearing.

The solution identified of recapturing value transferred by a post-investment adjustment to capital structure is much simpler and cheaper than adjusting debt maturity or adjusting the amount of debt in the balance sheet (a solution that can also reduce problems of under-investment – if debt is low, any transfer in value will also be small). Marginal adjustments to gearing are much simpler than major changes in maturity or gearing. In any event, the purpose of the solution in Myers (1977) is to promote a dialogue with the lenders which can always occur regardless of debt maturity.

In Chapter 3, the model in Jensen and Meckling (1976) is extended to identify when the over-investment problem arises. As with the under-investment problem, only in certain situations does a transfer of value from debt-holders to shareholders arise and, in some cases, this may not be sufficient to convert an unprofitable investment opportunity into one that is profitable.

As with the under-investment problem, transfers in value between stakeholders can arise when capital structure is changed. The presence of an investment opportunity is not necessary to achieve a change in capital structure – it can happen by retiring debt by issuing equity or vice versa. Value can be taken from debt-holders by simply reducing the credit quality of the existing debt by increasing gearing (or by other means).

This process of deceiving investors and causing them to suffer a loss of value is tested using an experiment on proxy debt investors to see how they react. The experiment shows that debt investors can identify where such loss of value occurs and can take appropriate action. Investors in debt securities are unlikely to continue to buy bonds when there is the expectation that the management will transfer value away from the debt-holders. The investors will react by demanding a greater return to compensate for this risk.

This suggests that maintaining a stable capital structure is the best way to reassure debt investors that it is unlikely that there will be any loss of value in their investments brought about by adverse capital structure changes. This is consistent with long run stability in gearing ratios, although adjustment to the long-run target will be needed from time to time.

The model in Myers and Majluf (1984) is extended to include alternative steps to the option considered in that paper of a simple preference for debt over equity. The problem of information asymmetry can be resolved by extending the idea of managing the capital structure as in the under-investment and over-investment problems. Techniques to overcome the information asymmetry problems are described to enable the company to make investments when its share price does not reflect the management's perception of value. One technique is to use bridge financing: the company borrows on a short-term basis (usually from banks) to undertake the investment and then refinances with debt and equity when the market value of its shares reflects all the relevant information. The providers of bridge finance expect to be repaid from the refinancing, so the lending decision they take is dependent on their view of the feasibility of the refinancing and the downside risk if the refinancing cannot be put in place.

This bridge financing technique in some ways supports the pecking order theory since it is debt, but it is a temporary financing that is replaced with long run financing in the preferred combination of debt and equity within a short period after the bridge finance is put in place. So, strictly, this approach does not support the pecking order theory which implies permanent debt. The use of bridge finance is a more dynamic approach where a temporary deviation away from a target gearing ratio is contemplated with the objective of subsequent reversion to the target.

Hypotheses are developed to test the proposed solutions where gearing increases and is then followed by an adjustment back to the target capital structure. This is achieved by comparing changes in gearing in the periods following a year in which there is both a financing deficit and an increase in gearing. The results support the idea that there is an increase in gearing to finance a deficit but that this is followed by reductions in gearing as the capital structure is adjusted.

In Chapter 4, the role of management and their personal objectives are examined in the context of the competitive landscape of the sector in which they operate. It is argued that managers prefer to be employed by companies that will grow because this helps their own remuneration to grow and that this growth can be facilitated by a balance sheet that gives the company a competitive advantage over the competition, particularly in relation to the ability to make acquisitions. Expansion by acquisition increases company size and reduces the prospect of becoming a target for another company's expansion ambitions.

Industry concentration is usually measured by the Hirschman-Herfindahl index which is based on company sales as in de Jong, Nguyen and van Dijk (2008). This index together with two further measures are used i) where company value is substituted for sales and ii) a measure known as firepower is developed to measure the relative financial strength of a company within a sector. Firepower is based on the Hirschman-Herfindahl measure of industry concentration but in this case, is computed using the enterprise value of the companies within the sector within which it operates and incorporates the company's capital structure. Firepower is designed to capture more than market share, that is the extra value associated with financial power such as economies of scale in its financing that will be reflected in the value of the enterprise and hence in its ability to compete. The relationship between firepower and gearing is analysed and identified. This relationship helps explain company decisions on capital structure in terms of management incentives.

The relationship between gearing and firepower is tested empirically and a positive relationship between company gearing and the concentration of other companies in the sector is identified. This supports the idea that where a company is faced with a fragmented sector, its balance sheet has less gearing so support acquisitions and vice versa.

The data for the empirical tests are taken from Compustat for north American companies for the period 1995 – 2014 restricted to non-financial company data: this includes data where the company is not present for the full period: this avoids survivorship bias. Yield curve data are taken from the US Treasury website, US consumer price index data are downloaded from US Department of Labour website, and yields on corporate bonds by maturity are from Bank of America Merrill Lynch/Federal Reserve Bank of St Louis, Economic Data

The two methods highlighted in Flannery and Hankins (2013) as the most efficient among a group of alternative estimating procedures, namely fixed effects and system GMM, are used here and the procedure in relation to system GMM used in that paper (using Stata's “xtdpdsys” command, two steps, with all the independent variables specified as "predetermined" and the maximum number of lags restricted to two or, in some cases, more) is followed.

Conclusions derived from the analyses carried out are set out at the end of each Chapter. A summary of those conclusions is set out in Chapter 5.

CHAPTER 2 MANAGING THE UNDER-INVESTMENT PROBLEM

2.1 Introduction

The objective of this Chapter is to assess the classical model on under-investment developed by Myers (1977) in a critical fashion and to develop further the notions and implications underpinning the model reflecting realistic market characteristics and managerial objectives. By extending the model in Myers (1977), new insights into the origins of the under-investment problem are revealed including solutions that are simpler and easier to implement than those suggested in Myers (1977).

Analysis of the variables used in the empirical support for the solutions in Myers (1977) leads to the generation of new testable hypotheses. Empirical analyses are presented to test the analytic and narrative arguments advanced via this set of hypotheses with results that do not support the solutions in Myers (1977).

The under-investment problem can arise where the debt-holders receive some benefit when the company acquires an investment opportunity with positive net present value. This benefit is acquired at the expense of shareholders and so reduces the advantages of the investment. Debt-holders could lose out if management rejects the investment opportunity because of the potential transfer of value away from shareholders – hence the label “under-investment”. Myers’ (1977) solution to the under-investment problem is to shorten debt maturity so that it matures at a date before the expiry of the investment opportunity. This is the connection to the empirical relationship between debt maturity and the market to book value ratio (a proxy for investment opportunities) established in Barclay and Smith (1995), Antoniou, Guney and Paudyal (2006), Akdal (2010) and Kleczyk (2012). Barnea, Haugen and Senbet (1980) address the same issue but propose including a call option in the debt contract to allow the company to retire the debt early – in effect implementing Myers' (1977) solution but in a different way. Similarly, Bodie and Taggart (1978) suggested call options should be written into bond contracts to facilitate the management of under-investment problem. Thatcher (1985) distinguish two forms of the call option to retire a bond: either the conventional option to call which is usually after an initial period (say 5 years); or, within the initial period dependent on certain other conditions being satisfied arguing that this represents a tool to manage agency costs of debt.

Banko and Zhou (2010) report that callable bonds are issued by companies with problems of information asymmetry and under-investment. Jung, Ellis and Eplin (2012) present support for the use of callable bonds in managing agency costs of debt: their approach included examining changes in bond ratings – this is a good way to identify transfers in value since a change in rating indicates changes in credit quality and hence the cost of debt which is directly linked to value. However, Crabbe and Helwege (1994) conclude that agency theory is unlikely to be the most important explanation for the issue of bonds with call provisions.

Other relevant evidence includes the negative relationship between gearing and the market to book value ratio established in Rajan and Zingales (1995), Graham (2000), Hovakimian (2006), de Jong, Kabir and Nguyen (2008), Antoniou, Guney and Paudyal (2008), Akdal (2010) and Harrison and Widjaja (2014). If gearing is minimised, then any possible transfer in value from equity holders to debt-holders is similarly minimised and hence both debt maturity and gearing are possible solutions to the under-investment problem. However, both solutions have serious implications for cost and for the financing flexibility of the company. Adjusting gearing or maturity to manage the under-investment problem associated with the acquisition of investment opportunities is not easy and not without cost. Simpler and lower cost techniques to manage any problem are presented in this Chapter.

The incremental contributions achieved in this Chapter show that:

- The model in Myers (1977) can be extended by the inclusion of some simple assumptions to address both internal and external financing and the mix of debt and equity in the external financing of the investment clarifying that transfers of value to debt-holders occur in only limited circumstances;
- In the case of internal financing, that there is no under-investment problem and hence that such a problem, if it does arise, can only arise in the external financing case;
- The external financing case makes clear that the under-investment problem is a consequence of the financing decision rather than the investment decision and that it arises only in limited circumstances;
- The circumstances of the under-investment problem can only arise where the existing debt-holders enjoy a transfer of value caused by a reduction in gearing following the financing of the investment;
- In the case of external financing where the investment opportunity represents a positive or zero net present value project, providing gearing is not reduced by the financing, there is no under-investment problem and even if there is some benefit

enjoyed by debt-holders, they cannot capture all the benefit of a positive net present value investment opportunity and so some benefit will accrue to shareholders, thus avoiding the under-investment problem;

- The under-investment problem can be avoided completely by i) ensuring that the company's gearing ratio is not reduced by the external financing; or ii) if gearing is reduced by the financing, then reversing any transfer of value from shareholders to debt-holders by a subsequent, marginal adjustment to capital structure: this solution is much simpler and less costly than those suggested in Myers (1977);
- The under-investment problem can arise in the case of financial distress but that there are incentives for management to pursue investment rather than to under-invest;
- The motivation for Myers' (1977) suggestion to reduce debt maturity (to put the investment decision in the hands of the lenders) is unnecessary since the management can always negotiate with lenders regardless of the maturity of debt if indeed that were necessary;
- The other solutions (mediation and adjustments to the loan contract) to the under-investment problem proposed in Myers (1977) are shown to be inappropriate and costly and that more efficient techniques to manage any under-investment problem are put forward;
- The empirical results that are cited in support of the solutions in Myers (1977) – essentially the negative relationship between gearing and debt maturity and the market to book value ratio – can be explained in other ways that do not support the solutions proposed in Myers (1977) for the under-investment problem. Two

explanations are provided for this negative relationship: first the accounting treatment of investment expenditures; and secondly, the link between the market value of the enterprise in i) the gearing ratio; and ii) the market to book value: this suggests using a gearing ratio based on book values: this is tested empirically;

- The empirical results (using gearing and debt maturity based on book values) confirm that debt maturity is only weakly related to the market to book value ratio and, using gearing measured in terms of book values, a positive relationship between gearing and the market to book value ratio is established confirming the arguments above and providing no support for the solutions in Myers (1977).

The analysis of the model in Myers (1977) is presented in section 2. In section 3, the empirical evidence supporting Myers (1977) is reviewed and two alternative explanations for the prior empirical results are presented: this leads to the development and testing of a number of hypotheses involving modifications to the past empirical approach are tested which provide an alternative explanation of the negative relationship between the market to book value ratio and debt maturity and gearing that does not support Myers' (1977) solutions. Results are set out in section 4 and conclusions are set out in section 5.

2.2 The under-investment model in Myers' (1977)

This section examines the following: the financial distress case of the under-investment problem – the debt overhang problem (in section 2.1); the solutions in Myers' (1977) (in section 2.2); the general case in Myers (1977) where volatility is held constant (but firm value is allowed to vary) where the model is extended by the including some simple assumptions to link the value of debt to the gearing ratio and the analysis of internal and external funding (in section 2.3); the general case in Myers

(1977) where firm value is held constant (but volatility is allowed to vary) where there is no need to consider the method of financing since firm value is held constant (in section 2.4); and methods to manage the transfer of value between shareholders and debt-holders are developed (in section 2.5).

The analysis in this Chapter focusses on the approach in Myers (1977). However, it is not the only source of the argument that shortening debt maturity is a solution to the under-investment problem. Mauer and Ott (2000) provide a real options framework in which the impact of an investment opportunity is examined, and the under-investment problem arises, and they show that the agency costs of under-investment can be significantly reduced by partially financing the growth option with new debt and that agency costs increase as debt maturity is shortened because bankruptcy costs rise. This is a major disadvantage to this solution to the under-investment problem.

2.2.1 Under-investment in financial distress

Essentially, the distress example involves a company whose only asset is the right to invest an amount, I (this is an upper case "i") and thereby obtain an asset with value V. The company has a liability of P. So, the company has a negative net worth. There is a debt overhang. Two cases are considered: first, where the debt matures before the investment decision is made; and secondly, where the debt matures after the investment opportunity expires. An option not included in Myers (1977) which is to negotiate with the lenders is then considered as an alternative solution to adjusting debt maturity.

This is followed by an analysis of incentives for management to invest. Arguments are presented that managers are more likely to over-invest (to prolong their employment) rather than under-invest as suggested by Myers (1977)

2.2.1.1 First case: debt matures before the investment decision is made

Obviously, if $I > V$ then the investment option will not be exercised in any event as the company value is less than the required investment: here the investment opportunity must have a negative net present value.

However, if $V \geq I + P$, then the company will raise the required amount of funds both to finance the investment and to meet the debt repayment. This investment will enable the debt to be paid off and for shareholders to obtain a non-negative net present value investment.

However, if $I+P > V \geq I$, then clearly the project is still worth undertaking, since it has a non-negative net present value (i.e. $V \geq I$) but it will not generate sufficient to cover both the investment (I) and the repayment of existing debt (P). Here, under-investment could arise since there is no return to shareholders despite the investment opportunity offering a positive net present value.

Because in this case, debt matures before the decision to invest arises, the company will be unable to make the debt repayment and so will be in default. The argument in Myers (1977) is that the debt-holders will assume control of the company. The debt-holders will then be able to exercise the investment option and generate value to achieve a partial repayment of the debt. In this case, the investment option could be exercised by the debt-holders and the under-investment problem need not arise.

Myers' (1977) argument is that as the debt maturity event precedes the exercise time for the investment option, that either the management will be forced to negotiate with the lenders or the lenders will be able to seize the initiative because there is a default (as the debt repayment is not made) and thereby avoid the adverse consequences (for the debt-holders) of the investment not being made.

2.2.1.2 Second case: debt matures after the investment decision is made

As with the previous case, there are three possible outcomes and the first two are identical in each of the two cases. A difference between this case and the previous case arises in the third possible outcome. If $I+P > V \geq I$, then because the investment returns are insufficient to pay off the debt and leave a positive net present value project for the shareholders, Myers' (1977) argument is that the managers would allow the option to expire and the debt-holders would have no opportunity to exercise the investment option because their ability to act would arise only after default which would occur after the option to invest expires. Thus, an investment option with a positive net present value would be allowed to lapse. This is Myers' (1977) under-investment problem and arises only because, according to his argument, the debt maturity occurs after the opportunity or decision to invest has passed.

Myers (1977) concludes that one way of mitigating the problem is for the company to use shorter term debt rather than longer term debt. The idea is to bring the decision point for the lenders to an earlier point in time by ensuring that the debt becomes due before the timing of the investment decision and, when it is not repaid, a default ensues allowing the debt-holders to take control of the company. Therefore Myers' (1977) paper is quoted as an explanation for the empirical negative relationship between companies with growth opportunities and debt maturity observed by Long and Malitz (1983), Barclay and Smith (1995), Antoniou, Guney and Paudyal (2006) and Kleczyk (2012).

The above summarises the argument in Myers (1977). However, two different outcomes that were not considered are possible. First, Myers (1977) assumed that there is no default and that the managers remain in control and take the decision not to invest. But the company is clearly in financial distress and very likely to be in breach of company law arising from its negative net worth situation (debt exceeds equity) and very likely to be in breach of a loan covenant so it may not be safe to assume that managers remain in control and can therefore pass up the investment opportunity.

Secondly, even though the debt may not yet be due for repayment, the management would be free to approach the debt providers: such an approach is not dependent on a particular maturity date. Informing the debt-holders of the investment opportunity would allow them to consider financing the investment to regain some part of their outstanding indebtedness. It could be in the interests of the management to do this as it could prolong their employment even if it were of no benefit to shareholders.

2.2.1.3 The motives of management

The argument in Myers (1977) is that management would walk away if there were no benefit for the shareholders. Also, it is assumed that managers would be happy to adjust maturity in the way envisaged in the solution. Both these assumptions are questionable and are not supported in the literature.

Stiglitz (1974) provides an irrelevance theorem concerning debt maturity which is based on an argument that follows Miller and Modigliani (1958) and their assumptions (perfect markets and no financial distress costs). However, asymmetric information distorts that conclusion. Flannery (1986) presents a simple model of asymmetric information in which there are two types of firm (good and bad) but where the firm type is not known by lenders who lend to both firm types at the same rate. In this way, good firms subsidise the debt cost of bad firms. Good firms then seek to refinance at the earliest opportunity when the information asymmetry is resolved to reduce the cost of debt: good firms therefore prefer shorter maturity or debt with embedded call options. To avoid signalling that they are bad firms, bad firms also prefer shorter maturities.

Diamond (1991) develops the model in Flannery (1986) by including liquidation risk and in Diamond (1993), control rents (funds consumed by management) are also included. These papers highlight the liquidation risk of shorter maturity debt. Johnson (2010) comments that too much short-term debt can lead to suboptimal liquidation risk. Mauer and Ott (2000) suggest that shortening maturity (to manage under-investment problems) can be balanced with reducing leverage to avoid the associated liquidity risk.

Stulz (2000) points out that in the extreme case of short-term debt, debt-holders have an opportunity to monitor the company and management at each loan maturity which is more effective than for longer term debt: the impact of monitoring is reduced as maturity increases and as leverage reduces. Such monitoring reduces management flexibility and represents an area of risk. Management have an incentive to minimise the impact of monitoring and any associated risk and this can be achieved with longer term debt that reduces the frequency of debt rollover. Datta, Iskandar-Datta, and Raman (2005) identify an inverse relationship between managerial ownership and debt maturity.

Similarly, less debt reduces monitoring and the associated risk. Berger, Ofek and Yermack (1997) provide evidence that management prefer low gearing. Stulz (2000) comments that conservative capital structures give more discretion to managers by mitigating the disciplining effect of debt.

Management are likely to prefer low gearing and debt maturity that does not promote frequent monitoring or increased default risk.

Lyandres and Zhdanov (2010) consider the option value of an investment opportunity in the presence of debt. In the absence of agency conflicts and assuming that the investment option would be lost in the event of default (for a company with debt) then shareholders would prefer the option to be exercised immediately to avoid losing its value – an effect they label as the accelerated investment effect. This risk can be mitigated by reducing the default risk including liquidity risk and overall gearing. Obviously, if the investment opportunity is not lost in default then the argument to accelerate investment falls away.

It is perhaps possible that the company is in financial distress but that this is known only to the management. Here the information asymmetry is opposite to that envisaged in the motivation for the pecking order theory as in Myers and Majluf (1984) where the firm's true value (as perceived by management) is not recognised by investors. In this case, investors including lenders do not perceive the situation of distress.

However, management have an incentive to prolong their employment so would prefer to exercise investment options that facilitate the achievement of that objective. By pursuing an investment project, the management remain employed and at least generate some value for the lenders even if ultimately, there is no net benefit for the shareholders. Indeed, in this situation, management might be tempted to overstate the merits of the investment to persuade the debt providers either to invest or to cooperate in finding new investors. Management have an incentive to over-invest rather than under-invest as in Jensen (1986) to be able to consume perks and other benefits.

Guedj and Scharfstein (2004) highlight managers of single-product early stage pharmaceutical firms who are reluctant to abandon development of their only viable drug candidates compared to the managers of mature firms with multiple products in development who are more willing to drop unpromising drug candidates. This is a relevant example because single-product companies without regulatory approval for their product may not be in distress, but their future is clearly uncertain. These are circumstances that are similar to those of the under-investment problem. However, here, the managers do not walk away as suggested in Myers (1977). Managers of such companies want to stay employed rather than shut the company/project down as they perhaps should if they were to follow the example of larger companies.

Myers (1977) points to a weakness in his own argument that the managers control the preparation of the investment case for the investment opportunity. They have all the information and projections which are needed to evaluate the opportunity. In this situation, it is perfectly possible for managers interested in continuing to be employed, to construct a suitably convincing (or exaggerated) case (i.e. showing a positive net present value) for prospective external investors (whether bank or equity providers) and thereby obtain the necessary finance.

The structure of management compensation arrangements is usually designed to align the interests of management with shareholders. This is often achieved by annual bonuses linked to earnings and with the award of share options where the value depends directly on the company's share price. Such arrangements are not usually designed explicitly to protect the debt-holders as their interests are not perfectly aligned with those of the shareholders. This difference in interests is recognised in the contractual arrangements between the company and lenders which include legal obligations and covenants that are intended to protect the lenders against any adverse consequences arising from the potential conflict of interests.

Brockman, Martin and Unlu (2010) distinguish the effects of the two types of management incentivisation arrangements: share ownership and share options. They report a negative relationship between managers with share ownership and short-term debt (more share ownership implies less short-term debt). Short-term debt increases monitoring and refinancing risk for managers. In the case of managers with share options, a different relationship is reported: higher volatility (which enhances the value of share options) is associated with more short-term debt (although high volatility usually discourages lenders, so this relationship also reflects lenders' preferences).

However, as a minimum, being remunerated by means of a salary (ignoring share ownership or share options) is likely to motivate managers to find ways to pursue investment projects even where there might have been an under-investment problem since it leads to the opportunity to consume perks as in Jensen (1986). In the circumstances of distress described by Myers (1977), there is a clear and obvious incentive for management to find ways to undertake any investment opportunity (even negative net present value projects) as this will prolong their employment and other benefits.

There is one other way (not considered in Myers (1977)) for the managers to maintain their employment. The investment opportunity could be transferred into a subsidiary into which external investors could be introduced. This transfer may only be possible if either the lenders agreed (if their consent was required) or the lenders could not prevent such a transfer. Such an arrangement would protect the external investors from suffering sub-optimal returns and allow the balance of profits (if any) to accrue to the lenders. This conveniently allows the management to prolong their employment and it avoids the existence of the prior claims of existing debt-holders interfering with the financing of the investment option. In this way, the under-investment option will not arise. But this option could only work if the lending arrangements with the lenders to the parent company did not prohibit such a structure.

Bhattacharya (1977) proposed a solution to the distress case in Myers (1977) which involved the use of new lenders that would be guaranteed senior access rights to the cash flows generated by the new investment. This mechanism, if permitted by the existing lenders (and usually there are restrictions on granting prior access to a new lender contained in loan agreements) would at least ensure that the investment would proceed. However, any surplus left over after servicing the new lenders would still be directed first towards the existing debt-holders rather than the equity holders. This solution is similar to the alternative described above where the investment opportunity is transferred into a subsidiary (if that avoids breaching any loan covenants) which can then be financed on a senior basis.

Bhattacharya and Faure-Grimaud (2001) analysed the question of whether there is a way of restructuring the existing debt in a way that encourages the existing equity holders to provide the funds for the new investment? Their answer was, in general, no. If the company is in the situation where the debt exceeds the total assets of the company, then the equity holders' value is effectively extinguished and so the company is really in the hands of the lenders who are likely to convert that part of their debt which can't be serviced in the future into new equity. The financing of the new investment is a matter for the new shareholders, not the old. So, there should be no under-investment problems in the distress case.

These arguments are discussed here in the context of the financial distress case, but they can be applied to general case which is considered below.

2.2.2 Myers' (1977) solutions

This section analyses the three solutions proposed in Myers (1977) to manage the under-investment problem: i) a requirement on companies to invest in positive net present value projects; ii) mediation; and iii) shortening debt maturity.

It would be possible for lenders to include clauses in the debt instrument which stipulate that the company must undertake positive net present value investment opportunities. But compliance could require the company to raise new capital – something a company is unlikely to commit to in a legal document. In fact, it is more likely that lenders impose limitations on investment in loan agreements rather than positive requirements.

In a sense, there is already such an obligation on directors whose job is to maximise shareholder wealth. So, it could be argued that it is unnecessary to impose such a requirement. Indeed, the usual response of banks faced with financial distress is to discourage new investment and seek to get their money back.

The construction of an agreement to impose such a positive obligation on a company would involve problems of definition and would still suffer the difficulty that the managers would ultimately control the information and therefore the investment decision. In any event, such an agreement would not provide much protection to lenders since if the managers or company did not comply and the option lapsed, what recourse would lenders have? The lenders could sue the directors but what they might recover might not be substantial.

Myers' (1977) second solution is mediation. Thus, the debt contract would specify that a mediator be appointed at the time of exercise of the investment option. The role of the mediator would be to ensure that managers did not prejudice the position of lenders by passing up the investment opportunity. The involvement is like the situation which arises at times of financial distress where lenders appoint an administrator to protect the interests of lenders.

Successful implementation of this procedure would depend on the management alerting the lenders to the need to involve the mediator. If managers were to take such a positive step, then they could also be relied on not to pass up profitable investment opportunities and so mediation would not be necessary.

Myers' (1977) third solution is that debt maturity should be shorter rather than longer since early maturity (i.e. before the exercise of the investment option) would force management into renegotiation with lenders and thereby avoid the under-investment problem. Thus, companies with growth opportunities where they use debt (to finance their business) should use short-term debt (rather than longer term debt) to avoid the under-investment problem. Therefore Myers' (1977) paper is quoted as an explanation for the negative relationship between investment opportunities (as identified by a high market to book value ratio) and debt maturity observed in Barclay and Smith (1995), Antoniou, Guney and Paudyal (2006, 2008) and Kleczyk (2012). There is also a link to the solution proposed in Haugen and Senbet (1981) where the suggestion is to include a call option that can be exercised by the company management to shorten debt maturity.

The difficulty with Myers' (1977) argument about maturity is that it is unlikely that management would take a decision to protect the lenders in this way as the threat is from the management themselves. If the management could not be relied upon to behave appropriately, why is it logical to assume that the management would feel a need to take preventative action by shortening debt maturity? By shortening debt maturity for these reasons, management are saying to the lenders, that management cannot be relied upon or trusted to look after the interests of lenders hence the preference for shorter maturity. It is more logical to argue that lenders should require a mechanism to be included in the debt contract to manage the risk (if that was appropriate) rather than relying on management to select a suitable maturity.

Rather than adjusting debt maturity, it would make more sense for the company to explain the timing of the exercise of the investment option – in which case the lenders would take steps to protect their position if that was necessary.

But this is an example of the conflicts between the interests of equity and debt-holders. Management are expected to take decisions that are in the interests of equity holders. It is for the lenders to seek such protections. It is for the management to resist such requests in the interests of preserving the best position for the shareholders.

If management wished to renegotiate with the debt-holders, then the maturity of the debt would not matter although the cost of such renegotiation could be affected by the maturity of existing debt. Myers (1977) argues that renegotiation only arises when debt maturity occurs before the exercise of the investment option. But it is always open to the management to renegotiate with debt-holders regardless of maturity.

Management can meet lenders and point out that a problem will arise and invite lenders to take such action as they would otherwise take if the debt was maturing at the earlier time. So, careful choice of debt maturity is not necessarily a solution to the under-investment problem – it does not assist the problem at all and is most unlikely to be adopted by management. Shortening debt maturity brings forward refinancing risks for the company which could otherwise be avoided and provides signals to debt providers that might be misinterpreted as implying financial distress. Shorter maturity increases liquidity risk and creates earlier monitoring events for lenders which managers would prefer to avoid as explained in Stulz (2000).

It is most unlikely that corporate treasurers would recognise the strategy proposed by Myers (1977). Indeed, the work of Graham and Harvey (2001) confirm that this is the case. They find very little support for this approach based on a survey of 392 CFOs seeking their views on the under-investment problem.

The conclusions of this section are that in the distress example (where the debt-holders can capture some of the cash flows accruing from a positive net present value investment opportunity) the under-investment problem does not present a difficulty that needs the adjustment of debt maturity for the following reasons:

1 Management have an incentive in the distress example to pursue the investment opportunity as it will prolong their employment. This means that management are unlikely to let a profitable investment opportunity lapse even if it is not directly beneficial to shareholders – at least they are not disadvantaged. Hart and Moore (1995) comment that management's empire building tendencies are sufficiently

strong to ensure that they will always take on new investments even if the net present value is negative (management is more likely to over-invest rather than under-invest).

2 Regardless of the maturity of debt, management always have the option to negotiate with the company's existing debt providers and thereby avoid the problem. It is not necessary to adjust debt maturity to create the option to negotiate with the debt providers. Allowing the investment option to expire is a static approach that ignores the dynamics of the option to negotiate.

3 The circumstances of the distress example suggest that the company is already in a financial distress situation and therefore is likely to be under the control of the lenders, and, if so, the under-investment problem should not arise: in distress, the lenders expect to become shareholders by swapping part of their debt in the restructuring process. Management aware of this, will treat the lenders as the new shareholders in waiting.

4 Shortening debt maturity is an option designed to prevent management taking a decision that is not in the interests of lenders. If management can be relied on to adjust debt maturity, then they surely could be relied upon not to take the decision that the change in maturity is designed to prevent – that is, to pass up a profitable investment opportunity.

These arguments indicate that for the distress case, company debt maturity need not be shortened to control for the under-investment problem.

2.2.3 Generalised case of the argument in Myers (1977)

The key components of the model in Myers (1977) are presented in this section within an analytic structure to facilitate the extension to Myers' (1977) model achieved in the subsequent sections of this Chapter. The extension of the model incorporates both internal and external financing and the financing mix (debt and/or equity) for the investment: both zero and positive net present value investment opportunities are considered.

Myers' (1977) proof for the general case follows closely the distress case described above but without the debt overhang. It is based on the following equality:

Enterprise value (V) = value of the debt (V_D) + value of the equity (V_E) or

$$V = V_D + V_E \qquad (2.1)$$

The approach is to examine how the values of existing debt and equity change and how value can be transferred from debt-holders to shareholders and vice versa. Additional assumptions are introduced as the model is developed beyond the original design of Myers (1977).

To examine how the values in the equation change in relation to investment, the variables in the above equation are differentiated with respect to I, the investment variable. Thus

$$dV/dI = dV_D/dI + dV_E/dI \quad \text{or,} \qquad (2.2)$$

rate of change of V = rate of change of V_D + rate of change of V_E

V_D is a function of V, the value of the company (or enterprise) and σ^2 which is the variance rate of the estimated future value of the company. Thus, V_D can be described as a function depending on two variables: first, the enterprise value, V; and secondly, it's associated variance as follows: $V_D = f[V, \sigma^2]$.

Myers (1977) derives the differential of V_D with respect to I. As V_D is not a direct function of I, the investment variable, partial differentials must be used. This involves differentiating with respect to V (and σ^2) and multiplying by dV/dI (and $d\sigma^2/dI$) as follows:

$$dV_D/dI = \partial f/\partial V \times dV/dI + \partial f/\partial \sigma^2 \times d\sigma^2/dI \qquad (2.3)$$

where the use of "∂" indicates partial derivatives.

The next step is to consider each of the two products on the right-hand side of equation (2.3) separately when the other term (on the right-hand side of the equation) is made equal to 0. In this way, it is possible to examine first, how the value of debt changes with investment when volatility is constant (i.e. $d\sigma^2/dI = 0$); and secondly, how the value of debt changes when the value of the company is unaffected by the investment (i.e. $dV/dI = 0$). By considering separately these two cases, an insight into how a combination of changes in the two variables will affect V_D can be obtained.

In the next section, Myers' (1977) argument is extended with certain additional assumptions to address these two cases with subsidiary scenarios:

i) When volatility is constant: internal and external financing including zero and positive net present value projects and the financing mix; and
ii) When enterprise value is constant (volatility varies): internal financing only (since the enterprise value is constant by assumption).

To identify the impact of investment on the value of existing debt and equity securities, it is assumed that the value of debt is related to the gearing ratio in the obvious way: if gearing increases/reduces, then the value of existing debt securities will fall/rise. Gearing is taken to be the ratio of the value of debt to the enterprise value (the sum of the values of debt and equity). It is assumed that no other factors (such as tax) have an impact on the value of existing securities.

2.2.3.1 Internal financing of the investment

Myers' (1977) argument did not envisage the possibility of $dV/dI = 0$ (which implies internal financing of a project with zero net present value). This followed from his assumption that $dV/dI \geq 1$ (which implies a positive increase in the value of the enterprise following investment). In this section, internal financing is considered in two separate cases: first, where the net present value of the investment opportunity is zero; and secondly, where the net present value is positive (i.e. non-zero).

Distinguishing between internal and external financing is very important because it will be shown that the under-investment problem does not arise in the internal financing case (with volatility constant). So, in the external financing case, where the under-investment problem can arise, it must be because of the financing rather than of the investment.

For zero net present value projects which are financed internally, then $dV/dI = 0$. If the value $dV/dI = 0$ is substituted in equation (2.4) then it follows that $dV_D/dI = 0$. So, there is no transfer of value to the debt-holders. Since $V = V_E + V_D$ then the rates of change of these variables is given by

$$dV/dI = dV_D/dI + dV_E/dI$$

In this case, as there is no change in gearing (because of internal financing) then $dV_D/dI = 0$ and therefore, it follows that $dV_E/dI = 0$. Hence there is no transfer of value between shareholders and debt-holders and so there is no under-investment problem.

For positive net present value projects, it is assumed that the following inequality applies, $dV/dI > 0$. Myers' (1977) argument relied on equation (2.3) namely,

$$dV_D/dI = \partial f/\partial V \times dV/dI \qquad (2.4)$$

where the sign of the value of the left-hand side of this equation depends on the sign of the value of $\partial f/\partial V$ (since in this scenario $dV/dI > 0$, by definition). Myers' (1977) assumes that $\partial f/\partial V > 0$ as this implies that the debt value increases as enterprise value increases (when volatility is constant). This means that the two terms on the right-hand side of equation (2.4) are positive and hence the product is also positive. Hence the sign of the left-hand side of equation (2.4) is positive and so there is an increase in the value of debt.

The extended model (examining discrete changes in the variables) can be used to examine whether the predicted increase in value of the debt results in the under-investment problem. The sign "Δ" is used to indicate change in the variable. It is assumed that changes in the value of existing debt and equity are driven by changes in gearing.

It is assumed that each variable changes because of an investment, ΔI, financed internally. Therefore, after the investment is made, the value of the enterprise must equal the sum of the values of the equity and debt, so

$$(V + \Delta V) = (V_E + \Delta V_E) + (V_D + \Delta V_D)$$

Since $V = V_E + V_D$, it follows that

$$\Delta V = \Delta V_E + \Delta V_D$$

By assumption, $\Delta V > 0$, because only projects with positive net present values have been specified. The post-investment gearing ratio will be given by

$$(V_D + \Delta V_D)/ (V + \Delta V)$$

Three different outcomes can be contemplated: gearing is unchanged, gearing rises or gearing falls. In case 1: gearing is unchanged, so pre-investment and post-investment gearing are identical. Hence

$(V_D + \Delta V_D)/ (V + \Delta V) = V_D/V$ which can be simplified to

$$\Delta V_D/\Delta V = V_D/V \qquad (2.5)$$

However, since the gearing ratio, V_D/V, is always less than unity, it follows that $\Delta V_D/\Delta V < 1$ which implies that $\Delta V_D < \Delta V$. Hence, the debt-holders enjoy an increase in value in their debt securities but they do not capture all the increase in value generated by the investment so there must be an increase in value for the shareholders and so no under-investment problem arises – the investment is still beneficial for shareholders even if the debt-holders capture some of the benefit of the investment.

While there is a transfer of value to the debt-holders, the investment remains profitable for the shareholders and management have no incentive to pass up the opportunity. It should be noted that it is not obvious that gearing could remain unchanged. As there is an increase in the value of debt (but not a commensurate increase in debt service), the existing interest stream would be spread over a larger value and this would amount to a reduction in return for the debt-holders that would be out of line with the return on the existing debt prior to investment so ΔV_D would be smaller to ensure that gearing will reduce as in the next case.

In case 2, it is assumed that gearing falls in which case, there must be an improvement in the value of the debt securities so $\Delta V_D > 0$. Post investment gearing must be less than pre-investment gearing and hence
$(V_D + \Delta V_D)/ (V + \Delta V) < V_D/V$ which simplifies to $\Delta V_D/\Delta V < V_D/V$.

As before, since the pre-investment gearing is less than unity, it follows that $\Delta V_D < \Delta V$ and so no under-investment problem arises. In contrast to the previous case, it is more likely that gearing would fall given an investment in a project with positive net present value.

In case 3, it is assumed that gearing rises although it is not easy to see how this could arise given the assumption of internal financing of an investment with positive net present value. Using the steps set out in case 2, the following inequality is obtained $\Delta V_D/\Delta V > V_D/V$. But gearing is less than unity although still a positive number. However, since gearing has increased, $\Delta V_D < 0$ which implies that ΔV must also be negative to satisfy the inequality. But ΔV is positive by assumption, so the result is a contradiction implying that gearing cannot rise and so there is no under-investment problem.

The conclusion is that the over-investment problem does not arise in the situation of internal financing. So, if there is an under-investment problem with external financing, it must arise because of the financing mix for the investment. This insight is not addressed in Myers (1977).

2.2.3.2 External financing

The implication of the above analysis is that there may be a change in the values of existing securities arising simply because of a change in overall gearing rather than because of the investment. For instance, financing the investment entirely with debt may increase overall gearing and damage the value of existing debt securities. Alternatively, if the new investment is financed entirely with equity, there may be an improvement in the value of existing debt securities resulting from the reduction in gearing. The financing effect needs to be distinguished from the effects of the investment.

This suggests that the analysis of investment opportunities should include estimates of the benefits or costs of any transfers in value from or to shareholders. Such an approach would follow the principles behind the adjusted present value approach which seeks to include the financing effects (including tax shelter) within the investment evaluation framework (see Myers (1974) for the original description).

For zero net present value projects financed externally, three cases are considered: all debt financing, all equity financing and a combination of debt and equity. First, case 1: all debt financing: let the increase in debt to finance the investment = D. Let the change in value of existing debt = ΔV_D and let the change in value of the existing equity

$= \Delta V_E$ as before. Therefore, the total value of all debt in issue after investment will be $= V_D + D + \Delta V_D$ and the post-investment value of equity $= V_E + \Delta V_E$. The post-investment enterprise value will be $= V + D$ and so $V + D = (V_E + \Delta V_E) + (V_D + D + \Delta V_D)$ and since $V = V_E + V_D$, it follows that $\Delta V_E + \Delta V_D = 0$. This means that any change in value of the two types of securities is split between them as in the internally financed case. But here, there has been an increase in gearing. The gearing ratio can be computed as above: pre-investment gearing ratio will be V_D/V and the post-investment gearing ratio will be $(V_D + D + \Delta V_D)/ (V + D)$.

In this case, for $D > 0$ the post-investment gearing ratio is greater than the pre-investment gearing ratio (by assumption) hence $(V_D + D + \Delta V_D)/ (V + D) > V_D/V$. Given such an increase in gearing, it is reasonable to assume that the value of the existing debt will reduce and hence that $\Delta V_D < 0$ and since $\Delta V_D + \Delta V_E = 0$, it can be concluded that $\Delta V_E > 0$ and hence there is no under-investment problem.

This analysis assumes that the new finance is equivalent in type, maturity and security as the existing debt securities. However, the existing debt securities could be senior ranking to the new debt and so be somewhat protected from a reduction in debt value. However, it is likely that there would be a reduction in value simply because of the overall increase in gearing. Any reduction in value would be less where there is seniority in security for the existing holders of debt securities.

If the existing debt were to be refinanced, then the new cost of debt would represent the credit risk of the enlarged company and there would be no transfer of value to or from the existing debt-holders as they would be refinanced. However, the cost of such refinancing would depend on the terms of the existing debt as to pre-payment penalties. In any event, there may be restrictions in the loan documentation that prevent or limit the issue of additional debt ranking equally with existing debt and are designed to limit transfers of value from debt-holders to shareholders. So, the assumption throughout this analysis is that such additional debt can be issued and can dilute the credit quality of existing debt.

So, in this case, there is no under-investment problem as there is an increase in the value of equity. This example is exactly the situation of the over-investment problem described in Jensen and Meckling (1976) and discussed more fully in Chapter 3. The basic idea is that a transfer in value from the debt-holders to the shareholders as above is, in effect, a subsidy. This may allow management to pursue an investment opportunity with a negative net present value that becomes a positive net present value project by the receipt of the subsidy – hence the label the over-investment problem: management could pursue sub-optimal investments.

The second case of external finance is where the investment in the zero-net present value project is financed entirely by new equity. The analysis follows the argument above for external financing by debt. Let the increase in equity = E; let the change in value of existing debt = ΔV_D; and let the change in value of the existing equity = ΔV_E. Therefore, the total value of debt after investment = $V_D + \Delta V_D$ and the post-investment value of equity = $V_E + E + \Delta V_E$ and the post-investment enterprise value is = V + E.

Assuming as before that a change in capital structure has no impact on the value of V, then pre- and post-investment enterprise values will be identical and so

$$V + E = (V_E + E + \Delta V_E) + (V_D + \Delta V_D)$$

and since $V = V_E + V_D$, it follows, as before, that $\Delta V_E + \Delta V_D = 0$.

In this case gearing reduces because of the all-equity financing. Using the expressions for pre-investment and post-investment gearing ratios set out above and since $E > 0$, the post-investment gearing ratio must be lower than the pre-investment gearing ratio and so $(V_D + \Delta V_D)/ (V + E) < V_D/V$.

Given such a reduction in gearing, it is reasonable to assume that the value of the existing debt will increase and hence that $\Delta V_D > 0$ and since $\Delta V_E + \Delta V_D = 0$ it can be concluded that $\Delta V_E < 0$. So, in this case, for a zero-net present value investment opportunity there is a reduction in the value of existing shareholders' equity and the under-investment problem can arise. However, this is a consequence of changes in gearing affecting the value of securities rather than as a direct result of the investment. The method of financing of the investment has created the opportunity for a change in capital structure to take place. Transfers in value between shareholders and debt-holders have occurred simply because of changes in capital structure and not directly because of the investment. The investment has created the opportunity to adjust the capital structure. It is the change in capital structure that has caused the transfer in value between the two groups of stakeholders. The effects of changes in gearing on the values of debt and equity need to be distinguished from the effects of investment.

So, the effect of the investment on the value of pre-investment debt or equity depends on how the investment is financed. This can be illustrated by considering the third case where the external financing is a combination of debt and equity in the same proportions as the existing capital structure. In such a case, the gearing ratio after investment will be equal to the gearing ratio before investment. Then, *ceteris paribus*, the value of pre-investment debt will remain unchanged. So, $\Delta V_D = 0$ and since $\Delta V_E + \Delta V_D = 0$ then $\Delta V_E = 0$ and there will be no under-investment problem. So, unchanged gearing is the neutral case for financing zero net present value projects: increases in gearing can shift value from the debt-holders to the equity holders and vice versa. So, the under-investment problem is a consequence of financing decisions rather than investment decisions.

If a company were to change its capital structure by simply buying in shares financed with an issue of debt (or vice versa) then there would be a transfer of value from the debt-holders to the equity holders (or vice versa) – as described in Frank and Goyal (2009) (see stylised fact number 16). This restructuring of the mix of debt and equity can be examined using the simple model above. The only change to the model above is that the investment is the acquisition of securities issued by the company – leading to the reduction in gearing and vice versa rather than an expansionary investment.

Changes in capital structure that are not accompanied by an expansionary investment can cause transfers in value between debt and equity holders and the phenomenon can be explained using this simple model.

Distinguishing the investment from the adjustments to the capital structure caused by choices about how the investment is financed points to the solution to the under-investment and over-investment problems. If, following the financing of an investment opportunity, value is transferred from shareholders to debt-holders (e.g. by issuing shares as in the example above and reducing gearing), the value can be recaptured by a subsequent transaction to reverse the effects. This would mean the company would need to issue debt and then retire equity to get the company back to its pre-investment gearing ratio. This would recapture any transfer in value.

Transfers of value in the reverse direction (from debt-holders to equity holders) could be recaptured (if desired) by an issue of shares after the investment that would be used to reduce debt and thereby restore gearing to its pre-investment level.

This analysis suggests that where there are transfers of value between debt-holders and shareholder occur, companies may need to adjust capital structure continuously to ensure that such transfers can be reversed. The implications of such a policy ~~isare~~ considered in a discussion about capital structure theories in section 2.2.4 below.

Finally, the case of a company which has no existing debt is worth considering. Regardless of how the investment is financed, there can be no transfer of value to or from existing debt-holders since there are none. So, one solution to avoid under-investment is to have no existing debt. Also, where there is debt, the transfer in value can be minimised by ensuring shorter maturity since if there is a transfer of value by means of a reduction in gearing then the amount of benefit transferred will be related to the maturity of the debt. For example, if there are only 2 years of loan life remaining then the old debt-holders get either 2 years of excessive interest if credit quality is improved or vice versa. However, such solutions (mentioned in Dennis, Nandy and Sharpe (2000)) are quite excessive: being able to adjust gearing post-investment is much simpler and cheaper and there are no implications for gearing or the maturity profile of debt.

Positive net present value projects financed externally are considered next. Here the post-investment enterprise value will be greater than the sum of the value of the enterprise pre-investment and the value of the securities issued to finance the investment. If D is the value of debt securities issued and E is the value of equity securities issued then, this assumption can be expressed in terms of the model above as $V + \Delta V + D + E > V + \Delta I$, where V is the value of the enterprise before investment.

As before, $\Delta I = D + E$. So, the above inequality implies $\Delta V > 0$ which simply reflects the assumed positive net present value of the investment project. After the investment, the enterprise value must be equal to the pre-investment values of the securities in issue plus any change in their values. So, the following relationship holds

$$V + \Delta V + D + E = V_E + \Delta V_E + E + V_D + \Delta V_D + D$$

Since $V = V_E + V_D$ and eliminating D and E, it follows that, as before,

$\Delta V = \Delta V_E + \Delta V_D$ and therefore, since $\Delta V > 0$

it follows that $\Delta V = \Delta V_E + \Delta V_D > 0$.

The pre- investment gearing ratio is V_D/V and the post-investment gearing ratio will be given by $(V_D + D + \Delta V_D)/ (V + \Delta V + D + E)$.

As above, three cases are considered. Instead of considering all debt or all equity financing, changes in gearing are considered since this is the factor which determines the change in debt value as described above. Alternative financing strategies were not considered in Myers (1977).

Case 1 is where the investment is financed with debt and equity in the same proportions as the existing capital structure. It could be postulated that, *ceteris paribus*, the value of existing debt remains unchanged as is argued above for the zero-net present value case. However, the positive net present value case is not quite so straightforward because there is an increase in enterprise value associated with the investment having a positive net present value. So, it is more appropriate to consider the change in gearing arising because of the investment. The change in gearing is simply the post-investment gearing ratio less the pre-investment gearing ratio which is given by:

$$(V_D + D + \Delta V_D)/ (V + \Delta V + D + E) – V_D/V. \qquad (2.6)$$

Since it is assumed that the new investment is financed with a combination of debt and equity that is equal to the existing gearing ratio, the expression for the change in gearing ratio simplifies to $\Delta V_D/\Delta V – V_D/V$. Three subsidiary scenarios can be considered in this case where the mix of debt and equity financing of the investment matches the company's existing gearing ratio: scenario i) gearing increases but this would contradict the assumption of investment in a positive net present value investment; scenario ii) gearing is unchanged in which case $\Delta V_D/\Delta V = V_D/V$ and since $V_D/V < 1$, it follows that $\Delta V_D < \Delta V$. So, while there may be an improvement in the value of the existing debt, there will be a simultaneous improvement in the value of the existing equity and so there will be no under-investment problem (as before, it is difficult to see how gearing could remain unchanged in view of the assumptions); and in scenario iii) gearing is reduced (the most likely outcome) in which case

$(V_D + D + \Delta V_D)/ (V + \Delta V + D + E) - V_D/V < 0$ which can be simplified to

$$(D + \Delta V_D)/ (\Delta V + D + E) - V_D/V < 0 \qquad (2.7)$$

Since the new debt represents a fixed proportion of the total investment that is equal to the existing gearing ratio (by assumption) then

$D/ (D + E) = V_D/V$ and so it follows that

$\Delta V_D/\Delta V < V_D/V$ and since $V_D/V < 1$, it follows that $\Delta V_D < \Delta V$ and hence that $\Delta V_E > 0$. So, there is no under-investment problem as the debt-holders cannot capture all the surplus value. So, while the debt-holders get a benefit, they cannot obtain all the surplus value and there is value remaining for the shareholders.

In case 2, a number of scenarios are considered to cover a range of possibilities: in scenario i) it is assumed that the investment is financed using a mix of debt and equity that ensures that the post-investment gearing ratio is equal to the pre-investment gearing ratio. This equality can be expressed in the following equation.

$$(V_D + D + \Delta V_D)/ (V + \Delta V + D + E) = V_D/V \qquad (2.8)$$

Since gearing is unchanged, there can be no change in the value of existing debt. Hence $\Delta V_D = 0$ and there is no under-investment problem.

In case 2, scenario ii) the mix of debt and equity in the new financing represents a gearing ratio that is greater than that in scenario i) then overall gearing will rise and so the value of existing debt will fall and so there will be no under-investment problem.

However, in case 2, scenario iii) where the mix of debt and equity in the new financing mix is less than in scenario i) (the unchanged gearing scenario) but more than in case 1 then overall gearing will fall and so $\Delta V_D > 0$. So, the expression for the change in gearing becomes

$$(V_D + D + \Delta V_D)/ (V + \Delta V + D + E) - V_D/V < 0 \qquad (2.9)$$

And if it is assumed that the amount of debt = D' + A where D' is the amount of debt that arises in case 1 and A is the balance of debt then the change in gearing simplifies to:

$(A + \Delta V_D)/(\Delta V) - V_D/V < 0$ and so

$(A + \Delta V_D)/(\Delta V) < V_D/V < 1$ and hence that

$A + \Delta V_D < \Delta V$

and since by assumption, $A > 0$ (the example of $A = 0$ amounts to the zero-net present value case and is addressed in case 1 above), it follows that $\Delta V_D < \Delta V$ and so the debt-holders cannot capture more than the net present value of the investment and the circumstances of the under-investment problem do not arise.

In case 3, it is assumed that the investment is financed using a mix of debt and equity that represents a gearing ratio that is less than the pre-investment level and so overall gearing falls below the pre-investment level, so $\Delta V_D > 0$, but it does not follow immediately whether ΔV_E is positive or negative. The outcome depends precisely on the post-investment gearing ratio. Here, if sufficient equity is used, there can be a transfer of value from equity holders to debt-holders. So, the under-investment problem is driven by the financing mix for the new investment.

In these circumstances, there may still be a reduction in equity value, but such a reduction can be addressed by the management techniques discussed further below. Any transfer of value between equity and debt-holders is a consequence of the financing structure rather than the investment itself. This was not considered in Myers (1977).

2.2.3.3 Changes in the value of existing debt (assuming the enterprise value is constant, but volatility varies)

The above analysis considered the differential of V_D with respect to investment while volatility was kept constant. In the analysis that follows, it is assumed that the enterprise value is unchanged following the investment (equivalently, zero net present value investment projects) and instead, changes in firm volatility only are considered. The starting point is equation (3)

$$dV_D/dI = \partial f/\partial V \times dV/dI + \partial f/\partial \sigma^2 \times d\sigma^2/dI.$$

Here, it is assumed that the first product on the right-hand side of the equation is zero because V is kept constant and so dV/dI is zero. So, the equation simplifies to

$$dV_D/dI = \delta f/\delta \sigma^2 \times d\sigma^2/dI.$$

Examining the right-hand side of this equation, $\delta f/\delta \sigma^2$ will be < 0, since rising uncertainty will lead to a reduced value for the debt assuming no changes in gearing. However, $d\sigma^2/dI$ could be positive, negative or zero. The three alternatives are:

Case 1: volatility increases following the investment, so $d\sigma^2/dI > 0$**.** Therefore dV_D/dI = (negative number) x (positive number) = negative number.

Thus, the value of debt declines, and the transfer of value is favourable to shareholders. This is the example in Jensen and Meckling (1976) who comment that this transfer in value could be so large as to induce managers to pursue negative net present value projects since the subsidy from debt-holders could make the projects yield positive returns for the shareholders. This is the asset substitution problem or over-investment problem (the converse of the under-investment problem). However, it is not so easy to see how volatility can be increased by investment. Simply expanding in an existing business activity is more likely to leave risk unchanged or possibly reduce volatility because of the enhanced diversification associated with an increase in scale of operations. An acquisition in a different country with high risk might achieve higher volatility deriving from country risk. However, asset substitution in its strictest sense is addressed by existing regulation requiring companies to publish information on acquisitions and to reveal relevant information to those investing that would preclude such an option.

Case 2, volatility reduces following the investment, so $d\sigma^2/dI < 0$ and risk declines because of the investment. Thus dV_D/dI = (negative number) x (negative number) = positive number

Therefore, the value of debt rises supporting Myers' (1977) assertion. This is the situation in which Myers' (1977) argument works without the need for the debt-holders to capture cash flows ahead of the shareholders. Here, the debt-holders enjoy an increase in value because of lower volatility. This could be achieved by an acquisition in a sector different to the existing business of the company: this is one of the benefits that conglomerates enjoy.

Case 3, volatility is unchanged by the investment so $d\sigma^2/dI = 0$. In this case, $dV_D/dI = 0$ and so there is no change in the value of debt.

As before, internal financing will not affect the outcome. However, external financing is not considered in this scenario since the assumption is that the enterprise value is constant. The impact of internal and external financing has already been considered in the case of constant volatility.

The results of the above analysis are summarised in Tables 2.1 and 2.2. For simplicity, the algebra in the discrete case is used to illustrate the results.

Table 2.1 The range of outcomes for an investment (volatility is constant)
This table sets out the outcomes of a non-negative net present value investment opportunity financed either internally or externally and where volatility is assumed constant, but the enterprise value can vary

Scenario	Outcome
Investment is financed internally:	
For the zero-net present value project, then $\Delta V = \Delta V_E + \Delta V_D = 0$	So $\Delta V_D = 0 = \Delta V_E$ because there is no change in gearing pre- or post-investment: no under-investment problem.
For the positive net present value project, then	Case 1: gearing is unchanged then $\Delta V_D = 0$ (although it is difficult to see how this can arise given the assumption): no under-investment problem.
$\Delta V = \Delta V_E + \Delta V_D > 0$	Case 2: gearing falls so $\Delta V_D > 0$ however, the debtholders are not able to capture more than the overall increase in company value, so the equity holders are not disadvantaged and so no under-investment problem. Case 3: gearing rises and so $\Delta V_D < 0$ and so there is no transfer of value from equity holders to debt-holders rather the opposite occurs so no under-investment problem (but it is difficult to see how gearing could rise given the investment in a positive net present value project).
Investment is financed externally:	
For the zero-net present value project	Case 1: investment is financed entirely with debt so gearing rises so $\Delta V_D < 0$ and so $\Delta V_E > 0$ and hence there is no under-investment problem. Case 2: investment is financed entirely with equity so gearing falls $\Delta V_D > 0$ and so $\Delta V_E < 0$ and hence there could be an under-investment problem caused by the financing decision. Case 3: the investment is financed by a mix of debt and equity in the same proportions as the existing capital structure. This will produce unchanged gearing so $\Delta V_D = 0 = \Delta V_E$ and there is no under-investment problem. It is the particular mix of debt and equity in the financing of the investment that causes the under-investment problem to arise.
For the positive net present value project	
Case 1: the investment is financed with debt and equity in the same proportions as the existing capital structure.	Scenario i): gearing rises so $\Delta V_D < 0$ and so $\Delta V_E > 0$ and hence there is no under-investment problem (although it is difficult to see how this could occur given the assumptions).
	Scenario ii): gearing is unchanged so $\Delta V_D = 0$ and $\Delta V_E > 0$ and hence there is no under-investment problem (although it is difficult to see how this could occur given the assumption). Scenario iii): gearing falls and so $\Delta V_D > 0$ but the debt-holders cannot capture all the increase in value resulting from the positive net present value investment and so there is no under-investment problem.
In case 2, it is assumed that the investment is financed using a mix of debt and equity that ensures that the	Scenario i): where the overall gearing ratio is unchanged after the investment then $\Delta V_D = 0$ and there is no under-investment problem.

post-investment gearing ratio is equal to the pre-investment level (scenario i)); and higher gearing than in scenario i) (scenario ii)); and lower gearing (scenario iii)) that is less than scenario i) but higher than case 1.	Scenario ii): where overall gearing increases post-investment in which case $\Delta V_D < 0$ and there is no under- investment problem. Scenario iii): where overall gearing falls by a mix of debt and equity in the financing of the investment that is less than in scenario i) but more than in case 1. Here, $\Delta V_D > 0$ but the debt-holders cannot capture more than the increase in firm value, so shareholders are not disadvantaged and so there is no under-investment problem.
Case 3, it is assumed that the investment is financed using a mix of debt and equity that represents a gearing ratio that is less than the pre-investment level	Overall gearing falls below the pre-investment level, so $\Delta V_D > 0$, but it does not follow immediately whether ΔV_E is positive or negative. The outcome depends precisely on the post-investment gearing ratio. Here the under-investment problem can arise but only because of the mix of financing of the new investment. As before, it is the particular mix of debt and equity in the financing mix of the new investment and its impact on overall gearing that determines whether there is an under-investment problem.

Table 2.2 The range of outcomes for an investment (enterprise value constant)
This table sets out the outcomes of a non-negative net present value investment opportunity financed either internally or externally and where it is assumed that the enterprise value is constant, but volatility varies

Scenario	Outcome
Investment is financed internally	By assumption, V is constant so there is no external financing and $\Delta V_E + \Delta V_D = 0$.
Case 1: Volatility increases because of the investment.	Increased volatility implies $\Delta V_D < 0$ and so $\Delta V_E \geq 0$. No under-investment problem.
Case 2: Volatility decreases because of the investment.	Reduced volatility implies $\Delta V_D > 0$ and so $\Delta V_E < 0$ and the circumstances of the under-investment problem do arise.
Case 3: Volatility is unchanged because of the investment.	Volatility is unchanged so $\Delta V_E = 0 = \Delta V_D$. No under-investment problem.

The under-investment problem can arise in those situations where the debt-holders enjoy an improvement in their position caused by reducing risk or rising enterprise value (equivalent to a reduction in the gearing ratio) other things being equal. This is the under-investment problem. Billett, King and Mauer (2004) document increases in the value of a target company's bonds (i.e. when it is acquired) if there is the prospect of either a reduction in gearing or a reduction in risk (equivalent to a reduction in volatility) – the circumstances in which there is a transfer of value to another party which potentially reduces the viability of the transaction for the acquirer.

However, there are tools available to management that mitigate this problem. The analysis points to the solution which is essentially to reverse the effects of the financing by a post-investment adjustment in capital structure.

2.2.4 Managing the transfer of value from shareholders to debt-holders

It has been shown that while shareholders benefit from positive net present value projects, ~~but that~~ there may still be a transfer of value from shareholders to debt-holders if $\Delta V_D > 0$. Of course, managers may ignore it. After all, ultimately, the debt-holders are very likely to get the same repayment regardless of any intervening temporary increases in value: however, the debt-holders will benefit from less risk during the life of their investment. In other words, the company will pay too much to the debt-holders compared with the risk suffered. The managers of the company have several ways of mitigating this difficulty.

Where the investment needs to be financed externally, management will have the option to arrange this additional finance in a way that can minimise the transfer of value to the existing debt-holders. The obvious way would be to finance the investment entirely with sufficient debt so that there was no net benefit to the holders of the pre-investment debt: for instance, a combination of debt and equity in proportions that resulted in there being no change in the credit quality of the existing debt as above (in case 2 scenario i)). This should ensure that there is no transfer of value to the existing debt-holders.

An obvious strategy is to increase gearing so much that there is a reduction in the value of existing debt. The existing debt would suffer a reduction in credit quality since overall gearing would have increased and so there would be a fall in the value of the existing debt. This would have the effect of transferring value to the equity holders. This is the scenario in Jensen and Meckling (1976). However, there are disadvantages as described more fully in Chapter 3.

Instead of examining the changes in value of existing debt and equity caused by investment as above, it is possible to examine changes in value of the existing debt and equity caused by changes in capital structure alone without the presence of an investment. These changes can be modelled using the model above. Instead of an investment in a project, a reduction of debt or equity is considered which is financed by means of an issue of equity or debt respectively. This approach separates the impact of changes in capital structure from the impact of the investment.

It can be assumed that this restructuring of capital is a zero-net present value project (ignoring tax shelter considerations) so the analysis summarised in Table 2.2 above applies and $\Delta V = \Delta V_E + \Delta V_D = 0$.

The value transferred to the holders of pre-investment debt can be recaptured by increasing gearing (by issuing debt to finance the purchase of shares). This will transfer value back to the shareholders.

Conversely, the opposite action will make ΔV_E negative and so create the circumstances of Myers' (1977) under-investment problem.

Decisions about financing can be used to manage the under-investment problem. If the company sets as its capital structure objective an unchanged gearing ratio (post-investment) then there should be no transfer of value to the existing debt-holders and the under-investment problem will be avoided.

If there were a transfer of value to the debt-holders then the longer the maturity of that debt, the larger would be the transfer in value. However, this assumes that the capital structure remains at the same level until redemption, so that the debt-holders would benefit throughout the remaining life of the debt. If, after a transfer of value to debt-holders, the company increased gearing to a level that reduced the credit quality of the pre-investment debt, then there would be a fall in value of that debt and the transfer in value would be more than recaptured. Such an increase could occur before redemption. So, the valuation of the transfer in value is not simply a question of maturity. The valuation will depend on whether it is likely that the company will seek to recapture value from debt-holders.

Frank & Goyal (2009) include the observation that gearing is stationary over the long-term as one of their stylized facts. If this is the case, then such a policy of stable capital structure would be consistent with companies avoiding transfers of value between the holders of their securities by maintaining stable gearing ratios. However, the stability of capital structure is by no means settled as there is substantial variation behind the apparent stability.

Baker, Greenwood and Wurgler (2003) examine market timing issues and present evidence that companies time issues of debt to minimise their borrowing costs concluding that capital structure at any point in time reflects the cumulative result of past attempts to exploit market levels rather and that such effects persist for a decade. The ability of managers to time market decisions is questioned by the efficient market hypothesis and by Berlin (2006). Butler, Grullon and Westen (2006) point out that after adjusting for a structural shift in US monetary and fiscal policy in the 1980s, there is no evidence that managers can time debt issues and criticize the techniques employed in Baker, Greenwood and Wurgler (2003).

Such results do not support more orthodox theories of capital structure such as the trade-off and pecking order theories. Consistent with these results, Leary and Roberts (2005) ask if firms rebalance their capital structure? Such a policy is in line with the solution proposed in this section of reversing value transfers (from shareholders to debt-holders) by restoring the previous gearing ratio. Leary and Roberts (2005) included the idea of adjustment costs being a factor in the process of rebalancing capital structure.

However, contrary to Baker and Wurgler (2002), Hovakimian (2006) found that while equity transactions may be timed to exploit favourable market conditions, such transactions did not have significant long-lasting effects on capital structure. Lemmon, Roberts and Zender (2008) report capital structures that are stable over long periods and that the major part of variation is time-invariant.

These approaches assume a target capital structure to which firms revert over time. Research has focussed on estimating the speed of adjustment. However, Hovakimian and Li (2012) suggests that the speed of adjustment is not a meaningful measure of the importance of target gearing ratios. DeAngelo and Roll (2015) suggest that factors that affect gearing can vary over time and so make the process of explaining capital structure behaviour more difficult and/or that capital structure is of second-order importance and is determined as a residual.

These quite different approaches do not preclude the proposed method of management of the under-investment problem – namely reversing value transfers by capital structure adjustments after the adverse transfer. Firms can make such adjustments in a way that is consistent with a stable capital structure target or with a capital structure policy that was more dynamic or flexible.

Where the market believes that the company would recapture value transferred to debt-holders by a subsequent issue of additional debt to return the company to its long run gearing ratio, then the market price of its debt and equity would reflect such a perception. There would not be an initial transfer of value to the debt-holders since the market would judge that the transfer of value to debt-holders would be temporary and that it would be reversed. In this way, the market price of the debt would not reflect a permanent transfer of value. Thus, the willingness of a company to rebalance its capital structure will ensure that the company does not suffer a value transfer from its shareholders to its debt-holders.

This strategy reverses the steps under which value is transferred to the debt-holders. Value can be recaptured by shareholders by putting the debt-holders back into the same (or worse) position that they enjoyed prior to the value transfer. This is achieved by restructuring the balance sheet to restore the value transferred to the debt-holders back to the shareholders.

The recapture strategy is clearly superior to the solution in Myers (1977) which requires the company to either shorten its existing debt maturity in the face of an investment opportunity (which would be costly) and lead to increased default risk; or the company should avoid longer maturities which would also increase default risk.

The recapture strategy is also superior to a related solution of minimising debt. Either the company would have to reduce its gearing in the face of an investment opportunity (which would require the issue of equity or the sale of assets); or the company would stick to a very conservative balance sheet.

Both options are clumsy, costly and excessive compared to the simple strategy of value recapture by restoring and maintaining a constant capital structure.

Solutions related to those in Myers (1977) include options embedded in debt instruments that allow the company to retire the debt issue. This allows the company the option to repay an existing debt issue if it was advantageous. Such a mechanism could be used to prevent value being transferred to debt-holders. However, such debt instruments which allow the company to retire the debt issue prematurely have a higher cost than a similar bond without the embedded option so there is a cost associated with such a mechanism. This option is less attractive than the strategy of value recapture.

The strategy of value recapture suggests that management will need to manage capital structure on a continuous basis. For instance, if, following successful operating performance, the company were to achieve a reduction in its gearing ratio, this would enhance the value of existing debt. Such an improvement could also be brought about by the company enjoying an unexpected windfall in the returns from its investment or the sale of a subsidiary. Any increase in value for the debt-holders would need to be recaptured. This could be achieved by rebalancing the capital structure by buying in equity financed by an increase in gearing.

The main conclusions deriving from the analysis developed in this Chapter are that the under-investment problem arises in only limited situations and that it may depend on how an investment is financed. However, even if the problem does arise, it can be managed in such a way that any transfer in value from equity holders to debt-holders is reversed by an adjustment in gearing. Even if debt cannot be issued to finance the investment itself (in a way that mitigates any transfer in value from the shareholders to the debt-holders), the company may have an opportunity to recapture the transfer of value by a subsequent adjustment in its capital structure which increases its gearing ratio to such an extent that the transfer of value is reversed. The exercise to recapture value transferred to debt-holders can be undertaken after the financing of the investment opportunity with the aim of returning the company to its long run target gearing ratio.

The solutions proposed by Myers (1977) need to be reconsidered. Management do not need to shorten debt maturity to create an opportunity to negotiate with lenders. That opportunity can always be created. Secondly, to prolong employment, management have an incentive to pursue positive net present value opportunities even if there is a transfer of value to the debt-holders. There is an argument that this incentive could encourage them to pursue any investment project when it prolongs their employment.

The next section considers the empirical evidence supporting Myers (1977). This analysis seeks to establish whether the tools suggested in Myers (1977) for managing the under-investment problem (the selection of shorter maturities) can be observed in practice.

2.3 Debt maturity and investment opportunities: empirical evidence

The empirical evidence that provides support for Myers' (1977) solution to the under-investment problem is the observed negative relationship between debt maturity and the market to book value ratio where the market to book value ratio is deemed a proxy for investment opportunities. So, the negative relationship is considered to be evidence that firms adjust their debt maturities to manage the under-investment problem arising from the presence of investment opportunities. The observed negative relationship is reported in several papers including Barclay and Smith (1995), Rajan and Zingales (1995), Guedes and Opler (1996), Antoniou, Guney and Paudyal (2006) and Kleczyk (2012).

The analysis in Myers (1977), suggests that the under-investment problem can be managed by reducing the maturity of debt and/or the amount of debt. Hence the observed negative relationship between gearing and the market to book value ratio could also be considered to support the method of management of under-investment as proposed in Myers (1977).

In this section, analytical and empirical evidence is presented that provides an alternative explanation of the observed relationships (between gearing and debt maturity and the market to book value ratio) that does not provide support for Myers' (1977) solution to the under-investment problem.

Section 2.2.4 above set out alternative techniques that can be employed to manage the under-investment problem that does not require either shortening debt maturity or adjusting gearing. Therefore, the hypothesis that is tested in this section is that there is an alternative explanation for the observed relationships (between gearing and debt maturity and the market to book value ratio) that does not provide support for Myers' (1977) solutions to the under-investment problem.

2.3.1 Literature review

Agency costs do not provide the only theory of debt maturity: tax, signalling and liquidity and market conditions are also relevant. In the tax hypothesis, it is argued that the term structure of interest rates, the marginal tax rate and the volatility of interest rates affect a firm's decision on maturity. A survey of literature relating to debt maturity is contained in Ravid (1996).

Brick and Ravid (1985) argue that when the yield curve is upward sloping, long-term debt is optimal since tax gains are optimised whereas Kane, Marcus and McDonald (1985) use a simulation model to argue that optimal maturity is negatively associated with the tax advantage of debt.

The signalling hypothesis addresses or explains problems of information asymmetry. Where a firm suffers from misperceptions of its quality and is unable to communicate its true state, it will tend to issue short-term debt if its quality is good and vice versa.

In Ross (1973) firms signal their quality by their strong capital structure. Gao and Zhu (2013) review information across countries and find that firms with more informational asymmetries tend to use more debt but less long-term debt.

Dividends are also a potential signal as in Cooper and Lambertides (2016) who find a positive relationship between large dividend increases and increases in gearing contrary to the established negative relationship between dividends and gearing.

The market timing hypothesis suggests firms can take advantage of market conditions to time issues of securities – see Baker and Wurgler (2002).

Other factors explaining debt maturity include size (large companies tend to issue for longer time periods but are also active issuers of commercial paper which is particularly short in maturity); and asset maturity (companies with long life assets tend to issue longer term debt and vice versa). Mitchell (1991) observes that companies on Nasdaq and companies with convertible debt are more likely to issue bonds with a maturity of less than 10 years. Of course, in general, convertible bonds do not have maturities which are much longer than 10 or 12 years.

Morris (1976) identified a positive relationship between the weighted average maturity of debt and company size, gearing, liquidity and asset maturity. He argues in favour of matching assets and liabilities to avoid financial distress problems arising at the time of rollover. This is also an objective of the lenders. The lenders usually plan repayments on a basis that coincides with the company's ability to repay – hence the matching. Long-term debt is most likely to be used by larger, less risky companies with relatively poor growth prospects – Stohs and Mauer (1996). Such companies offer the best credit risk by their size, stability, market position (mature) and reduced risk arising from lower growth.

Barclay and Smith (1995) observe 1) that companies with many growth opportunities (as measured by the market to book value ratio – the ratio of the market value of the enterprise to its book value) have less long-term debt; and 2) that larger companies with good credit ratings have more long-term debt. The authors argue that this supports Myers' (1977) view that companies with significant growth opportunities can avoid certain agency costs of debt (including the under-investment problem) by shortening debt maturity.

However, Stohs and Mauer (1996) argue that the Barclay and Smith (1995) debt maturity regressions are not specified correctly because they do not control for differences in gearing. Stohs and Mauer (1996) included the gearing ratio as an independent variable in their regression of debt maturity finding that the coefficients of the investment opportunity set of variables (such as the market to book value ratio) decline in both magnitude and statistical significance. Their conclusion is that the agency cost explanations of debt maturity are not supported.

All the above studies examined debt maturity on a company basis. The study by Guedes and Opler (1996) examined the maturity of incremental debt issues, observing that large companies with high credit ratings are the most likely to issue long-term debt and the most likely to issue short-term debt. Guedes and Opler (1996) also observed (as did Barclay and Smith (1995)) that companies with strong growth prospects (as measured by the market to book value ratio) tend to issue shorter term debt supporting Myers' (1977) view.

Diamond (1991) argues that poorly rated companies may not be able to borrow long-term at all. This is because investors prefer to hold long-term corporate debt in stable companies with high credit quality. Companies not satisfying these criteria will be unlikely to access this type of finance. This highlights an important aspect of the debt maturity and capital structure choices made by companies in that they can only choose what is offered. If lenders are not happy with companies with low credit quality then debt may not be available or, available only on unacceptable terms.

Barclay, Morellec and Smith (2006) examined the relationship between debt capacity (the additional amount of debt that could be borrowed based on an additional asset) and growth options. They examined the relationship between gearing (as measured by book values) and several variables including the market to book value ratio. The coefficient of the market to book value ratio was estimated at a negative value of 0.01 implying that an improvement in the market to book value ratio from 1.0 to 3.0 would decrease the book gearing ratio by 2% – a very small amount. They contrast this result with an earlier study, Barclay, Smith and Watts (1995), where they regressed market value-based measure of gearing (book value of debt as a proportion of the market value of assets) against the market to book value ratio, obtaining a negative value coefficient of 0.06: their argument is that growth options reduce debt capacity.

The observed negative relationship between debt maturity and the market to book value ratio is also reported in Rajan and Zingales (1995) who cover the US, Japan, Germany, France, Italy, UK and Canada. Johnson (2003) reported a negative relationship. Antoniou, Guney and Paudyal (2006) identify determinants of debt maturity in France, Germany and the UK incorporating factors from the tax, liquidity and agency cost explanations of debt maturity. However, their results do not confirm the negative relationship between debt maturity and the market to book value ratio with statistical significance. Kleczyk (2012) studies US data and reports a negative relationship between debt maturity and the market to book value ratio: also reported are negative relationships between debt maturity and excess bond returns, abnormal earnings, the term spread (essentially a measure of the yield curve) and inflation. Also identified is the positive relationship between debt maturity and firm size.

There are a number of reports of the negative relationship between debt and the market to book value ratio which can be argued supports the arguments in Myers (1977) for example, Rajan and Zingales (1995), Dennis, Nandy and Sharpe (2000) who studied revolving credit agreements, de Jong, Nguyen and van Dijk (2007) (who studied both gearing and debt maturity), de Jong, Kabir and Nguyen (2008) (who studied data from 42 countries), Antoniou, Guney and Paudyal (2008) studied gearing in G5 countries and reported negative coefficients for the market to book value ratios which were statistically significant except for the US. Akdal (2010) measured maturity as debt exceeding 1 year of maturity and total gearing (expressed as a proportion of market and book value) and found negative coefficients for UK data. Dang (2011) found a negative relationship between gearing and the market to book value ratio that was not observed for debt maturity. Harrison and Widjaja (2014) studied the relationship between gearing and the market to book value ratio before and after the financial crisis in 2008 and reported a negative relationship in both periods and for the whole period. Some of these results and those in relation to debt maturity are summarised in the Appendix to this Chapter.

Billett, King and Mauer (2007) investigate the relationship between covenants in loan agreements and i) debt maturity; ii) gearing; and iii) investment opportunities. They find that covenant protection increases with growth opportunities, debt maturity and gearing. Credit risk increases as debt maturity rises or as gearing increases. To manage the risk, lenders seek more legal protection in the form of covenants so a positive relationship between each of debt maturity and gearing and covenant protection is to be expected. The positive relationship between investment opportunities (as proxied by the market to book value ratio) and covenant protections suggests that lenders perceive such companies as having higher credit risk suggesting a further rationale for the negative relationship between gearing and investment opportunities.

Chava, Kumar and Warga (2010) conclude that “firms voluntarily proscribe their operational flexibility to lower agency risk for bondholders and reduce the cost of debt financing”: however, this suggests that covenants are proposed by firms but in fact they are demanded by lenders to protect their position: borrowers would rather avoid all covenants if that were possible. The position of the firm is that they will negotiate covenants in the interests of obtaining finance at a suitable cost and with an acceptable degree of restriction on operational flexibility. It is not the firm seeking to protect the debt-holders by inserting covenant protections.

Rajan and Winton (1995) point out that monitoring increases in the presence of a separate class of creditor encouraging lenders to seek additional security and, when lenders are collateralised, monitoring reduces since lenders have the best possible position available. The incidence of taking collateral increases in the period prior to financial distress.

The main conclusion of the empirical studies in relation to agency costs is that there is a negative relationship between debt and debt maturity and companies with growth opportunities as proxied by the market to book value ratio. This negative relationship is included in Frank and Goyal (2009) as one of their stylised facts.

2.3.2 Developing testable hypotheses

The analysis described and conducted in this section extends the methodology employed in the empirical studies reported above with the objective of testing whether the hypothesis that the negative relationship between debt maturity and gearing and the market to book value ratio is consistent with Myers' (1977) solution for the under-investment problem or whether alternative explanations for these negative relationships are available in the light of the various analyses conducted in section 2.2 above and below.

In designing the hypotheses, two alternative explanations for the negative relationship between gearing and debt maturity (since they are related as in Stohs and Mauer (1996)) and the market to book value ratio are presented. The first considers an accounting perspective behind the calculation of the market to book value ratio (the accounting treatment of investment expenditures); and the second examines the construction of the market to book value ratio and the gearing ratio and shows how their structure can produce a negative correlation between the two.

The accounting for different types of investment expenditure can affect the market to book value ratio as the following analysis demonstrates. Suppose a new company seeks to invest an amount "A" at a rate of return equal to its cost of capital – in other words, an investment in a project with zero net present value. Suppose that this investment comprises two different types of expenditure; first, investment in plant and equipment – capital expenditure – and other expenditure on items that will be recorded in the balance sheet as tangible assets including working capital; and secondly, expenditure on items that are not tangible such as advertising, promotion, research, marketing, exploration and so on and in respect of which, the company's auditors require such expenditure to be expensed – written off in the income statement.

Suppose the proportion of the total investment that is invested in assets that are recorded in the balance sheet is θ. The balance sheet will therefore consist of assets with value θ.A immediately after investment. The quantity θ will vary from company to company depending on the nature of the activity of the company. Those companies operating in capital intensive industries will tend to have higher values for θ than say businesses with high levels of expenditure on off-balance sheet items.

These two types of expenditure can be defined as balance sheet investment (because the investment is recorded there); and off-balance sheet investment (since, by definition, such expenditure is written off and ~~so it~~ cannot appear in the balance sheet).

If a lender were invited to provide some debt for this project and that they might take a simple view offering to lend a proportion, ϕ, against the book value of the assets in the balance sheet. Then, the maximum amount of debt will be given by $\phi.\theta.A$. It is reasonable to assume that the lender considers that the off-balance sheet investment is not suitable as support for a loan and so the lender takes no account of its value for the same reasons the auditors require such expenditure to be expensed (written off).

The market value of the enterprise (the sum of the market values of the company's debt and equity) is assumed to be given by the present value of its cash flows which must be A, since by assumption, it is assumed to be an investment with zero net present value. Hence the market to book value ratio will be A divided by the book value, $\theta.A$, which is simply $1/\theta$.

The gearing ratio computed using market values is the amount of debt ($\phi.\theta.A$) divided by the company's enterprise value (at market values which is equal to A) which simplifies to $\phi.\theta$.

So, in a regression model, the dependent variable, gearing (based on market values) is $\phi.\theta$ and one of the independent variables, the market to book value ratio, is $1/\theta$. If θ is large, then the amount of debt and gearing will be large but the market to book value ratio will be small and vice versa. The two quantities are clearly inversely related. Attempting to fit a regression line for gearing (based on market values) against the market to book value ratio will inevitably produce a negative coefficient for the market to book value ratio. The negative relationship is simply the consequence of the lender's approach to the amount of a loan that can be supported by the assets in place coinciding with the auditor’s approach to recognition of assets that can be shown on a balance sheet.

This analysis presents an alternative explanation for the negative relationship between gearing (based on market values) and the market to book value ratio that provides no insight into the management of the under-investment problem.

Interestingly, if the value of θ is a maximum of unity, then the minimum value for the market to book value ratio is unity.

This model although somewhat simplistic can be extended to many investments with the same criteria where the company makes new investments each year. The same relationship between gearing and the market to book value ratio will arise. This model needs a label and is hereafter referred to as the on-off model (distinguishing between on-balance sheet and off-balance sheet expenditure).

2.3.2.1 Alternative measures of investment opportunities

The above analysis is also relevant to alternative measures of investment opportunities. The alternative measures are also affected by the split between balance sheet investment and non-balance sheet investment.

An alternative measure of the investment opportunity set suggested in Barclay and Smith (1995) and Adam and Goyal (2008)) is the price earnings ratio which is a measure of value. This is tested in Adam and Goyal (2008) who compute a value for the company’s investment opportunities by focussing on mining companies since such companies publish information on their reserves which can be valued using an option pricing model: the estimated company valuations are then compared to the alternative measures of the investment opportunity set. Mining companies with reserves of minerals in the ground are investment opportunities and can be valued using option pricing techniques as can producing mines.

The authors find the market to book value ratio to be the best performing proxy. They also find that the price earnings ratio is significantly correlated with firms' investment opportunities; and that the purely accounting-based proxy (capital expenditure to assets in place), also appears to be positively related to the value of investment opportunities, but that this relation is not robust.

Mining companies (as used in Adam and Goyal (2008)) and oil exploration companies illustrate the difference between balance sheet expenditure and expenditure that must be written off. A mining exploration company which drills holes seeking minerals is required under conventional accounting policies to write off the costs of unsuccessful exploration – which is obviously sensible. Eventually, it is hoped that the company will make a discovery at which time the value of the potential resources identified will be reflected in the company's share price but not necessarily in its balance sheet. The company will then have higher market value but no corresponding higher balance sheet value and certainly little ability to borrow on balance sheet assets (at least not until the discovery has been proved by further appraisal work such as additional drilling). This is a good example of high market to book value ratio but low gearing – an inverse relationship. Here the value of θ for this type of activity will be low since exploration expenditure that is unsuccessful will not be recorded as an asset in the balance sheet.

The market to book value ratio will reflect potential value as well as existing value – so the value of existing mines and potential mines will be reflected in the share price. For a mine to be developed, there will need to be substantial capital expenditure that will be recorded in the balance sheet and the market to book value ratio will then fall as the balance sheet expands without necessarily any increase in market value.

An option pricing model was used in Adam and Goyal (2008) to estimate market values of mining companies with existing mines and discoveries. Option valuation is a technique that is suitable for the valuation of mining companies, so it is to be expected that there will be a good correlation between the market to book value ratio and the value of investment opportunities based on an option pricing model as was observed.

The authors also find some evidence of a relationship between the price earnings ratio and the option valuation approach. The valuation methodology based on price earnings ratios works when companies produce earnings but mining discoveries that are investment opportunities (i.e. not developed) produce no earnings. Companies that have both mines in production and discoveries will have some earnings (from producing mines) that will be reflected in the share price, but the potential value of discoveries will also be reflected in the share price thus increasing the price earnings ratios beyond that of a company that has only producing mines. So, if a company makes a discovery that is not producing earnings and is not reflected in the balance sheet, then this will increase the value of the company and hence the market to book value ratio and similarly will increase the price earnings ratio. So, there is likely to be a positive relationship between the market to book value ratio and the price earnings ratio as reported in Adam and Goyal (2008).

Barclay and Smith (1995) also considered alternative proxies for investment opportunities: research and development expenditure (as a proportion of firm value); depreciation (as a proportion of firm value); and the earnings price ratio (the inverse of the price earnings ratio).

Research and development expenditure will be associated with companies that generate intangible value. Current accounting practice is to write off research expenditure (an example of which is exploration expenditure) but to capitalise (i.e. include in the balance sheet) development expenditure (as with the construction costs of a mine). Writing off research expenditure has the effect of reducing book values and so enhances the market to book value ratio: for this type of expenditure the value of θ is zero. Research expenditure is like marketing or promotional costs for a brand and cannot be included in the balance sheet and must be written off. High expenditure on research and development (expressed as a proportion of firm value) will tend to be correlated with companies with low θ and hence have higher market to book value ratios and be negatively related to debt maturity: this was confirmed by Barclay and Smith (1995).

Equally, companies with higher levels of depreciation (expressed as a proportion of firm value) will tend to be associated with companies that have investments in tangible assets such as plant and machinery and are likely to have higher θ values and hence lower market to book value ratios. So, a positive relationship is to be expected between depreciation (as a proportion of firm value) and debt maturity: this relationship was confirmed in Barclay and Smith (1995).

The earnings/price ratio used in the Barclay and Smith (1995) study is the inverse of the price earnings ratio used in Adam and Goyal (2008) who identified a good correlation with the investment opportunity set (and indirectly the market to book value ratio). So, it is to be expected that the earnings/price ratio will be positively related to gearing as was confirmed in Barclay and Smith (1995). These comments are summarised in Table 2.3.

Table 2.3 Comparison of proxies for investment opportunities
This table sets out a comparison of alternative proxies for the measurement of investment opportunities and their relationship to gearing and possible alternative explanations

Proxy for investment opportunities	Predicted relationship	Alternative explanation
Market to book value ratio	Negative confirmed by Barclay and Smith (1995)	High market to book value ratios tend to be associated with companies with asset-light balance sheets which borrow less than companies with tangible assets in their balance sheets; a lesser borrowing capacity is associated with shorter maturity.
Research and development expenditure/firm value	Negative confirmed by Barclay and Smith (1995)	A high value for this proxy tends to be associated with companies with asset-light balance sheets that are not ideal candidates for debt
Depreciation/firm value	Positive confirmed by Barclay and Smith (1995)	Higher depreciation tends to be associated with companies with tangible assets so a lower market to book value ratio and so more debt including longer term debt.
Earnings/price ratio	Positive confirmed by Barclay and Smith (1995)	Earnings/price is inversely related to the price earnings ratio which is positively related to investment opportunities and hence to the market to book value ratio as reported in Adam and Goyal (2008).

Adam and Goyal (2008) identified a non-robust relationship between the ratio of capital expenditure to book assets and the estimated market value of the company (as a proxy for the investment opportunity set).

These alternative measures of the investment opportunity set do not overcome the link between the market to book value ratio and gearing (based on market values) that is caused by the proportion of investment expenditure that is recorded on the balance sheet (which is the factor θ discussed above).

There is a further factor that contributes to the negative relationship between gearing and the market to book value ratio which is considered below.

2.3.2.2 Spurious negative correlation due to structural links between the market to book value ratio and gearing (based on market values)

If the market to book value ratio is a good proxy for investment opportunities, then a company with stable capital structure and without any investment opportunities with significantly positive net present value should exhibit a stable market to book value ratio over time.

If a company obtains an investment opportunity which has a significantly positive net present value, then its equity value will rise to reflect the increase in shareholder value once the details of the investment are known to the market. When the equity value increases so will the market to book value ratio (as the book value will be unchanged until the time when investment begins).

However, there will also be a corresponding reduction in gearing when it is measured by the ratio of debt to the market value of the enterprise (assuming no changes in the amount of debt issued by the company). The amount of debt should be unchanged until the investment begins or until the company takes a step to adjust its capital structure. An investment opportunity with positive net present value will therefore tend to increase the market to book value ratio and decrease the gearing ratio (when measured by the ratio of debt to the market value of the enterprise value) at the time of revelation to the market. This causes a negative correlation between the two variables.

Similarly, for the under-investment problem, if a company obtains an investment opportunity with a negative net present value then, once known in the market, the share price and market value would fall and at the same time gearing (measured by the ratio of debt to the market value of the enterprise value) would rise contributing to the same negative correlation as above.

This negative movement in the variables caused by their structure could explain some, or all, of the negative relationship detected between these two variables. It might be that the negative relationship detected is due entirely to this effect and that the observed relationship provides no insight into the management of capital structure or the under-investment problem.

Parsons and Titman (2008) commented on the “mechanical” link between gearing and the market to book value ratio and suggested caution when using this variable. Barclay and Smith (2005) also acknowledge this link.

The use of gearing based on market values is to capture the absolute amount of debt rather than a split between time periods. The absolute amount of debt captures the potential transfer of value more precisely than the ratio of long-term debt to total debt. The appropriate regression equation would include the dependent variable as i) the ratio of debt with maturity longer than 3 years expressed as a proportion of total debt; and ii) gearing expressed as a proportion of the market value.

If gearing or debt maturity is measured by a fraction which has the market value of equity in the denominator then since the market to book value ratio has the market value of equity in the numerator, an inverse relationship is to be expected between gearing/debt maturity and the market to book value ratio. As equity value increases, the market to book value rises and gearing/debt maturity falls and vice versa.

It is also possible to consider computing a gearing ratio based on the amount of debt with maturity longer than say 3 years as a proportion of market value as this addresses the absolute amount of debt (with longer maturity) which might be responsible for the major part of a transfer of value from shareholders to debt-holders.

Suppose the market to book value ratio is (E+D)/BVTA where E = market value of equity; D = debt; and BVTA = book value of total assets; suppose also that the gearing ratio is D/(E+D) where it is expressed as a proportion of the enterprise value; and that a measure of debt maturity is D_3/E which expresses the amount of debt with a maturity more than 3 years (i.e. D_3) as a fraction of the enterprise value (E+D).

Then the dependent variables are i) gearing = D/(E+D); and ii) debt maturity = $D_3/(E+D)$

In the situation where the company does not have any investment opportunities with substantially positive net present value, then the market to book value will be stable other things being unchanged. Suppose there is a sudden increase in the equity value arising from the acquisition of a new and highly profitable investment opportunity – having substantial positive net present value. This can be modelled using a quantity, Δ, which represents the increase in shareholder value. This will affect the dependent variables as follows: i) gearing = $D/(E+D+\Delta)$; and ii) debt maturity = $D_3/(E+D+\Delta)$.

The adjusted market to book value ratio will be given by $(E+\Delta+D)/BVTA$. In the dependent variables, Δ is in the denominator and in the explanatory variable, the market to book value ratio, Δ is in the numerator. As Δ rises, the values of the dependent variables fall and the value of the market to book value ratio rises (and vice versa). There is a negative relationship that arises as a direct consequence of the construction of the two variables. This construction effect can explain the negative relationship between debt maturity and the market to book value ratio as reported in Barclay and Smith (1995) and others.

This analysis assumes that the market to book value residual reacts to the acquisition of a significantly positive net present value project but that the corresponding investment has not been made. But as time passes, the investment will be financed and appear on the company's balance sheet and this will impact upon both the market to book value ratio and the gearing ratio. There will be a further change in these two quantities.

Assume that the investment amounts to J and that this is financed by using a mix of debt and equity in the same gearing ratio based on market values as prevailed before the investment opportunity was acquired. This will restore the gearing ratio to the long run level. It is also assumed that an investment of J will increase the book value of the enterprise value – here the reality that there will be some non-balance sheet expenditure that will be expensed can be included using the ratio θ as above: the increase in the book value will therefore be θ.J. It is also assumed that the expenditure of J will increase the market value of the enterprise by the same amount. Some additional labels are needed. Let the gearing ratio be G and let the market to book value ratio be M, in both cases, these are the values that apply prior to the acquisition of the investment opportunity. Assume also that the ratio of debt with a maturity of more than 3 years is G_3 and that it is also stable over time.

After financing the new investment, gearing will return to the long run gearing ratio of G and the book value of the enterprise will increase from BVTA to BVTA+J; and the market value of the enterprise will increase from D+E+Δ (the level after acquisition of the investment opportunity but prior to any investment spending) to D+E+Δ+J. The new market to book value ratio will be (D+E+Δ+J)/ (BVTA+θ.J). This quantity can be compared to the market to book value ratio after the acquisition of the investment opportunity but before investment of: (D+E+Δ)/BVTA. The difference is (D+E+Δ)/BVTA less (D+E+Δ+J)/ (BVTA+θ.J) which can be simplified by inserting in place of (D+E) the term M.BVTA. The above expression then simplifies to

(M.BVTA+Δ)/BVTA less (M.BVTA+Δ+J)/ (BVTA+θ.J)

By inserting (θ.M.J - θ.M.J) into the top of the right-hand fraction, the expression becomes

(1+Δ/BVTA) less (1+Δ+J - θ.M.J)/ (BVTA+θ.J)

As it is assumed that M = 1/θ so the expression simplifies further to

Δ/BVTA less Δ/ (BVTA+θ.J) which is clearly positive for θ > 0 and hence the market to book value declines at the same time as gearing rises. Once again, a negative correlation occurs between changes in these variables. This approach applies to debt maturity which will also demonstrate a negative correlation to the market to book value ratio thus providing a further explanation for the negative relationship between debt maturity and the market to book value ratio reported in Barclay and Smith (1995) and elsewhere.

A similar argument follows for the ratio of the amount of debt with maturity longer than 3 years as a proportion of market value (assuming that debt maturity remains at a constant proportion of total debt).

The variables, gearing and the market to book value ratio will change as set out in Table 2.4.

Table 2.4 Causes of changes in the market to book value ratio, gearing and maturity
This table demonstrates how changes to the market to book value ratio, gearing (based on market values) and maturity (based on market values) are driven by changes in the market value of the enterprise caused by the acquisition of a profitable investment opportunity

Time of measurement	**Gearing based on market values**	**Gearing with maturity > 3 years**	**Market to book value ratio**
1 Before the acquisition of the investment opportunity	$D/(D+E) = G$	$D_3/(D+E) = G_3$	$(D+E)/BVTA = M$
2 Once the opportunity has been acquired and is disclosed to the market but before the investment has been made	$D/(D+E+\Delta) < G$ Gearing falls	$D_3/(D+E+\Delta) < G_3$ The amount of debt maturing after 3 years (as % of market value) falls	$(D+E+\Delta)/BVTA > M$ The market to book value ratio rises
3 After the investment has been made and based on maintaining the long run gearing and maturity ratio	G Gearing rises and returns to its long run level	G_3 The amount of debt maturing after 3 years (as % of market value) rises	$(D+E+\Delta+J)/(BVTA+\theta.J)$ $< (D+E+\Delta)/BVTA$ The market to book value ratio falls after investment

Table 2.4 indicates that over time, changes in the market to book value ratio are negatively linked to changes in gearing. When gearing falls, the market to book value ratio rises and vice versa. The relationship is negative for the proportion of debt maturing after 3 years (expressed as a proportion of the market value). This could explain some, or all, of the inverse relationship between the market to book value ratio and gearing/debt maturity that has been observed.

This inverse relationship can be modelled using a simple Monte Carlo simulation. First, two sets of numbers are generated randomly, M and G. These have no correlation so that when they are regressed against each other, no statistically significant relationship can be detected. These numbers are then used as proxies for the stable values of the market to book value ratio (M) and a measure of gearing or maturity (G).

A random number was then used to generate changes in equity value (i.e. Δ). This was then used to model changes in both M and G as follows:

M is translated into M x (1 + Δ); and

G is translated into G / (1 + Δ)

M and G are generated using Excel's random number function, so they are numbers between zero and one. To ensure that Δ is scaled appropriately, it is set as a fraction of a random variable and rescaled by deducting 0.5 so that it can also model the under-investment problem (i.e. negative net present value projects). The translated variables are then regressed. An inverse relationship was detected as predicted.

The strength of this relationship depended on the scale factor. Where the size of Δ in relation to M and G was high (say around 50%) then the detected negative relationship was statistically significant. This is only a simulation to illustrate the possibility that the relationship detected between gearing and the market to book value ratio (and residual) could be explained in part by the structure of these variables.

The change in market value of the company could instead be caused by any change in market values – not necessarily the acquisition of an investment opportunity with positive or negative net present value. Suppose some news causes the market to judge that share prices are low in relation to prospects for corporate profits: this would lead to an increase in share prices generally. This effect might be restricted to a group of companies rather than all companies (e.g. to a sector or to those companies with a significant exposure to a country or region). This effect could create the Δ as described in the analysis above in relation to an investment opportunity.

In a similar way, bad economic news could cause a negative movement in share prices. Good (bad) economic news will put up (down) the market to book value ratio and at the same time reduce (increase) gearing (measured by the ratio of debt to the market value of the enterprise) and debt maturity (measured by the ratio of debt beyond a specified time horizon to the market value of the enterprise). This will cause a negative correlation between these variables as the analysis above demonstrates and as is reported in Barclay, Marx and Smith (2003) and elsewhere.

This source of negative correlation between gearing (based on market values) and the market to book value ratio is hereafter referred to as the structural connection between the two variables.

So, general movements in share values will also contribute to the negative correlation (between gearing measured against market values and the market to book value ratio) in the same way as the presence of a significantly positive net present value investment opportunity. Together these two effects (the on-off model and the structural problem) may explain all the negative correlation between gearing (based on market values) and the market to book value ratio. There may be no implications for the under-investment problem.

The market to book value ratio includes the market value of the enterprise in the numerator. The implications of the on-off model and the structural link identified above between gearing (based on market values) and the market to book value ratio apply directly to the measure of the company's size which is taken as the natural logarithm of the market value of the enterprise. It is therefore to be expected that size (market value of the enterprise) and the natural logarithm of size will be negatively correlated with gearing (based on market values).

2.3.2.3 Developing hypotheses to explain the relationship between debt and maturity and the market to book value ratio

Given the analysis above, testing gearing based on market values against the market to book value ratio will identify a negative relationship that doesn't necessarily represent evidence of the management of the under-investment problem; and similarly, for the ratio of debt maturing after 3 years expressed as a proportion of the market value of the enterprise. Hypotheses 1 and 2 broadly replicate what has already been reported in the literature and summarised in the Appendix to this Chapter. This amounts to a test on the data to confirm past results. Both hypotheses are implied by the on-off model and the structural problem described above and possibly also by Myers' (1977) solution for the under-investment problem.

- Hypothesis 1: Debt maturity (measured as the amount of debt maturing after 3 years as a proportion of the total debt) will be negatively related to the market to book value ratio. This is implied by the on-off model and the structural problem described above and possibly also by Myers' (1977) solution for the under-investment problem.

- Hypothesis 2: Gearing (expressed in market value terms) will be negatively related to the market to book value ratio. This is implied by the on-off model and the structural problem described above and possibly also by Myers' (1977) solution for the under-investment problem.

This definition of debt maturity used in hypothesis 1 (and in previous studies) is not perfect. Company A with a low level of gearing could have a high proportion of debt maturing after 3 years whereas company B might have a higher level of gearing with a large proportion of debt maturing before 3 years. The method of characterising maturity as the proportion of debt maturing after say 3 years would show company A as having a higher proportion of debt maturing after 3 years compared with company B. However, company B might have more long-term debt as a proportion of total book value. The problem of agency costs is not just about maturity but also about the amount of debt. Shortening debt maturity is one solution (as argued in Myers (1977)) but reducing the amount of debt also reduces the potential transfer of value from shareholders to debt-holders. Here, additional variables can be used to assess the relationship between debt maturity and the market to book value ratio. The amount of longer-dated debt can be addressed by computing a gearing ratio based on debt maturing after 3 years expressed as a proportion of market value or book value. This provides an alternative measure of debt maturity.

The measure of debt maturity that is used in hypothesis 3 is the amount of debt that has a maturity greater than 3 years expressed as a proportion of market value. This has the advantage that the amount of longer term debt is used rather than a proportion of total debt (as hypothesis 2).

- Hypothesis 3: Maturity (the amount of debt with a maturity longer than 3 years expressed as a proportion of the market value of the enterprise) will be negatively related to the market to book value ratio for the reasons given above.

To examine whether there is a negative relationship between gearing and the market to book value ratio that avoids the problems identified above, gearing (and debt maturity) can be expressed in terms of the book value of assets rather than the market value. In the on-off model above, debt amounted to $\phi.\theta.A$ and the market value of the enterprise value amounted to A so that the gearing ratio measured using market values simplified to $\phi.\theta$ whereas the market to book value ratio was simply A divided by $\theta.A$ or $1/\theta$. If instead of market values, book values are used to compute gearing, then gearing will be $\phi.\theta.A/\theta.A$ which simplifies to ϕ and hence θ does not feature on the left-hand side of the regression equation and so the negative relationship inherent in the model is avoided.

Similarly, if the company acquires a positive net present value project, then while this affects the market to book value ratio, it won't affect the gearing ratio (based on book values). The choice of book value to measure gearing avoids the structural problems described above. In addition, if debt is provided by lenders by reference to the amount of the book value of the enterprise value, then to the extent that the company has a high market to book value ratio, this is more likely to encourage lenders to lend more than would be indicated by the book value of assets rather than less since the additional value inherent in the market to book value ratio is likely to be linked to additional future profitability which would encourage lenders rather than discourage them.

Therefore, there should be a positive relationship (or, as a minimum, not a negative relationship) between gearing (measured using book values) and the market to book value ratio. Accordingly, additional hypotheses can be formulated.

- Hypothesis 4: Gearing (debt expressed as a proportion of the book value of the enterprise) will be positively (or at least not negatively) related to the market to book value ratio. This hypothesis, if substantiated, contradicts Myers' (1977) solution for the under-investment problem; and similarly

- Hypothesis 5: Maturity (the amount of debt with a maturity longer than 3 years expressed as a proportion of the book value of the enterprise) will be positively (or at least not negatively) related to the market to book value ratio. As before, this hypothesis, if substantiated, will contradict Myers' (1977) solution of the under-investment problem.

However, there may be a further alternative explanation. Since the market to book value ratio is strongly negatively related to company size and since debt maturity (as measured by the proportion of debt maturing after 3 years and as the ratio of debt maturing after 3 years as a proportion of total book value) is positively related to size (these relationships are confirmed in the correlation statistics in Table 2.7 below) then it is to be expected that even when maturity is measured using book values that a negative relationship between debt maturity and the market to book value ratio will be seen. The common factor is size. To adjust for this size effect, the market to book value ratio can be scaled by the size variable (the natural logarithm of the enterprise value) to create a new independent variable which is defined in Table 2.5 (scaled MTBV is the market to book value ratio divided by the size variable).

A modified hypothesis can be formulated:

- Hypothesis 6: the amount of debt maturing after 3 years expressed as a proportion of the book value will not be negatively related to the scaled market to book value ratio.

The strategy of value recapture suggests that adjustments to gearing (should they be needed) will occur from time to time. This implies a negative relationship between changes in gearing (based on market values) and changes in the market to book value ratio. Such a relationship would tend to confirm the validity of the model that gearing (based on market values) and the market to book value ratio are negatively related due to the way they are constructed rather than providing evidence of the management of agency costs. This negative relationship should also be seen when changes in debt maturing after 3 years (expressed as a proportion of market value) is used in place of changes in total gearing.

In direct contrast, if gearing (based on book values) is positively related to the market to book value ratio then we would expect to see changes in gearing (based on book values) positively related to changes in the market to book value ratio.

Three further hypotheses can therefore be formulated:

- Hypothesis 7: Changes in gearing (based on market values) are negatively associated with changes in the market to book value ratio;

- Hypothesis 8: Changes in debt maturity (measured by expressing the amount of debt with a maturity longer than 3 years as a proportion of the market value of the enterprise) will be negatively related to changes in the market to book value ratio; and

- Hypothesis 9: Changes in gearing (based on book values) are positively associated with changes in the market to book value ratio.

Changes in the market to book value ratio and gearing can be computed as the difference between the value in one year and the value in the previous year. This quantity can be used in substitution for the actual market to book value ratio and similarly for gearing.

The method of testing these hypotheses is described in the next section.

2.3.3 Data and methodology

The data are taken from Compustat for North American companies for the period 1995 – 2014: this sample includes data where the company is not present for the full period, thereby avoiding survivorship bias. A total of 195,600 company-year observations in respect of 23,600 companies are included. However, not all company-year observations are complete and so the usable data are smaller in number: the sample size available varies between each regression depending on the variables employed. A further constraint is the requirement to use lagged values of the variables: this requires that each company-year observation has a corresponding value for the previous year. This requirement leads to a further reduction in sample size where there is no previous company-year value. For instance, using system GMM with two lags requires 3 consecutive company-year observations and so the sample size for this approach is smaller than for fixed effects modelling where only two consecutive company-year observations are required. For these reasons, the sample size varies between regression analyses.

The sample excludes financial companies (with SIC codes between 6,000 and 6,499).

Yield curve data are taken from the US Treasury website, US consumer price index data are downloaded from US Department of Labour website and yields on corporate bonds by maturity are from Bank of America Merrill Lynch/Federal Reserve Bank of St Louis, Economic Data.

Not all companies provide data for all years and so this is an unbalanced panel dataset (of the small "T" large "N" type). Also, certain values for some variables are extreme and need to be modified. It has therefore been necessary to winsorize variables at the 1% level following Johnson (2003). Summary statistics of the data are set out in Table 2.6.

The next part of this section addresses the variables, the equations and the methods of estimation.

2.3.3.1 Variables

The regression equation used in Barclay and Smith (1995) includes the following independent variables: the market to book value ratio; a regulation dummy; the logarithm of company size, an abnormal earnings measure; and a measure for the term structure. Stohs and Mauer (1996) use similar variables but include also company gearing, tax rates, asset maturity, credit rating, and a measure of earnings volatility. Barclay, Marx and Smith (2003) also include profitability but exclude abnormal earnings, tangibility (the proportion of fixed assets to total assets); tax variables, asset maturity and a commercial paper dummy. Similarly, Barclay, Smith and Morellec (2006) used the market to book value ratio, a regulation dummy, the logarithm of real sales, a tax credit dummy, the fixed asset ratio, profitability and a net operating loss dummy.

Johnson (2003) used predicted leverage, the market to book value ratio, asset life, size and size squared, volatility, investment tax credit dummy, net operating losses, a rating dummy, abnormal earnings and the yield curve.

Antoniou, Guney and Paudyal (2006) included an extensive set of regressors covering the main hypotheses of debt maturity namely tax minimisation, liquidity risk and signalling (see Connelly, Certo, Ireland and Reutzel (2011) for a review of these ideas), contracting/agency costs and equity market conditions.

Kleczyk (2012) includes the market to book value ratio, a regulation dummy, size (logarithm of market value), abnormal earnings, excess bond returns, the term spread, inflation, the short-term real rate of interest and dummy variables for each month in which debt is issued.

In the empirical analyses conducted in this Chapter, the primary concern is to explain the reported negative relationship between debt and debt maturity and the market to book value ratio as this is considered to support Myers' (1977) solutions to the under-investment problem. However, additional independent variables are included within the modelling structure to ensure that the model specifications are not subject to under-specification biases. This selection is also informed by the choice of explanatory variables employed in testing the relationship between gearing and the market to book value ratio. The definitions of the variables employed are set out in Table 2.5 below.

Table 2.5 Definitions of the variables and expected signs of coefficients

This table sets out the definitions of all the variables used in the regression analyses and their expected signs

Debt maturity	The amount of debt maturing after 3 years expressed as a proportion of total debt following Barclay and Smith (1995) and Kleczyk (2012). Johnson (2003) uses the complementary proportion of debt maturing within 3 years.
Debt maturity (book value)	The amount of debt maturing after 3 years expressed as a proportion of the book value of the company. This is the definition used in Barclay and Smith (1995).
Gearing (market value)	The total amount of debt expressed as a proportion of the market value of the company. This formulation is commonly used (see Kleczyk (2012)).
Gearing (book value)	The total amount of debt expressed as a proportion of the book value of the company. This formulation is commonly used (see Kleczyk (2012)).
The market to book value ratio	The enterprise value (the sum of the market values of debt and equity) divided by total book value of assets as used in Barclay and Smith (1995), Antoniou, Guney and Paudyal (2006), Johnson (2010), Kleczyk (2012) and elsewhere. This variable is considered to represent the company's investment opportunity set. To the extent that a company has valuable investment options (i.e. having a positive net present value) the company's market value will reflect this potential value. The greater the value of these options the greater will be the market to book value ratio. Such companies are potential candidates for the under-investment problem as envisaged in Myers (1977).
Expected sign	"–" to track existing results in the literature except where positive coefficients are hypothesised above.
Regulation	A dummy variable that takes a value of 1 if the company is regulated (ie has a SIC code between 4000 and 4999) but is otherwise zero. It is argued in Barclay and Smith (1995) that regulated companies have less discretion over investment decisions so the need for the supposed discipline of shorter term debt maturity is lower with the result that regulated companies should have longer maturity debt than non-regulated companies. Since ~~such~~ regulated companies are likely to be large and with relatively modest growth prospects, they are ideal candidates to issue long-term bonds. Regulated companies represent approximately 10% of the total dataset.
Expected sign	"+" since such companies have less need to manage under-investment problems.
Size	The natural logarithm of the enterprise value adjusted by US inflation (the Consumer Price Index) following Johnson (2012). Larger firms will be able to issue longer maturity bonds with lower issue costs and lower cost of debt in general (because of lower volatility) compared to smaller firms and hence size should be associated with longer maturity as reported in Barclay and Smith (1995), Johnson (2003) and Kleczyk (2012). However, some large companies use commercial paper which is short-term (less than 1 year) and can be a permanent source of cheap debt. If this is present, it will counteract the tendency for larger firms to have longer maturity debt.
Expected sign	"+" as, in general, larger companies can borrow for longer: however, for gearing based on market values, a negative relationship is implied by the on-off model and the structural model since the logarithm of market value is on the right-hand side of the regression equation in the numerator but is in the denominator in the left-hand size of the regression equation. This should not be the case where gearing is measured using book values where the structural problems are avoided.
Commercial paper dummy	A dummy variable that takes the value of unity if the company has a short-term credit rating and is zero otherwise. This addresses the possibility that some

companies, particularly large ones, issue commercial paper and so will tend to have shorter maturity overall than companies that do not issue commercial paper. This variable is included in Barclay, Marx and Smith (2003).

Expected sign "–" as companies that can issue commercial paper thereby shorten their debt maturity.

Abnormal earnings The proportionate change in earnings, year on year (i.e. next year's earnings compared with the current year) as in Barclay and Smith (1995). This variable assesses the management's private knowledge of the future and is a measure of information asymmetry. If future earnings are unexpectedly good, then this would enhance the value of the company's bonds. So, to avoid such a transfer of value, the company should minimise the maturity of its debt and vice versa. By minimising the maturity, the potential transfer of value is reduced (as discussed above). Hence a negative relationship between future earnings and maturity is to be expected. However, significant changes in debt maturity are not easy to achieve on an annual basis. It is not practical for a company to change its maturity profile each year to reflect the management's expectations about the following year's earnings. There could be substantial costs involved. A policy that required annual adjustments to the maturity profile of debt could require the debt instruments to include call provisions. This of itself would involve additional cost which would need to be evaluated against the possible benefits.

In practice, the abnormal earnings variable is likely to proxy for other variables. A high measure of abnormal earnings could be associated with higher growth (and may also be linked to a higher market to book value ratio). But higher growth is also associated with smaller companies. As smaller companies tend to have shorter maturity debt, a higher value for abnormal earnings will be associated with shorter debt maturity. Also, higher abnormal earnings could be linked to higher volatility (including smaller companies) and so such companies will tend to be regarded adversely by lenders. Such companies will tend to have less debt and shorter maturities. So, there are at least two reasons why companies with high abnormal earnings will tend to have shorter term debt and where those reasons do not support the method of the management of the under-investment problem in Myers (1977).

Equally, higher abnormal earnings are likely to be associated with higher market to book value ratio and if there is a negative relationship between the market to book value ratio and debt maturity then this will also imply a negative relationship between abnormal earnings and debt maturity. This variable is sometimes described as "firm quality": see the survey work of Dichev, Graham, Harvey and Rajgopal (2013) which describes the significance of this single measure of performance and the steps management take to manipulate it.

Expected sign "–" as better prospects should discourage longer maturities as that could amount to a transfer of value to the debt-holders at the expense of shareholders.

Average asset life The value of fixed assets divided by annual depreciation. This produces a crude measure of the number of years of deprecation and hence asset life. It is quite common for companies and lenders to match debt maturity to asset life. Loans are amortised over the life of the asset. This variable is included in Barclay, Marx and Smith (2003).

Expected sign "+" as lenders tend to match loans to asset life.

Fixed asset ratio The ratio of fixed assets to total assets. Lenders prefer fixed assets as security compared with non-fixed assets such as current assets. Therefore, the total amount of debt is likely to be governed by the amount of available fixed assets rather than total assets. The impact of the fixed asset ratio on maturity derives from the connection between debt and maturity which are positively and significantly correlated. This variable is sometimes labelled "tangibility". This variable is included in Barclay, Marx and Smith (2003).

Expected sign "+/–" although a higher fixed asset ratio encourages lenders, the effect on maturity is not so easy to predict.

Debt market conditions In addition to the above company specific variables and to reflect debt market conditions, the following variables are included. The impact of these variables ~~reflecting debt market conditions~~ is likely to be affected by the problem identified in relation to firm quality, namely that companies are not able easily to amend the maturity structure of their liabilities because of short-term changes in debt market conditions. The *Yield curve, Bond spread, Inflation* and *Short-term real interest rate* are all included as independent variables as in Kleczyk (2012).

Expected sign "–" based on a simple consideration of cost.

Yield curve The difference in yield between a long-term risk-free asset (20-year US government bond) and a short-term risk-free asset (3 months Treasury bill). The idea is that maturity may reflect the differences in costs between short and long-term debt as their respective costs are linked to the returns on risk-free assets of similar maturity. The cost of debt is usually expressed as a margin over the risk-free asset and such margin is not necessarily independent of maturity. This margin generally increases with maturity and is measured by the excess corporate bond return variable described below.

Bond spread The difference between the yield on a portfolio of investment grade bonds with maturity of 15 years less the yield on a portfolio of investment grade bonds with maturity of less than 3 years. This measures the additional borrowing costs of longer dated debt (compared with shorter term borrowing costs).

Inflation This is computed by reference to changes in the US consumer price index.

Short-term real interest rate The difference between the interest rate on the 6-month US treasury bill and inflation.

ScaledMTBV (in relation to hypothesis 6) The market to book value ratio divided by the Size variable and is designed to reduce the effect of size on the relationship between debt maturity and the market to book value ratio.

Expected sign "+" thus contradicting the solution in Myers (1977).

Lagged dependent variable To take account of a policy of adjusting capital structure and debt maturity to a target, lagged values of the dependent variables are included as explanatory variables as in Fama and French (2002).

Expected sign "+" except where the dependent variable represents changes in gearing or debt maturity where the coefficient of the lagged dependent variable will be negative suggesting that changes are returning the ratio to a long run target.

In the regression tests using gearing or changes in either debt maturity or gearing as the dependent variable, similar signs to those indicated above are expected.

The effects being studied here are considered to persist through time and, as such, are not time-dependent thereby removing the need to include time dummy variables:

this approach follows Guney, Li and Fairchild (2011) and Barclay, Marx and Smith (2003).

Industry dummies are also excluded from the modelling. That is, while industry effects do have an impact on the market to book value ratio and gearing such industry effects are reflected in the models by using variables that are expressed as proportions of sector values. For instance, in some cases, relative gearing is used to reflect the position of the subject company in relation to others in the same sector.

2.3.3.2 Model equations

The regression equation used to test each hypothesis is set out below the hypotheses.

Static models do not provide for delays in adjusting capital structure as is argued above in relation to the value recapture strategy. Accordingly, a lagged value of the dependent variable is included as an explanatory variable. The subscripts indicate firm (i) and time (t).

- Hypothesis 1: Debt maturity (measured as the amount of debt maturing after 3 years as a proportion of the total debt) will be negatively related to the market to book value ratio. This is implied by the on-off model and the structural problem described above and possibly also by Myers' (1977) solution for the under-investment problem.

$$Debtmat_{i,t} = \alpha + \beta_1 Debtmat_{i,(t-1)} + \beta_2 MTBV_{i,t} + \beta_3 Reg_{i,t} + \beta_4 Size_{i,t} + \beta_5 CPD_{i,t} + \beta_6 Abegs_{i,t} + \beta_7 AAL_{i,t} + \beta_8 FAR_{i,t} + \beta_9 Ycurve_t + \beta_{10} Bondspread_t + \beta_{11} Inflation_t + \beta_{12} Shortint_t + \varepsilon_{i,t} \quad (2.10)$$

Dependent variable: $Debtmat_{i,t}$ = the amount of debt maturing after 3 years expressed as a proportion of total debt.

Independent variables: 1) lagged value of $Debtmat_{i,t}$; 2) MTBV = market to book value ratio; 3) Reg = regulation dummy; 4) Size = natural logarithm of the enterprise value; 5) CPD = commercial paper dummy; 6) Abegs = abnormal earnings; 7) AAL = average asset life; 8) FAR = fixed asset ratio; 9) Ycurve = yield curve; 10) Bondspread = bond spread; 11) Inflation = inflation; and 12) Shortint = short-term interest rate. Finally, $\varepsilon_{i,t}$ is the error term.

- Hypothesis 2: Gearing (expressed in market value terms) will be negatively related to the market to book value ratio. This is implied by the on-off model and the structural problem described above and possibly also by Myers' (1977) solution for the under-investment problem.

$$Gearmkt_{i,t} = \alpha + \beta_1 Gearmkt_{i,(t-1)} + \beta_2 MTBV_{i,t} + \beta_3 Reg_{i,t} + \beta_4 Size_{i,t} + \beta_5 CPD_{i,t} + \beta_6 Abegs_{i,t} + \beta_7 AAL_{i,t} + \beta_8 FAR_{i,t} + \beta_9 Ycurve_t + \beta_{10} Bondspread_t + \beta_{11} Inflation_t + \beta_{12} Shortint_t + \varepsilon_{i,t} \quad (2.11)$$

Dependent variable: $Gearmkt_{i,t}$ = gearing (measured using market values).

Independent variables: 1) $Gearmkt_{i,(t-1)}$ = lagged value of $Gearmkt_{i,t}$; 2) the other independent variables as per equation (2.10) for hypothesis 1; and $\varepsilon_{i,t}$ is the error term.

- Hypothesis 3: Maturity (the amount of debt with a maturity longer than 3 years expressed as a proportion of the market value of the enterprise) will be negatively related to the market to book value ratio. As before, this hypothesis is in contradiction of Myers' (1977) solution of the under-investment problem.

$$Gearmkt3_{i,t} = \alpha + \beta_1 Gearmkt3_{i,(t-1)} + \beta_2 MTBV_{i,t} + \beta_3 Reg_{i,t} + \beta_4 Size_{i,t} + \beta_5 CPD_{i,t} + \beta_6 Abegs_{i,t} + \beta_7 AAL_{i,t} + \beta_8 FAR_{i,t} + \beta_9 Ycurve_t + \beta_{10} Bondspread_t + \beta_{11} Inflation_t + \beta_{12} Shortint_t + \varepsilon_{i,t} \quad (2.12)$$

Dependent variable: $Gearmkt3_{i,t}$ = amount of debt with a maturity greater than 3 years expressed as a proportion of book values.

Independent variables: 1) lagged value of $Gearmkt3_{i,t}$; 2) the other independent variables as per equation (2.10) for hypothesis 1; and $\varepsilon_{i,t}$ is the error term.

- Hypothesis 4: Gearing (total debt expressed as a proportion of the book value of the enterprise) will be positively (or at least not negatively) related to the market to book value ratio. This hypothesis contradicts Myers' (1977) solution for the under-investment problem; and similarly

$$Gearbk_{i,t} = \alpha + \beta_1 Gearbk_{i,(t-1)} + \beta_2 MTBV_{i,t} + \beta_3 Reg_{i,t} + \beta_4 Size_{i,t} + \beta_5 CPD_{i,t} + \beta_6 Abegs_{i,t} + \beta_7 AAL_{i,t} + \beta_8 FAR_{i,t} + \beta_9 Ycurve_t + \beta_{10} Bondspread_t + \beta_{11} Inflation_t + \beta_{12} Shortint_t + \varepsilon_{i,t} \quad (2.13)$$

Dependent variable: $Gearbk_{i,t}$ = gearing (measured using book values).

Independent variables: 1) lagged value of $Gearbk_{i,t}$; 2) the other independent variables as per equation (2.10) for hypothesis 1; and $\varepsilon_{i,t}$ is the error term.

- Hypothesis 5: Maturity (the amount of debt with a maturity longer than 3 years expressed as a proportion of the book value of the enterprise) will be positively (or at least not negatively) related to the market to book value ratio. As before, this hypothesis is in contradiction of Myers' (1977) solution of the under-investment problem.

$$Gearbk3_{i,t} = \alpha + \beta_1 Gearbk3_{i,(t-1)} + \beta_2 MTBV_{i,t} + \beta_3 Reg_{i,t} + \beta_4 Size_{i,t} + \beta_5 CPD_{i,t} + \beta_6 Abegs_{i,t} + \beta_7 AAL_{i,t} + \beta_8 FAR_{i,t} + \beta_9 Ycurve_t + \beta_{10} Bondspread_t + \beta_{11} Inflation_t + \beta_{12} Shortint_t + \varepsilon_{i,t} \quad (2.14)$$

Dependent variable: $Gearbk3_{i,t}$ = amount of debt with a maturity greater than 3 years expressed as a proportion of book values.

Independent variables: 1) lagged value of $Gearbk3_{i,t}$; 2) the other independent variables as per equation (2.10) for hypothesis 1; and $\varepsilon_{i,t}$ is the error term.

- Hypothesis 6: the amount of debt maturing after 3 years expressed as a proportion of the book value will not be negatively related to the scaled market to book value ratio.

$$Gearbk3_{i,t} = \alpha + \beta_1 Gearbk3_{i,(t-1)} + \beta_2 ScaMTBV_{i,t} + \beta_3 Reg_{i,t} + \beta_4 Size_{i,t} + \beta_5 CPD_{i,t} + \beta_6 Abegs_{i,t} + \beta_7 AAL_{i,t} + \beta_8 FAR_{i,t} + \beta_9 Ycurve_t + \beta_{10} Bondspread_t + \beta_{11} Inflation_t + \beta_{12} Shortint_t + \varepsilon_{i,t} \quad (2.15)$$

Dependent variable: $Gearbk3_{i,t}$ = amount of debt with a maturity greater than 3 years expressed as a proportion of book values.

Independent variables: 1) lagged value of $Gearbk3_{i,t}$; 2) ScaMTBV = scaled MTBV; 3) the other independent variables as per equation (2.10) for hypothesis 1: and $\varepsilon_{i,t}$ is the error term.

- Hypothesis 7: Changes in gearing (based on market values) are negatively associated with changes in the market to book value ratio;

$$\Delta Gearmkt_{i,t} = \alpha + \beta_1 \Delta Gearmkt_{i,(t-1)} + \beta_2 \Delta MTBV_{i,t} + \beta_3 Reg_{i,t} + \beta_4 Size_{i,t} + \beta_5 CPD_{i,t} + \beta_6 Abegs_{i,t} + \beta_7 AAL_{i,t} + \beta_8 FAR_{i,t} + \beta_9 Ycurve_t + \beta_{10} Bondspread_t + \beta_{11} Inflation_t + \beta_{12} Shortint_t + \varepsilon_{i,t} \quad (2.16)$$

Dependent variable: $\Delta Gearmkt_{i,t}$ = changes in gearing (measured using market values).

Independent variables: 1) lagged value of $\Delta Gearmk_{i,t}$; 2) $\beta_2 \Delta MTBV_{i,t}$ is the change in the market to book value ratio; 3) the other independent variables as per equation (2.10) for hypothesis 1; and $\varepsilon_{i,t}$ is the error term.

- Hypothesis 8: Changes in debt maturity (measured by expressing the amount of debt with a maturity longer than 3 years as a proportion of the market value of the enterprise) will be negatively related to changes in the market to book value ratio;

$$\Delta Gearmkt3_{i,t} = \alpha + \beta_1 \Delta Gearmkt_{i,(t-1)} + \beta_2 \Delta MTBV_{i,t} + \beta_3 Reg_{i,t} + \beta_4 Size_{i,t} + \beta_5 CPD_{i,t} + \beta_6 Abegs_{i,t} + \beta_7 AAL_{i,t} + \beta_8 FAR_{i,t} + \beta_9 Ycurve_t + \beta_{10} Bondspread_t + \beta_{11} Inflation_t + \beta_{12} Shortint_t + \varepsilon_{i,t} \quad (2.17)$$

Dependent variable: $\Delta Gearmkt3_{i,t}$ = amount of debt with a maturity greater than 3 years expressed as a proportion of market values.

Independent variables: 1) lagged value of $\Delta Gearmkt3_{i,t}$; 2) $\Delta MTBV_{i,t}$ is the change in the market to book value ratio; 3) the other independent variables as per equation (2.10) for hypothesis 1; and $\varepsilon_{i,t}$ is the error term.

- Hypothesis 9: Changes in gearing (based on book values) are positively associated with changes in the market to book value ratio.

$$\Delta Gearbk_{i,t} = \alpha + \beta_1 \Delta Gearbk_{i,(t-1)} + \beta_2 \Delta MTBV_{i,t} + \beta_3 Reg_{i,t} + \beta_4 Size_{i,t} + \beta_5 CPD_{i,t} + \beta_6 Abegs_{i,t} + \beta_7 AAL_{i,t} + \beta_8 FAR_{i,t} + \beta_9 Ycurve_t + \beta_{10} Bondspread_t + \beta_{11} Inflation_t + \beta_{12} Shortint_t + \varepsilon_{i,t} \quad (2.18)$$

Dependent variable: $\Delta Gearbk_{i,t}$ = changes in gearing (measured using book values).

Independent variables: 1) lagged value of $\Delta Gearbk_{i,t}$; 2) $\Delta MTBV_{i,t}$ is the change in the market to book value ratio; 3) the other independent variables as per equation (2.10) for hypothesis 1; and $\varepsilon_{i,t}$ is the error term.

The testing methodology is described in the next section.

2.3.3.3 The methods of estimation

A key assumption underlying ordinary least squares regression is that the error terms are not correlated with the independent variables. Violation of this orthogonality assumption can lead to biased and inconsistent estimates. In corporate finance, the structure of the panel data is short (defined as a combination of small T (number of years per company) and large N (number of companies) and the nature of the data can impose challenges to the estimation of coefficients by conventional methods such as ordinary least squares: in particular, error terms are likely to be correlated with regressors.

A random/fixed effects approach can be employed where an element (the individual effect) within the error term is assumed to be correlated with the regressors. In the random effects model, it is assumed that there is an individual effect but that it is not correlated with the regressors. The Hausman test can determine which of the two approaches (random or fixed effects) is the more appropriate.

For example, leverage ratios have a significant time-invariant component that is correlated with some of the independent variables. A traditional ordinary least squares approach will ignore both firm-specific effects and serial correlation in the error structure. To address this difficulty, a fixed effects model can be employed. Lemmon, Roberts and Zender (2008) provide a comparison of the effects of using the two methods (ordinary least squares and fixed effects). Significant differences in the estimated coefficient values are obtained (see Table V in that paper).

An improvement on the fixed effects model is available in the system generalised method of moments (system GMM) estimator which was developed by Arellano and

Bond (1991) and Blundell and Bond (1998) and which addresses concerns about the estimation of dynamic panel data models in the presence of firm specific effects. System GMM can deal with lagged levels and differences of the dependent variable and exogenous variables.

The effectiveness of seven different estimation approaches is considered in Flannery and Hankins (2013) covering ordinary least squares, fixed effects, Arellano and Bond's (1991) difference GMM method, Blundell and Bond's (1998) system GMM, four period long differencing which replicates Huang and Ritter's (2009) implementation of the estimator in Hahn, Hausman and Kuersteiner (2007); long differencing allowing for unbalanced panels (an alternative adaptation of the method in Hahn, Hausman and Kuersteiner (2007)); and least squares dummy variable correction which corrects for the biased fixed effects estimated coefficient using an estimate of the of the short-panel bias estimated from each firm's data.

The analysis concluded that for unbalanced panel data, system GMM and fixed effects worked the best (on data generated by Monte Carlo simulation) and that the results were only slightly impacted by endogeneity.

An excellent and comprehensive analysis of the appropriate methods of estimation for unbalanced dynamic panel data sets is contained in Antoniou, Guney and Paudyal (2006) who argued that system GMM is the most appropriate estimation method to use in addition to fixed effects. System GMM offers the flexibility to identify independent variables as i) exogenous (being determined externally to the model and the other equation variables); ii) predetermined (being determined by previous or lagged values of the variable); and iii) endogenous (being determined by other equation variables in the model). Flannery and Hankins (2013) tested the option of describing all their variables as “endogenous” (in the Stata command xtdpdsys) but found little difference to using the option “predetermined” which is why this choice has been made here and their recommendation followed.

The two methods highlighted in Flannery and Hankins (2013) as the most efficient, namely fixed effects and system GMM, are used here and the procedure in relation to system GMM used in that paper (using Stata's “xtdpdsys” command, two steps, with all the independent variables specified as "predetermined" and the maximum number of lags restricted to two or, in some cases, more) is followed.

There are two tests used with system GMM, the Sargan test (see Sargan (1958)) and Hansen’s J test (see Hansen (1982)). Hansen’s test is not available in Stata in conjunction with xtdpdsys. However, both tests must be used with care and as pointed out in Roodman (2009a and 2009b) can be unreliable and can give unreliable positive results. One problem highlighted in Roodman (2009a) is the presence of too many instruments.

In the empirical analysis, the emphasis is primarily on the sign and size of the coefficient of the market to book value ratio as this is the basis of support for the solutions for the under-investment problem in Myers (1977). Comments on the other variables in the regression equations will focus on those coefficients which are significant in both a statistical and an economic sense. Economic significance is considered in terms of the impact on the dependent variable of a change in the independent variable which is computed as the product of the coefficient variable and the range of values for the variable between the 10^{th} and 90^{th} percentiles: an impact in excess of 5% on the dependent variable of the indicated range for the independent variable is reported as economically significant. A further test of economic significance is based on changes in the dependent variable expressed as a proportion of standard deviation relating to a change in an independent variable of one standard deviation: this is included as appropriate.

2.3.3.4 Descriptive statistics

Summary statistics are set out in Table 2.6 and correlation statistics in Table 2.7.

Over the period 1995-2014, the mean amount of debt maturing after 3 years is 40% with wide variation as indicated by the standard deviation. The mean value of the market to book value ratio is quite high although the median value less but still significantly more than one indicating valuable investment opportunities in the absence of an alternative explanation.

Table 2.6 Summary statistics 1995-2014

	Observ-ations	Median	Mean	Std. Dev.	Var-iance	Skew-ness	Kur-tosis	Min-imum	Max-imum
Debt maturity (%>3 years)	107,623	0.342	0.396	0.377	0.142	0.263	1.466	-0.050	1.000
Market to book value ratio	114,838	1.265	3.130	4.992	24.916	2.823	10.030	0.391	21.282
Regulation dummy	195,841	0.000	0.100	0.301	0.090	2.660	8.073	0	1
Size	115,359	5.181	5.185	2.634	6.936	-0.196	3.515	-12.51	18.79
Commercial paper dummy	195,839	0.000	0.048	0.215	0.046	4.206	18.692	0	1
Abnormal earnings	103,544	-0.006	0.294	1.056	1.116	2.403	8.701	-1.087	3.972
Average asset life	158,126	5.208	8.318	9.005	81.088	1.913	6.043	0.604	36.46
Fixed asset ratio	167,081	0.203	0.299	0.275	0.076	0.837	2.487	0	0.953
Yield curve	195,841	0.024	0.022	0.015	0.000	-0.008	1.756	-.003	0.045
Bond spread	195,841	0.014	0.020	0.014	0.000	0.015	1.644	-.005	0.042
Inflation	195,841	0.024	0.023	0.010	0.000	-0.256	2.564	0.001	0.041
Short-term interest rate	195,841	0.000	0.003	0.020	0.000	0.153	1.683	-0.029	0.037
Debt >3 years (% of market)	75,058	0.047	0.136	0.183	0.034	1.541	4.835	-0.002	0.784
Debt >3 years (% of book)	107,296	0.063	0.151	0.199	0.040	1.683	5.872	-0.004	0.948
Gearing (gross, market)	115,359	0.136	0.232	0.260	0.068	1.148	3.444	0.000	0.989
Gearing (gross, book)	169,990	0.205	0.307	0.417	0.174	2.931	13.557	0.000	2.324
Scaled market to book value ratio	114,812	0.252	0.844	1.836	3.371	3.908	19.950	-1.330	11.740
Differences in:									
Debt maturity (%>3 years)	83,924	0.000	-0.005	0.267	0.071	0.038	7.872	-1.050	1.050
Debt >3 years (% of market)	57,160	0.000	-0.001	0.121	0.015	0.198	13.393	-0.785	0.784
Debt >3 years (% of book)	83,605	0.000	-0.002	0.126	0.016	-0.346	19.567	-0.951	0.951
Gearing (gross, market)	95,723	0.000	0.007	0.276	0.076	-0.289	34.964	-0.989	0.989
Gearing (gross, book)	149,092	0.000	-0.043	3.432	11.779	-0.065	18.916	-2.324	2.324
Market to book value ratio	95,165	0.000	-0.005	0.267	0.071	0.038	7.872	-20.89	208.9

Definitions of the variables are set out in Table 2.5

Correlation statistics are set out in Table 2.7.

Table 2.7 Correlation statistics 1995-2014

	Debt maturity (%>3 years)	Market to book value ratio	Reg-ulation dummy	Size	Comm-ercial paper dummy	Abnormal earnings	Average asset life
Market to book value ratio	-0.283***						
Regulation dummy	0.220***	-0.077***					
Size	0.495***	-0.133***	0.184***				
Commercial paper dummy	0.180***	-0.084***	0.189***	0.425***			
Abnormal earnings	-0.179***	0.175***	-0.023***	-0.264***	-0.081***		
Average asset life	0.214***	-0.120***	0.196***	0.122***	0.071***	-0.054***	
Fixed asset ratio	0.247***	-0.120***	0.279***	0.197***	0.108***	-0.038***	0.637***
Yield curve	-0.013***	0.039***	-0.012***	0.025***	-0.001	0.066***	0.016***
Bond spread	0.001	0.031***	-0.017***	0.015***	0.000	0.060***	0.020***
Inflation	-0.009**	-0.033***	0.013***	-0.035***	0.003	-0.014***	-0.017***
Short-term interest rate	-0.014***	-0.028***	0.023***	-0.052***	0.002	-0.068***	-0.052***
Debt >3 years (% of market)	0.715***	-0.272***	0.227***	0.296***	0.060***	-0.093***	0.255***
Debt >3 years (% of book)	0.751***	-0.167***	0.199***	0.332***	0.055***	-0.069***	0.165***
Gearing (gross, market)	0.270***	-0.287***	0.181***	0.071***	0.037***	0.050***	0.184***
Gearing (gross, book)	0.043***	0.355***	0.076***	-0.064***	-0.010***	0.185***	-0.024***
Scaled market to book value ratio	-0.288***	0.783***	-0.072***	-0.292***	-0.099***	0.210***	-0.123***
Differences in:							
Debt maturity (%>3 years)	0.244***	-0.028***	0.002	-0.010**	0.006	-0.015***	0.025***
Debt >3 years (% of market)	0.271***	-0.002	0.000	0.024***	0.008**	-0.017***	0.029***
Gearing (gross, market)	0.011**	-0.068***	0.004	-0.057***	-0.009*	0.054***	0.024***
Gearing (gross, book)	0.003	0.168***	-0.003	-0.001	-0.004	0.047***	-0.012***
Market to book value ratio	0.000	0.378***	0.000	0.095***	0.003	-0.014***	-0.018***

Asterisks represent significance at the 1%(***), 5%(**) and 10%(*) confidence levels.
The definitions of the variables are set out in Table 2.5.

Table 2.7 is continued on the next page.

Table 2.7 Correlation statistics, continued from previous page

	Fixed asset ratio	Yield curve	Bond spread	Inflation	Short-term interest rate	Debt >3 years (% of market)	Debt >3 years (% of book)
Yield curve	0.009***						
Bond spread	0.002	0.771***					
Inflation	-0.020***	-0.413***	-0.147***				
Short-term interest rate	0.003	-0.767***	-0.759***	0.078***			
Debt >3 years (% of market)	0.275***	0.003	0.025***	-0.005	-0.008**		
Debt >3 years (% of book)	0.217***	-0.005*	0.000	-0.015***	-0.001	0.835***	
Gearing (gross, market)	0.256***	0.001	0.017***	0.002	0.019***	0.671***	0.492***
Gearing (gross, book)	0.079***	0.025***	0.024***	-0.017***	-0.019***	0.178***	0.341***
Scaled market to book value ratio	-0.110***	0.028***	0.029***	-0.014***	-0.031***	-0.232***	-0.169***
Differences in:							
Debt maturity (%>3 years)	0.004	0.039***	0.063***	-0.025***	-0.011***	0.338***	0.237***
Debt >3 years (% of market)	0.013***	-0.006*	0.003	-0.014***	0.001	0.247***	0.310***
Gearing (gross, market)	0.020***	0.030***	0.050***	-0.031***	0.007**	0.149***	0.070***
Gearing (gross, book)	0.040***	0.007**	-0.003	-0.031***	0.003	0.004	0.075***
Market to book value ratio	0.015***	-0.026***	-0.055***	-0.018***	0.036***	-0.023***	0.010**

				Differences in:			
	Gearing (gross, market)	Gearing (gross, book)	Scaled market to book value ratio	Debt maturity (%>3 years)	Debt >3 years (% of market)	Gearing (gross, market)	Gearing (gross, book)
Gearing (gross, book)	0.446***						
Scaled market to book value ratio	-0.187***	0.402***					
Differences in:							
Debt maturity (%>3 years)	0.124***	0.010**	-0.011***	0.644***			
Debt >3 years (% of market)	0.028***	0.023***	-0.007*	0.719***	0.710***		
Gearing (gross, market)	0.330***	0.139***	-0.030***	0.062***	0.459***	0.163***	
Gearing (gross, book)	0.067***	0.379***	0.147***	0.028***	0.079***	0.209***	0.260***
Market to book value ratio	-0.065***	0.084***	0.215***	-0.013**	-0.083***	0.011**	-0.230***

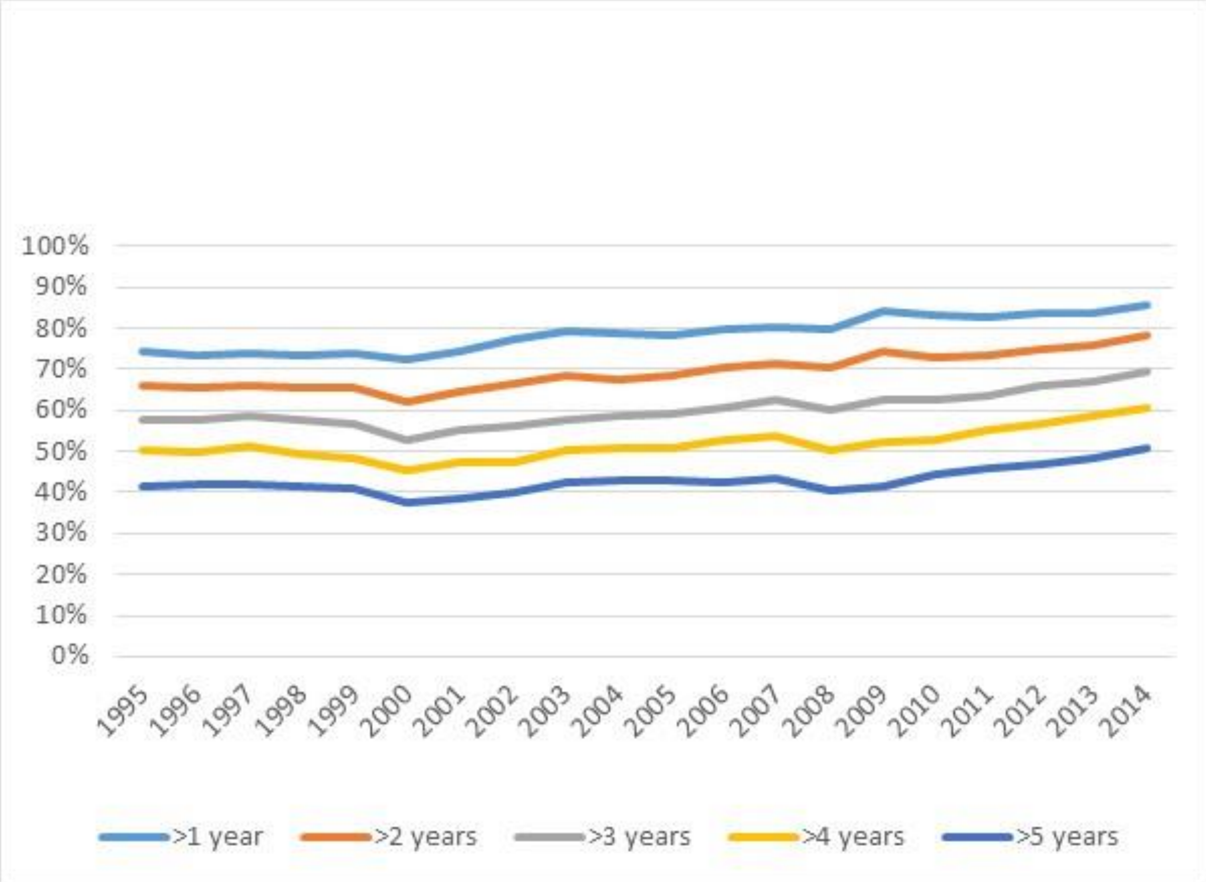
	Differences in Gearing (gross, book)
Differences in:	
Market to book value ratio	0.245***

Asterisks represent significance at the 1%(***), 5%(**) and 10%(*) confidence levels.
The definitions of the variables are set out in Table 2.5.

Table 2.7 contains a matrix of correlation coefficients among the dependent and independent variables. These measurements indicate simple relationships between the variables that for the most part are statistically significant. These include a negative relationship between the proportion of debt maturing after 3 years and the market to book value ratio as expected given the results in Barclay and Smith (1995), Rajan and Zingales (1995), Guedes and Opler (1996), Johnson (2003), Antoniou, Guney and Paudyal (2006) and Kleczyk (2012). Similarly, a negative correlation is reported between gearing (based on market values) and the market to book value ratio in line with the debt maturity measure. However, when gearing is measured using book values, a positive correlation with the market to book value ratio is observed.

Table 2.8 describes debt maturity as an average for each year in the sample period (1995-2014) by maturity bands. The bands are for each of 1 to 5 years where the statistic is the average of debt maturing after that maturity band expressed as a proportion of total debt. It is apparent that the maturity bands broadly move in tandem showing that, overall, debt maturity has increased over the sample period although slowly. For example, the amount of debt that is longer than 3 years is around 60% (of total debt) at the beginning of the period rising to around 70% (of total debt) nearly 20 years later. (This may reflect the steady reduction in interest rates over the period reducing the relative cost of shorter maturity debt compared to longer maturity debt.)

Table 2.8 Chart of average maturity over the period 1995-2014
This table sets out the average debt maturity where maturity is measured as the proportion of debt with a maturity longer than specified time periods (exceeding 1, 2, 3, 4 and 5 years) as a proportion of total debt



2.4 Results

This section reports the regression results for each of the hypotheses described above.

The results of the test of hypothesis 1 are set out in Table 2.9. This replicates past results in that debt maturity (the amount of debt with maturity longer than 3 years expressed as a proportion of total debt) is regressed against the market to book value ratio and certain other control variables. The expectation is that there will be a negative coefficient for the market to book value ratio. The results confirm this expectation and do not reject the hypothesis. These results are consistent with past results such as those reported in Barclay and Smith (1995) and Barclay, Marx and Smith (2003).

A lagged value of the dependent variable is included in the fixed effects regression: in the case of system GMM, two lagged values of the dependent variable are included (since two lags are specified – this has the effect of reducing the sample size). The coefficients of the once-lagged dependent variable are positive and statistically significant. The fixed effects coefficient for the lagged dependent variable is less than in the system GMM reflecting the downward bias in this estimator.

The coefficient of the market to book value ratio is negative and statistically significant in both columns as predicted, supporting the hypothesis. Using the fixed effects coefficient value of 0.007 and applying it to the difference in the values of the market to book value ratio at the 10th and 90th percentile levels, the associated change in debt maturity would amount to approximately 4.9% – a relatively modest adjustment in the amount of debt with a maturity longer than 3 years. Equivalently, a one standard deviation movement in the market to book value ratio would trigger a change in debt maturity that would represent just 8% of the standard deviation of that variable.

However, this is only a proportion so does not provide an insight into absolute amounts. If this represented only a small amount of debt, it would be less convincing evidence that companies managed the under-investment problem by adjusting debt maturity than would be the case if the absolute amount of debt were large.

The fixed effects results are similar in size and significance to the system GMM results except for the commercial paper dummy and the constant (no significance in system GMM). The signs are as expected except that the bond spread coefficient is positive: this is a variable that measures the cost of long-term bonds and as indicated previously should be negatively related to the amount of long-term debt.

The economically significant variables are size, average asset life and regulation. The coefficient of size is positive as expected suggesting that larger companies borrow for longer and this contrasts with the implications of the on-off model and the structural model (which predicts a negative coefficient for the market to book value ratio when tested against gearing ~~is~~ based on market values).

The coefficient of average asset life is positive as predicted, confirming that lending is linked to asset life. The coefficient of the regulation dummy is also positive, as predicted, confirming that regulated companies do not use short debt maturity to manage problems of under-investment as argued in Barclay and Smith (1995).

The coefficient of the commercial paper dummy is statistically significant and negative as predicted, confirming that the use of such a financing technique reduces debt maturity in the obvious way. The debt market variables have low economic significance – as suggested in Table 2.5: it is not easy (but is costly) to adjust either debt maturity or the amount of gearing to short term changes in debt market conditions.

Table 2.9 Determinants of debt maturity (proportion greater than three years)
This table sets out the regression results where the dependent variable is the amount of debt maturing after 3 years expressed as a proportion of total debt against the variables in the left-hand column (hypothesis 1)

Variables	Fixed effects	System GMM
Dependent variable (1-year lag)	0.325***	0.460***
	(46.8)	(36.85)
Dependent variable (2-year lag)		-0.0655***
		(-6.085)
Market to book value ratio	-0.00652***	-0.00807***
	(-11.70)	(-12.80)
Regulation dummy	-	0.174***
		(4.312)
Size	0.0331***	0.0373***
	(15.88)	(14.81)
Commercial paper dummy	-0.0230***	-0.0147
	(-3.082)	(-1.207)
Abnormal earnings	-0.00883***	-0.00624***
	(-6.641)	(-4.046)
Average asset life	0.00433***	0.00488***
	(9.983)	(7.646)
Fixed asset ratio	0.00827	0.0292
	(0.536)	(1.446)
Yield curve	-1.462***	-1.364***
	(-7.952)	(-6.853)
Bond spread	1.043***	1.073***
	(6.397)	(6.736)
Inflation	-0.856***	-0.883***
	(-5.400)	(-4.880)
Short-term interest rate	-0.128	-0.198
	(-0.918)	(-1.362)
Constant	0.108***	0.0111
	(7.50)	(0.725)
F test	297.9***	
Adjusted R squared	0.131	
Hausman p value	0.00***	
Wald test p value		0.00***
Arellano-Bond AR(1)		0.00
Arellano-Bond AR(2)		0.26
Sargan statistic		0.00
Observations	50,521	42,254
Number of firms	9,792	8,473

Robust t-statistics in parentheses. *** p<0.01, ** p<0.05, * p<0.1. The Sargan test result is unreliable here - as pointed out in Roodman (2009b) it is not infallible and cannot be relied on too faithfully. The Hansen test statistic is not reported here as it is not available in xtdpdsys – see discussion in section 2.3.3.3. To test for collinearity, the variance inflation factors were computed and were all less than 10. The definitions of the variables are set out in Table 2.5.

The results of the test of hypothesis 2 where gearing (based on market values) is regressed against the market to book value and the other control variables are set out in Table 2.10. These results support the hypothesis and established results such as those in Barclay, Marx and Smith (2003).

The coefficient of the lagged dependent variable is positive and statistically significant in both fixed effects and system GMM. The coefficient of the market to book value ratio is negative and statistically significant in both columns as predicted supporting the hypothesis. Using the fixed effects coefficient value of 0.006 and applying it to the difference in the values of the market to book value ratio at the 10th and 90th percentile levels, the associated change in debt maturity would amount to approximately 4.2%. In terms of a movement in the market to book value ratio of one standard deviation, gearing (based on market values) would adjust by 11.5% of one standard deviation of gearing (based on market values).

The fixed effects coefficients are supported in sign and significance by the system GMM results except for the commercial paper dummy (significant in system GMM but not in fixed effects); abnormal earnings (significant in fixed effects but not in system GMM); and the short-term interest rate (significant in system GMM but not in fixed effects).

The coefficient of size is negative and statistically significant which was expected given the explanations implied by both the on-off model and the structural model suggesting that larger companies have less gearing. Also, the coefficient of abnormal earnings is positive and statistically significant suggesting that total gearing is not affected by information asymmetry. As with debt maturity, bond spread has a positive coefficient.

Both the above results are in line with previous results confirming the negative relationship between debt maturity and gearing and the market to book value ratio.

The economically significant variables are size and regulation. The coefficient of size is negative as predicted by the on-off model and the structural model as discussed above. The coefficient of regulation is positive and large suggesting that such companies are significant borrowers: given their predictable cash flows they are desirable targets for lenders. The commercial paper dummy has a statistically significant coefficient in system GMM (but not under fixed effects) confirming that such a financing method is associated with more gearing.

The fixed asset ratio and average asset life both have positive and statistically significant coefficients as predicted but their economic significance is small.

Table 2.10 Determinants of gearing (based on market values)

This table sets out the regression results where the dependent variable is the amount of debt expressed as a proportion of the enterprise value measured using market values against the variables in the left-hand column (hypothesis 2)

Variables	Fixed effects	System GMM
Dependent variable (1-year lag)	0.425***	0.461***
	(60.56)	(33.5)
Dependent variable (2-year lag)		0.00462
		-0.453
Market to book value ratio	-0.00582***	-0.00617***
	(-18.04)	(-12.26)
Regulation dummy	-	0.558***
		(8.676)
Size	-0.0273***	-0.0397***
	(-21.45)	(-20.04)
Commercial paper dummy	0.0031	0.0279***
	(0.679)	(2.604)
Abnormal earnings	0.00597***	-2.98E-05
	(7.467)	(-0.0273)
Average asset life	0.000712***	0.00172***
	(3.096)	(4.117)
Fixed asset ratio	0.0940***	0.108***
	(10.17)	(7.342)
Yield curve	-0.525***	-0.499***
	(-6.679)	(-5.293)
Bond spread	1.204***	0.954***
	(20.59)	(13.06)
Inflation	-0.574***	-0.650***
	(-7.877)	(-7.586)
Short-term interest rate	-0.0612	0.149*
	(-0.943)	(1.888)
Constant	0.261***	0.246***
	(31.19)	(21.38)
F test	732.4***	
Adjusted R squared	0.268	
Hausman p value	0.00***	
Wald test p value		0.00***
Arellano-Bond AR(1)		0.00
Arellano-Bond AR(2)		0.62
Sargan statistic		0.00
Observations	73,948	64,001
Number of firms	11,224	9,817

Robust t-statistics in parentheses. *** p<0.01, ** p<0.05, * p<0.1. The Sargan test result is unreliable here - as pointed out in Roodman (2009b) it is not infallible and cannot be relied on too faithfully. The Hansen test statistic is not reported here as it is not available in xtdpdsys – see discussion in section 2.3.3.3. To test for collinearity, the variance inflation factors were computed and were all less than 10. The definitions of the variables are set out in Table 2.5.

Hypothesis 3 is a refinement of hypothesis 1 in that debt maturity is measured as the amount of debt with maturity greater than 3 years expressed as a proportion of total market value. This measures the amount of debt with the longer maturity and which should be negatively related to the market to book value ratio in line with hypothesis 1. This is not a replication of past results since a different dependent variable is being used but the results should be similar to those in Table 2.9.

The results of the test of hypothesis 3 are set out in Table 2.11. In this case, system GMM using two lags does not produce a satisfactory AR(2) statistic so a three-lag version of system GMM is included in the Table and produces very similar results to the two lags case. The results support the hypothesis.

The coefficient of the lagged dependent variable is positive and statistically significant in both fixed effects and system GMM as in the previous results. The coefficient of the market to book value ratio is negative and statistically significant in both columns as predicted supporting the hypothesis. Using the fixed effects coefficient value of 0.0034 and applying it to the difference in the values of the market to book value ratio at the 10^{th} and 90^{th} percentile levels, the associated change in debt maturing after 3 years would amount to approximately 2.3% of the total market value – a very modest and marginal difference. Equivalently, a one standard deviation movement in the market to book value ratio would trigger a change in debt maturity (debt with maturity longer than 3 years expressed as a proportion of total enterprise value) that would represent 9% of the standard deviation of that variable.

The fixed effects coefficients are supported in sign and significance by the system GMM results except for the commercial paper dummy; fixed asset ratio (not significant in system GMM); and short-term interest rate (different signs but no significance).

The coefficients of size (negative) and regulation (positive) are both statistically and economically significant which is consistent with the results in Table 2.11. This suggests that larger companies have less gearing with longer maturities. This result is consistent with the idea that debt maturity and gearing are correlated. Nevertheless, this contrasts with the positive coefficient in Table 2.9.

Also, the coefficient of abnormal earnings is positive and statistically significant suggesting that total gearing is not affected by information asymmetry. As with the previous results, bond spread has a positive coefficient. The other results are consistent with those in Table 2.9 and need no further elucidation here.

These results support hypothesis 3 and are consistent with results of previous studies of debt maturity such as Barclay, Marx and Smith (2003).

Table 2.11 Determinants of debt maturity as a proportion of market value

This table sets out the regression results where the dependent variable is the amount of debt maturing after 3 years expressed as a proportion of total enterprise value based on market values against the variables in the left-hand column (hypothesis 3)

Variables	Fixed effects	System GMM 2 lags	System GMM 3 lags
Dependent variable (1-year lag)	0.363***	0.449***	0.449***
	(35.98)	(27.81)	(25.20)
Dependent variable (2-year lag)		-0.0422***	-0.0581***
		(-3.403)	(-3.921)
Dependent variable (3-year lag)			0.0922***
			(6.413)
Market to book value ratio	-0.00340***	-0.00337***	-0.00415***
	(-12.86)	(-9.485)	(-9.005)
Regulation dummy	-	0.210***	0.163***
		(6.994)	(5.214)
Size	-0.00773***	-0.00676***	-0.00950***
	(-6.501)	(-5.195)	(-6.127)
Commercial paper dummy	-0.00614	0.00587	0.0118
	(-1.342)	(0.757)	(1.231)
Abnormal earnings	-0.00292***	-0.00343***	-0.00375***
	(-3.599)	(-3.875)	(-3.417)
Average asset life	0.00188***	0.00277***	0.00273***
	(7.030)	(6.895)	(6.050)
Fixed asset ratio	0.0205**	0.00536	0.00515
	(2.258)	(0.476)	(0.366)
Yield curve	-0.521***	-0.589***	-0.699***
	(-5.892)	(-6.926)	(-7.256)
Bond spread	1.085***	0.890***	0.937***
	(15.51)	(12.97)	(12.42)
Inflation	-0.485***	-0.640***	-0.724***
	(-6.029)	(-8.765)	(-8.635)
Short-term interest rate	0.108	-0.0304	-0.134*
	(1.530)	(-0.448)	(-1.797)
Constant	0.121***	0.0757***	0.0956***
	(14.68)	(9.480)	(9.894)
F test	203.5***		
Adjusted R squared	0.151		
Hausman p value	0.00***		
Wald test p value		0.00***	0.00***
Arellano-Bond AR(1)		0.00	0.00
Arellano-Bond AR(2)		0.04	0.75
Sargan statistic		0.00	0.00
Observations	44,581	35,210	28,122
Number of firms	8,799	7,061	5,684

Robust t-statistics in parentheses. *** p<0.01, ** p<0.05, * p<0.1. The Sargan test result is unreliable here - as pointed out in Roodman (2009b) it is not infallible and cannot be relied on too faithfully. The Hansen test statistic is not reported here as it is not available in xtdpdsys – see discussion in section 2.3.3.3. To test for collinearity, the variance inflation factors were computed and were all less than 10. The definitions of the variables are set out in Table 2.5. In this case, system GMM using two lags does not produce a satisfactory AR(2) statistic so a three-lag version of system GMM is included although this reduces the available sample size.

The above results confirm existing results in the literature that both debt maturity and gearing are negatively related to the market to book value ratio as reported in Barclay, Marx and Smith (2003). To overcome the problems identified earlier in respect of gearing measured using market values, hypotheses were formulated to test gearing and debt maturity based on book values rather than market values.

These hypotheses are tested using the same regression equation as before but using gearing ratios based on book values rather than market values with a corresponding lagged dependent variable included. Hypothesis 4 proposes that gearing based on book values will not be negatively related to the market to book value ratio. The results are reported in Table 2.12 and support the hypothesis.

The coefficient of the lagged dependent variable is positive and statistically significant in both fixed effects and system GMM. The coefficient of the market to book value ratio is positive and statistically significant in both columns as predicted supporting the hypothesis and contradicting the solution to the under-investment problem in Myers (1977). The coefficient is also much larger in size (0.021) than the corresponding coefficient reported in Table 2.10 and can be applied to the range of values for the market to book value ratio of 6.91 (between the 10^{th} and 90^{th} percentiles) implying a change in gearing of approximately 14.3% which is substantial and much greater than the relatively small negative adjustments (approximately 4%) implied by a similar change in the market to book value ratio when the gearing ratio is computed using market values. Equivalently, a one standard deviation movement in the market to book value ratio would trigger a change in gearing (based on book values) that would represent 25% of the standard deviation of that variable.

The other economically significant variables are abnormal earnings, average asset life, fixed asset ratio, regulation, short-term interest rate and yield curve.

These results can be compared to the results in Table 2.10 (where gearing was measured using market values). The coefficient of size is negative in both regressions. The coefficient of abnormal earnings is positive in both regressions. The coefficient of average asset life has changed sign although the coefficient is small in both cases.

The coefficient of the fixed asset ratio is much larger here than when gearing based on market values is used as in Table 2.10. The system GMM coefficient for the fixed asset ratio in Table 2.12 is 0.373 and is 0.288 in the fixed effects model. Using a coefficient value of 0.3 and applying this to the difference in fixed asset ratio between the 10th and 90th percentile (a difference of 0.74) would produce a difference in gearing of 22%. Equivalently, a one standard deviation movement in the fixed asset ratio would trigger a change in gearing (based on book values) that would represent 20% of the standard deviation of that variable. This result supports the analysis behind the on-off model that gearing is linked directly to the book value of assets.

There are no other significant differences in the results between Tables 2.10 and 2.12.

Table 2.12 Determinants of gearing (based on book values)
This table sets out the regression results where the dependent variable is the amount of debt expressed as a proportion of the enterprise value measured using book values against the variables in the left-hand column (hypothesis 4)

Variables	Fixed effects	System GMM
Dependent variable (1-year lag)	0.495***	0.571***
	(44.18)	(32.35)
Dependent variable (2-year lag)		-0.0343***
		(-2.694)
Market to book value ratio	0.0207***	0.0157***
	(21.17)	(14.93)
Regulation dummy	-	0.330***
		(4.764)
Size	-0.0128***	-0.00816***
	(-6.424)	(-3.795)
Commercial paper dummy	0.0148***	0.00217
	(3.381)	(0.295)
Abnormal earnings	0.0127***	0.00576***
	(7.578)	(3.708)
Average asset life	-0.00389***	-0.00218***
	(-10.12)	(-4.569)
Fixed asset ratio	0.288***	0.373***
	(15.38)	(15.20)
Yield curve	-1.449***	-0.634***
	(-11.86)	(-7.238)
Bond spread	-0.126	-0.149**
	(-1.151)	(-2.143)
Short-term interest rate	-1.370***	-0.512***
	(-13.21)	(-7.042)
Inflation	-1.405***	-0.665***
	(-13.62)	(-8.324)
Constant	0.179***	0.0434***
	(13.94)	(3.329)
F test	364.9***	
Adjusted R squared	0.325	
Hausman p value	0.00***	
Wald test p value		0.00***
Arellano-Bond AR(1)		0.00
Arellano-Bond AR(2)		0.21
Sargan statistic		0.00
Observations	83,943	77,789
Number of firms	12,447	11,808

Robust t-statistics in parentheses. *** p<0.01, ** p<0.05, * p<0.1. The Sargan test result is unreliable here - as pointed out in Roodman (2009b) it is not infallible and cannot be relied on too faithfully. The Hansen test statistic is not reported here as it is not available in xtdpdsys – see discussion in section 2.3.3.3. To test for collinearity, the variance inflation factors were computed and were all less than 10. The definitions of the variables are set out in Table 2.5.

Hypothesis 5 postulates that the amount of debt with a maturity greater than 3 years (expressed as a proportion of the book value of the enterprise) is not negatively related to the market to book value ratio unless the size effect dominates. Results are set out in Table 2.13 which support the hypothesis, although somewhat weakly.

The coefficient of the lagged dependent variable is positive and statistically significant in both fixed effects and system GMM. The market to book value ratio has a negative coefficient although it is small (approximately 0.0021). If this were applied to the difference in the market to book value ratio between the 10^{th} and 90^{th} percentiles (a difference of approximately 6.91) then a change in debt maturity of 1.45% is implied – quite small. Equivalently, a one standard deviation movement in the market to book value ratio would trigger a change in maturity (based on the amount of debt maturing after 3 years expressed as a proportion of book values) that would represent 5% of the standard deviation of that variable.

The only other economically significant variables are size (where the sign is positive as before) and regulation. There are no other useful results from Table 2.13 that support or contradict the hypothesis.

These results demonstrate that even when book values are used, there is still a small indication that the market to book value ratio and debt maturity are negatively related. However, there may be an alternative explanation. Since the market to book value ratio is strongly negatively related to company size and since debt maturity (as measured by the proportion of debt maturing after 3 years) is positively related to size (see the correlations in Table 2.7, which are positive and significant and the positive coefficient of size in Table 2.13) then it is to be expected that even when maturity is measured using book values that a negative relationship between debt maturity and the market to book value ratio will be seen.

Hypothesis 6 addresses this effect by using a scaled measure of the market to book value ratio instead of the market to book value ratio. The scaled version is simply the market to book value ratio divided by the size variable and attempts to address the interaction between size and maturity.

The regression can then be repeated using the scaled version of the market to book value ratio in place of the market to book value ratio. The results are set out in Table 2.14.

Table 2.13 Determinants of debt maturity as a proportion of book value

This table sets out the regression results where the dependent variable is the amount of debt maturing after 3 years expressed as a proportion of total enterprise value at book values against the variables in the left-hand column (hypothesis 5)

Variables	Fixed effects	System GMM
Dependent variable (1-year lag)	0.402***	0.521***
	(37.29)	(31.98)
Dependent variable (2-year lag)		-0.0427***
		(-3.448)
Market to book value ratio	-0.00214***	-0.00193***
	(-6.163)	(-7.196)
Regulation dummy	-	0.0512**
		(2.541)
Size	0.0150***	0.0144***
	(14.55)	(14.90)
Commercial paper dummy	-0.00728**	-0.0165***
	(-2.039)	(-3.049)
Abnormal earnings	-0.000323	0.000138
	(-0.378)	(0.174)
Average asset life	0.00116***	0.00173***
	(4.845)	(5.274)
Fixed asset ratio	0.0456***	0.0495***
	(4.995)	(4.655)
Yield curve	-0.440***	-0.259***
	(-5.279)	(-3.416)
Bond spread	0.302***	0.280***
	(4.144)	(4.639)
Inflation	-0.516***	-0.367***
	(-6.789)	(-5.287)
Short-term interest rate	0.0654	0.119**
	(0.960)	(2.110)
Constant	-0.000212	-0.0354***
	(-0.0297)	(-6.107)
F test	194.8***	
Adjusted R squared	0.181	
Hausman p value	0.00***	
Wald test p value		0.00***
Arellano-Bond AR(1)		0.00
Arellano-Bond AR(2)		0.37
Sargan statistic		0.00
Observations	50,501	42,214
Number of firms	9,789	8,463

Robust t-statistics in parentheses. *** p<0.01, ** p<0.05, * p<0.1. The Sargan test result is unreliable here - as pointed out in Roodman (2009b) it is not infallible and cannot be relied on too faithfully. The Hansen test statistic is not reported here as it is not available in xtdpdsys – see discussion in section 2.3.3.3. To test for collinearity, the variance inflation factors were computed and were all less than 10. The definitions of the variables are set out in Table 2.5.

Table 2.14 reports the result of a regression test of hypothesis 6 which examines the relationship between gearing based on book values and the scaled market to book value ratio together with the other control variables. The results support the hypothesis.

These results broadly replicate the results in Table 2.13 except that the coefficient of the scaled market to book value ratio is not significant although it is still negative but much smaller. There is no significant negative relationship between debt maturing after 3 years (expressed as a proportion of the book value of assets) and the scaled market to book value ratio as predicted in the hypothesis.

The other independent variables have similar size coefficients and statistical significance in both Tables 2.13 and 2.14. The results in Table 2.14, other than in respect of the scaled market to book value ratio, add little to the results in Table 2.13.

Table 2.14 Relationship between book debt maturity and the scaled MTBV ratio
This table sets out the regression results where the dependent variable is the amount of debt maturing after 3 years expressed as a proportion of total enterprise value at book values against the variables in the left-hand column (hypothesis 6) including the scaled market to book value ratio

Variables	Fixed effects	System GMM
Dependent variable (1-year lag)	0.403***	0.532***
	(37.48)	(32.81)
Dependent variable (2-year lag)		-0.0345***
		(-2.733)
Scaled MTBV ratio	-0.000727	-0.00121
	(-0.852)	(-1.400)
Regulation dummy	-	0.0562***
		(2.802)
Size	0.0122***	0.0124***
	(13.69)	(13.78)
Commercial paper dummy	-0.00630*	-0.0123**
	(-1.764)	(-2.358)
Abnormal earnings	-0.000535	-3.06e-05
	(-0.624)	(-0.0383)
Average asset life	0.00131***	0.00202***
	(5.467)	(5.947)
Fixed asset ratio	0.0411***	0.0435***
	(4.486)	(3.890)
Yield curve	-0.499***	-0.307***
	(-6.015)	(-4.040)
Bond spread	0.306***	0.283***
	(4.205)	(4.620)
Inflation	-0.544***	-0.378***
	(-7.161)	(-5.492)
Short-term interest rate	0.0153	0.0785
	(0.226)	(1.382)
Constant	0.0129*	-0.0309***
	(1.943)	(-5.208)
F test	190.4***	
Adjusted R squared	0.179	
Hausman p value	0.00***	
Wald test p value		0.00***
Arellano-Bond AR(1)		0.00
Arellano-Bond AR(2)		0.25
Sargan statistic		0.00
Observations	50,501	42,214
Number of firms	9,789	8,463

Robust t-statistics in parentheses. *** p<0.01, ** p<0.05, * p<0.1. The Sargan test result is unreliable here - as pointed out in Roodman (2009b) it is not infallible and cannot be relied on too faithfully. The Hansen test statistic is not reported here as it is not available in xtdpdsys – see discussion in section 2.3.3.3. To test for collinearity, the variance inflation factors were computed and were all less than 10. The definitions of the variables are set out in Table 2.5.

Hypothesis 7 suggests that changes in gearing (based on market values) will be negatively related to changes in the market to book value ratio. This is a consequence of the analysis that the structure of these variables contributes to the reported negative relationship between gearing and the market to book value ratio.

The results are set out in Table 2.15. The results support the hypothesis.

In this case, the system GMM approach produces an Arellano-Bond AR(2) statistic just less than 10% so the three-lag version of system GMM is included and produces coefficients similar to the two-lag version with similar levels of significance and which produces a satisfactory Arellano-Bond (AR2) statistic.

The coefficient of the lagged dependent variable is negative and statistically significant in both fixed effects and system GMM consistent with earlier results and confirming that there is reversion to a target level of gearing. The coefficient of changes in the market to book value ratio is negative and statistically significant in all columns as predicted supporting the hypothesis.

The size of the change in gearing implied by the product of the coefficient and the change in the market to book value ratio between the 10^{th} and 90^{th} percentiles is 2.3%. Equivalently, a one standard deviation movement in changes in the market to book value ratio would trigger a change in gearing (based on market values) that would represent 18% of the standard deviation of that variable.

The system GMM results are supportive of the fixed effects results except for abnormal earnings. The coefficient of size is negative consistent with earlier results and is economically significant as is regulation. The bond market conditions are all positively related to changes in gearing (except for the short-term interest rate) which is not predicted although it has been argued that modifying gearing in response to changes in market conditions (or other factors) is not something that can be easily or quickly undertaken. The other results are unexceptional.

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Table 2.15 Determinants of changes in gearing (based on market values)

This table sets out the regression results where the dependent variable is changes in the amount of debt expressed as a proportion of the enterprise value measured using market values against the variables in the left-hand column (hypothesis 7)

Variables	Fixed effects	System GMM 2 lags	System GMM 3 lags
Dependent variable (1-year lag)	-0.272***	-0.294***	-0.374***
	(-43.72)	(-27.88)	(-28.55)
Dependent variable (2-year lag)		-0.159***	-0.271***
		(-17.42)	(-21.61)
Dependent variable (3-year lag)			-0.162***
			(-15.89)
Change in the market to book value ratio	-0.00793***	-0.00529***	-0.00522***
	(-25.11)	(-13.48)	(-12.10)
Regulation dummy	-	0.159***	0.211***
		(3.888)	(4.406)
Size	-0.0176***	-0.0359***	-0.0352***
	(-15.45)	(-17.76)	(-15.95)
Commercial paper dummy	0.00984**	0.0315**	0.0320**
	(2.127)	(2.481)	(2.340)
Abnormal earnings	0.00434***	-0.00106	-0.00197
	(4.672)	(-0.858)	(-1.491)
Average asset life	0.00144***	0.00208***	0.00186***
	(5.528)	(4.476)	(3.571)
Fixed asset ratio	0.0601***	0.0459***	0.0469***
	(6.367)	(2.902)	(2.667)
Yield curve	0.269***	-0.557***	-0.264**
	(3.307)	(-5.662)	(-2.259)
Bond spread	0.781***	0.751***	0.807***
	(12.57)	(10.18)	(9.546)
Inflation	-0.310***	-0.867***	-0.528***
	(-4.530)	(-9.984)	(-5.283)
Short-term interest rate	0.540***	-0.0812	0.190**
	(9.178)	(-1.060)	(2.023)
Constant	0.0588***	0.173***	0.155***
	(7.998)	(15.33)	(12.39)
F test	341.5***		
Adjusted R squared	0.139		
Hausman p value	0.00***		
Wald test p value		0.00***	0.00***
Arellano-Bond AR(1)		0.00	1.00
Arellano-Bond AR(2)		0.09	0.51
Sargan statistic		0.00	0.00
Observations	63,952	55,256	47,759
Number of firms	9,811	8,589	7,571

Robust t-statistics in parentheses. *** p<0.01, ** p<0.05, * p<0.1. The Sargan test result is unreliable here - as pointed out in Roodman (2009b) it is not infallible and cannot be relied on too faithfully. The Hansen test statistic is not reported here as it is not available in xtdpdsys – see discussion in section 2.3.3.3. To test for collinearity, the variance inflation factors were computed and were all less than 10. The definitions of the variables are set out in Table 2.5. In this case, system GMM using two lags does not produce a satisfactory AR(2) statistic so a three-lag version of system GMM is included although this reduces the available sample size.

Hypothesis 8 is similar to hypothesis 7 but changes in debt maturing after 3 years (expressed as a proportion of market value) is hypothesised to be negatively related to changes in the market to book value ratio. The results are set out in Table 2.16 which provide support for the hypothesis.

The coefficient of the lagged dependent variable is negative and statistically significant in both fixed effects and system GMM consistent with earlier results and confirming that there is reversion to a target level of debt maturity. The coefficient of changes in the market to book value ratio is negative and statistically significant in both columns as predicted supporting the hypothesis.

As predicted in the hypothesis, Table 2.16 demonstrates that there is a clear negative relationship between changes in the proportion of debt maturing after three years (based on market values) and changes in the market to book value ratio. The size of the change in gearing implied by the product of the coefficient and the change in the market to book value ratio between the 10th and 90th percentiles is approximately 2.2%. Equivalently, a one standard deviation movement in changes in the market to book value ratio would trigger a change in debt maturity (based on market values) that would represent 22% of the standard deviation of that variable (i.e. changes in debt maturity) indicating a significant relationship, both statistically and economically.

The only other economically significant independent variable is size with a negative sign consistent with the results in Table 2.15. The results in respect of the other variables are unexceptional.

Table 2.16 Determinants of changes in maturity (based on market values)

This table sets out the regression results where the dependent variable is changes in the amount of debt with maturity in excess of 3 years expressed as a proportion of the enterprise value measured using market values against the variables in the left-hand column (hypothesis 8)

Variables	Fixed effects	System GMM
Dependent variable (1-year lag)	-0.282***	-0.326***
	(-29.85)	(-21.57)
Dependent variable (2-year lag)		-0.247***
		(-18.87)
Change in the market to book value ratio	-0.00321***	-0.00200***
	(-11.53)	(-6.269)
Regulation dummy	-	0.0332
		(1.211)
Size	-0.0118***	-0.0166***
	(-10.28)	(-10.74)
Commercial paper dummy	0.00383	0.0148
	(0.862)	(1.353)
Abnormal earnings	-0.00317***	-0.00305***
	(-2.754)	(-2.607)
Average asset life	0.00243***	0.00343***
	(8.080)	(7.028)
Fixed asset ratio	-0.0144	-0.0489***
	(-1.560)	(-3.277)
Yield curve	0.154	-0.632***
	(1.575)	(-6.070)
Bond spread	0.886***	0.764***
	(10.85)	(9.897)
Inflation	-0.189**	-0.775***
	(-2.300)	(-8.825)
Short-term interest rate	0.460***	-0.296***
	(6.150)	(-3.868)
Constant	0.0349***	0.0913***
	(4.354)	(9.261)
F test	132.7***	
Adjusted R squared	0.101	
Hausman p value	0.00***	
Wald test p value		0.00***
Arellano-Bond AR(1)		0.00
Arellano-Bond AR(2)		0.61
Sargan statistic		0.00
Observations	35,199	28,115
Number of firms	7,058	5,683

Robust t-statistics in parentheses. *** p<0.01, ** p<0.05, * p<0.1. The Sargan test result is unreliable here - as pointed out in Roodman (2009b) it is not infallible and cannot be relied on too faithfully. The Hansen test statistic is not reported here as it is not available in xtdpdsys – see discussion in section 2.3.3.3. To test for collinearity, the variance inflation factors were computed and were all less than 10. The definitions of the variables are set out in Table 2.5.

Hypothesis 9 is tested by regressing changes in gearing (based on book values) against changes in the market to book value ratio (a positive relationship is predicted by the hypothesis) and the other independent variables. The results are set out in Table 2.17 and support the hypothesis.

The coefficient of the lagged dependent variable is negative and statistically significant in both fixed effects and system GMM consistent with earlier results and confirming that there is reversion to a target level of debt maturity. The coefficient of changes in the market to book value ratio is positive and statistically significant in both columns as predicted supporting the hypothesis. The size of the change in gearing implied by the product of the coefficient and the change in the market to book value ratio between the 10^{th} and 90^{th} percentiles is approximately 10.0% which is substantial. Equivalently, a one standard deviation movement in changes in the market to book value ratio would trigger a change in debt maturity (based on market values) that would represent 22% of the standard deviation of that variable (ie changes in debt maturity) indicating a significant relationship, both statistically and economically.

The other economically significant independent variables are average asset life (which is negative here but positive in all other Tables) the fixed asset ratio, regulation and size. Here the coefficient of size is positive suggesting that changes in gearing are positively related to company size consistent with the on-off model and the structural model. The results in respect of the other variables are unexceptional.

Table 2.17 Determinants of changes in maturity (based on book values)

This table sets out the regression results where the dependent variable is changes in the amount of debt with maturity in excess of 3 years expressed as a proportion of the enterprise value measured using book values against the variables in the left-hand column (hypothesis 9)

Variables	Fixed effects	System GMM
Dependent variable (1-year lag)	-0.223***	-0.169***
	(-19.43)	(-9.758)
Dependent variable (2-year lag)		-0.0958***
		(-6.655)
Change in the market to book value ratio	0.0145***	0.00911***
	(16.30)	(11.59)
Regulation dummy	-	-0.118***
		(-2.804)
Size	0.0117***	0.000970
	(6.569)	(0.495)
Commercial paper dummy	0.00744**	-0.0164*
	(2.021)	(-1.924)
Abnormal earnings	0.00805***	0.00708***
	(4.060)	(4.073)
Average asset life	-0.00380***	-0.00228***
	(-7.910)	(-3.941)
Fixed asset ratio	0.284***	0.286***
	(12.42)	(10.67)
Yield curve	-0.595***	-0.525***
	(-4.603)	(-6.083)
Bond spread	-0.106	-0.198***
	(-0.884)	(-2.800)
Inflation	-0.880***	-0.752***
	(-7.596)	(-9.562)
Short-term interest rate	-0.446***	-0.308***
	(-5.058)	(-4.433)
Constant	-0.0682***	-0.0107
	(-5.504)	(-0.860)
F test	88.10***	
Adjusted R squared	0.111	
Hausman p value	0.00***	
Wald test p value		0.00***
Arellano-Bond AR(1)		0.00
Arellano-Bond AR(2)		0.48
Sargan statistic		0.00
Observations	72,774	67,203
Number of firms	11,033	10,345

Robust t-statistics in parentheses. *** p<0.01, ** p<0.05, * p<0.1. The Sargan test result is unreliable here - as pointed out in Roodman (2009b) it is not infallible and cannot be relied on too faithfully. The Hansen test statistic is not reported here as it is not available in xtdpdsys – see discussion in section 2.3.3.3. To test for collinearity, the variance inflation factors were computed and were all less than 10. The definitions of the variables are set out in Table 2.5.

2.5 Conclusions

The contributions identified in this Chapter are listed at the beginning of this Chapter and in Chapter 1. Here, the main findings are presented more briefly with more emphasis on the empirical tests conducted.

The key contribution is to show that the under-investment problem arises when there are transfers in value between debt-holders and shareholders caused by the financing mix of the external financing for the investment rather than the investment itself and that such transfers can be reversed by a post-investment adjustment in capital structure that restores the gearing ratio prior to the investment. This solution is simple with low costs and is preferable to the solutions proposed in Myers (1977) of shortening debt maturity of reducing gearing – both of which have significant associated costs and reductions in flexibility.

To avoid problems of under-investment, a company should aim to maintain constant gearing or at least avoid improving the position of the debt-holders by reducing gearing or volatility. By publishing statements about the company's policy to maintain a constant gearing ratio should encourage the market to assume that any improvement in gearing that benefitted debt-holders would be temporary and would be reversed. In this way, there would be no transfer in value to debt-holders. This approach coupled with the option to reverse adverse transfers by post-investment capital structure adjustments are much simpler and cheaper than the solution in Myers (1977) of either shortening debt maturity or reducing gearing – both of which are clumsy, difficult and costly to implement.

The motivation for reducing debt maturity in Myers (1977) is to create a need to meet with lenders. However, management need not adjust debt maturity to be able to enter into negotiations with lenders: the option to negotiate exists regardless of debt maturity and reducing debt maturity carries other disadvantages such as accelerating refinancing and liquidity risk.

In summary: there will be no under-investment problem if gearing remains constant; gearing can be kept constant if the financing mix of the new investment matches existing gearing; if the financing mix cannot match existing gearing and if, as a result, of such a mis-match, gearing falls, then the under-investment problem will be avoided if there is a post-investment adjustment to capital structure that restores gearing to the pre-investment level. It should also be noted that in some cases, even if gearing falls, there is no under-investment problem (depending on there being a positive net present value investment of sufficient size).

Empirical results summarised in the Appendix to Chapter 2 (the negative relationship between both debt maturity and gearing (based on market value) and the market to book value ratio) are considered to support the solution in Myers (1977) and similar results are obtained here. However, two explanations for these relationships are identified: the on-off model and the structural link between gearing (based on market value) and the market to book value ratio. Both these explanations imply a similar negative relationship between gearing (based on market values) and size and suggest that the established results may not provide support for the solution to the under-investment problem in Myers (1977).

Hypotheses are developed to test these alternative explanations empirically. In view of these explanations, an alternative gearing measure is used (based on book values rather than market values) that is not affected by the above structural link or by the implications of the on-off model. When gearing (based on book values) is regressed against several independent variables, the coefficient of the market to book value ratio is positive rather than negative (when gearing based on market values is used). However, when gearing is restricted to debt with a maturity longer than 3 years (can based on book values) a negative coefficient is obtained but it is small and is reversed when the market to book value ratio is scaled by size. This tends to confirm that existing empirical results are due to the explanations provided and do not represent any evidence about the management of the under-investment problem.

Similar results are obtained for size (also predicted by the on-off model and the structural links between the variables): gearing based on market values is negatively related to size. Gearing (based on book values) is also negatively related to size: however, changes in gearing (based on book values) is positively related to size and debt with a maturity greater than 3 years as a proportion of book value is positively related to size.

Some simple conclusions can be drawn for the management of capital structure.

Under-investment need not be a problem: the only problem that might arise in the context of an investment is that a transfer of value from shareholders to debt-holders can arise because the mix of financing for the investment improves the position of existing debt-holders: this transfer can be reversed by a subsequent adjustment to capital structure that cancels the improvement. Companies need not reduce debt maturity or reduce the amount of debt issued (both of which carry significant disadvantages for the company) to manage the under-investment problem.

The policy of adjusting capital structure is consistent with the idea of measuring speed of adjustment as in Graham and Leary (2011).

Appendix to Chapter 2: Summary empirical results in relation to the market to book value ratio

Dependent variable is debt maturity	Definition of debt maturity	Coefficient and significance of the market to book value ratio	Country	Time	Observations	Methodology
Barclay and Smith (1995)	Proportion > 3 years	-2.33***	US	1974-1991	37,155	fixed effects
		-4.78***	US	1974-1992	37,969	pooled
		-4.37***	US	1974-1993	5545	cross-section
Dennis, Nandy and Sharpe (2000)	Debt term	-0.192*	US	1987-1995	2,634	Two stage least squares
Kleczyk (2012)	Proportion > 3 years	-0.0095***	US	1991-2000	N/A	pooled OLS
		-0.1306*	US	1991-2000		cross-section
		-0.0047	US	1991-2000		fixed effects
		-0.0080**	US	1991-2000		random effects
		-0.0067**	US	1991-2000		GLS corrected for heteroskedasticity and AR(1)
Harrison and Widjaja (2014)	Long-term gearing	-0.0575***	US	2004-2011	2,648	random effects
Similar results were obtained for shorter time periods						
Stohs and Mauer (1996)	weighted average maturity	0.223	US	1980-1989	3,279	fixed effects
(includes leverage in the equation which reduces the significance of the coefficient of the market to book value ratio)		0.159	US	1980-1989	3,279	pooled
		-0.220	US	1980-1989	328	cross-section

Appendix to Chapter 2: Summary empirical results in relation to the market to book value ratio, continued

Dependent variable is debt maturity	Definition of debt maturity	Coefficient and significance of the market to book value ratio	Country	Time	Observations	Methodology
Antoniou, Guney and Paudyal (2006)	Proportion > 1 year	-0.0026	France	1985-2000	2,430	fixed effects
		-0.0054	France	1986-2001	2,133	system GMM
		-0.0033	Germany	1989-2000	3,936	fixed effects
		0.0025	Germany	1990-2000	3,467	system GMM
		0.0011	UK	1971-2000	26,779	fixed effects
		-0.0014	UK	1972-2000	24,703	system GMM
Johnson (2003)	Proportion < 3 years	-0.074***	US	1986-1995	20,565	pooled
		-0.0815***	US	1986-1995	4,945	cross-section
		-0.0209***	US	1986-1995	17,714	fixed effects
Cai, Fairchild and Guney (2008)	Proportion > 1 year	0.001	China	1999-2004	1,544	Fixed effects, system GMM
Cai, Cheunga and Goyal (1999)	Bond maturity	0.034	Japan	1980-1993	173	OLS
Kim, Mauer and Stohs	Weighted average	-0.05	US	1980-1989	3,280	Fixed effects
Dependent variable is gearing (measured using market values)		-0.0175***	France	1989-2000	2,145	system GMM
Antoniou, Guney and Paudyal (2008)		-0.0015*	Germany	1989-2000	4,952	As above
		-0.0875***	Japan	1989-2000	16,664	As above
		-0.0045*	UK	1989-2000	14,495	As above
		-0.0013	USA	1989-2000	11,584	As above

Appendix to Chapter 2: Summary empirical results in relation to the market to book value ratio, continued

Dependent variable is gearing (measured using book values)	Definition of gearing	Coefficient and significance of the market to book value ratio	Country	Time	Observations	Methodology
Rajan and Zingales (1995)	based on book values	-0.17***	US	1987-1991	2,207	maximum likelihood and a
		-0.04	Japan	1987-1991	303	censored Tobit model.
		-0.20***	Germany	1987-1991	176	as above
		-0.17**	France	1987-1991	126	as above
		-0.19	Italy	1987-1991	98	as above
		-0.13***	UK	1987-1991	544	as above
		-0.11***	Canada	1987-1991	275	as above
Rajan and Zingales (1995)	based on market values	-0.08***	US	1987-1991	2,207	maximum likelihood and a
		-0.07***	Japan	1987-1991	303	censored Tobit model.
		-0.21***	Germany	1987-1991	176	as above
		-0.15**	France	1987-1991	126	as above
		-0.18*	Italy	1987-1991	98	as above
		-0.6**	UK	1987-1991	544	as above
		-0.13***	Canada	1987-1991	275	as above
de Jong, Nguyen and van Dijk (2007)	Cournot firms					
(use lagged value of the market to book value ratio)	Long-term debt > 1 year/market value of assets	-0.006***	US	1985-2004	2,504	fixed effects, 2-stage LS
	Long-term debt > 1 year/book value of assets	-0.002	US	1985-2004	2,504	lagged dependent variables
	Total debt > 1 year/market value of assets	-0.008***	US	1985-2004	2,504	as above
	Total debt > 1 year/book value of assets	-0.002	US	1985-2004	2,504	as above

Appendix to Chapter 2: Summary empirical results in relation to the market to book value ratio, continued

Dependent variable is gearing (measured using book values)	Definition of gearing	Coefficient and significance of the market to book value ratio	Country	Time	Observations	Methodology
	Bertrand firms					
	Long-term debt > 1 year/market value of assets	-0.002*	US	1985-2004	3,513	as above
	Long-term debt > 1 year/book value of assets	-0.002**	US	1985-2004	3,513	as above
	Total debt > 1 year/market value of assets	-0.003***	US	1985-2004	3,513	as above
	Total debt > 1 year/book value of assets	-0.004***	US	1985-2004	3,513	as above
Akdal (2010) In this specification, year dummies are included. When year dummies are excluded, significance reduces for the market value ratios and disappears for the book value measures of gearing	Long-term debt > 1 year/market value of assets	-0.10***	UK	2002-2009	1,616	pooled OLS
	Long-term debt > 1 year/book value of assets	-0.09***	UK	2002-2009	1,616	pooled OLS
	Total debt > 1 year/market value of assets	-0.10***	UK	2002-2009	1,616	pooled OLS
	Total debt > 1 year/book value of assets	-0.07***	UK	2002-2009	1,616	pooled OLS
Hovakimian (2006)	Gearing (book values)	-0.024**	US	1983 - 2002	51,251	pooled OLS
de Jong, Kabir and Nguyan (2008)	Gearing (market value) averages	-0.007**	Australia	1997-2001	254	pooled OLS
(Only the statistically significant results are presented here)		-0.015***	Belgium	1997-2001	82	pooled OLS
		-0.014***	Canada	1997-2001	413	pooled OLS
		-0.145***	Chile	1997-2001	81	pooled OLS
		-0.017***	Denmark	1997-2001	99	pooled OLS
		-0.009***	France	1997-2001	503	pooled OLS
		-0.001***	Germany	1997-2001	571	pooled OLS

Appendix to Chapter 2: Summary empirical results in relation to the market to book value ratio, continued

Dependent variable is gearing (measured using book values)	Definition of gearing	Coefficient and significance of the market to book value ratio	Country	Time	Observations	Methodology
de Jong, Kabir and Nguyan (2008)	Gearing (market value) averages	-0.005*	India	1997-2001	226	pooled OLS
		-0.035*	Indonesia	1997-2001	177	pooled OLS
(Only the statistically significant results are presented here)		-0.024***	Ireland	1997-2001	37	pooled OLS
		-0.011**	Italy	1997-2001	164	pooled OLS
		-0.015*	Korea	1997-2001	142	pooled OLS
		-0.011*	Malaysia	1997-2001	496	pooled OLS
		-0.110***	Mexico	1997-2001	54	pooled OLS
		-0.063**	New Zealand	1997-2001	47	pooled OLS
		-0.077***	Peru	1997-2001	19	pooled OLS
		-0.001***	Philippines	1997-2001	77	pooled OLS
		-0.015**	Portugal	1997-2001	31	pooled OLS
		-0.030***	Singapore	1997-2001	310	pooled OLS
		-0.015***	Sweden	1997-2001	206	pooled OLS
		-0.013**	Switzerland	1997-2001	164	pooled OLS
		-0.032***	Taiwan	1997-2001	153	pooled OLS
		-0.004***	UK	1997-2001	795	pooled OLS
		-0.012***	US	1997-2001	2533	pooled OLS

CHAPTER 3 MANAGING INFORMATION ASYMMETRY

3.1 Introduction

The objective of this Chapter is to assess the classical models on over-investment (developed by Jensen and Meckling (1976)) and pecking order (developed by Myers and Majluf (1984)) in a critical fashion and to develop further the notions and implications underpinning the model reflecting realistic market characteristics and managerial objectives. These analyses lead to the generation of new methods of managing the under-investment problem and the problem of information asymmetry in the pecking order theory. This leads to the development of testable hypotheses. Both experimental and empirical analyses are presented to test the analytic and narrative arguments advanced via this set of hypotheses.

The over-investment problem can arise when the company can obtain a transfer of value from debt-holders to shareholders. This transfer of value can be used to subsidise an investment opportunity that has a negative net present value. If the value transferred is sufficiently large, the investment opportunity can become viable which is why it is called the over-investment problem – companies might be tempted to invest sub-optimally.

The technique posed in the model developed by Jensen and Meckling (1976) is to transfer value from debt-holders to shareholders by misrepresenting the nature of the investment opportunity: a riskier investment is substituted in place of the opportunity disclosed (hence the name asset substitution). Once the true nature of the investment is known and the information asymmetry resolved, there will be a reduction in value of the debt which will precipitate a transfer of value to the shareholders. Asset substitution is an example of information asymmetry.

The motivation for the pecking order theory is information asymmetry. Companies do not wish to issue new shares when the issue price of those new shares does not reflect the company's perception of their true value. Such an issue of shares would have the effect of transferring value from the old or existing shareholders to the new shareholders. Faced with such a problem, companies will prefer to use debt to fund the investment or otherwise pass up the investment opportunity thus creating the circumstances of the under-investment problem.

The pecking order theory is closely related to the under-investment and over-investment problems. In each case, there is a transfer of value between stakeholders that can benefit or disadvantage existing shareholders and, for each case, possible solutions for the problems arising require changes to capital structure.

The incremental contributions achieved in this Chapter show that:

- the over-investment problem is the converse of the under-investment problem in that a transfer of value from debt-holders at the expense of shareholders is the underlying problem generating over-investment whereas in the under-investment scenario, it is a transfer of value from shareholder to debt-holders that can lead to the under-investment problem;
- the tools proposed in Chapter 2 to manage the under-investment problem can be used to achieve a transfer of value from debt-holders to shareholders as in the over-investment problem: this mechanism involves reducing the value of

existing debt by reducing the credit quality: this can be achieved quite simply by increasing overall company gearing by using a suitably large amount of debt in the financing mix of the new investment: if sufficient debt is used to finance the investment then overall gearing will rise and this will reduce the credit quality of the pre-investment debt and thus reduce its value for the benefit of shareholders (see Table 2.1). At face value, this could be a source of value creation for shareholders (if debt-holders accepted such transfers of value);

- providers of debt finance will not be content to suffer transfers of value from their investments to shareholders (as postulated in the solution to the under-investment problem): this will make it difficult for a company to promote such a transfer and pursue sub-optimal investments;
- debt investors, aware of the behaviour of a company seeking to transfer value from debt-holders to shareholders, will seek a premium in the cost of debt that will compensate for the risk of a value transfer occurring;
- a good strategy for the company to avoid this increased debt cost is to maintain a constant capital structure and so avoid debt investors seeking a premium (to compensate for the risk of a transfer in value) and thereby optimise the company's cost of capital;
- there is a stark contrast between Myers' (1977) solution to the under-investment problem (shortening debt maturity and/or reducing the debt amount) and the solution to the pecking order problem (increasing debt): both problems involve the risk of under-investment and yet the solutions proposed about debt are exactly opposite;
- in the case of the pecking order theory, there are several solutions that can be used to manage potential transfers of value between old and new shareholders

in the presence of asymmetric information that enable sensible investment opportunities to be pursued without value being lost by shareholders: one technique that is proposed is the use of short-term bridging finance. This is pure debt financing and so in a certain narrow sense is consistent with the solution in the pecking order theory. However, the idea of the short-term finance is that it will be replaced with long-term finance which could include equity which can be issued at a time when the problem of information asymmetry has been resolved. In this way, a company can pursue a long-term capital structure strategy (for example, constant gearing) with temporary deviations (using bridge financing) when information asymmetry precludes an equity issue;

- the bridge financing technique is tested using the dataset described in Chapter 2 and shows that while there is support for the pecking order theory in common with tests reported in Shyam-Sunder and Myers (1999), that the data also support the idea that increases in gearing at the time of investment are subsequently reversed and that such temporary increases in gearing are suggestive of the use of short-term bridge financing which is one of the solutions proposed for problems of information asymmetry;
- these results suggest that problems of asymmetric information can be managed in a way that makes no predictions about capital structure and thus that there is no basis for arguing that there is a natural preference for debt over equity (as proposed in the pecking order theory);
- if there is no motivation for the pecking order theory (since there are alternative solutions to problems of information asymmetry) then the implication for capital structure theory is that companies should maintain reserve borrowing capacity to be able to use bridge financing should the need arise. This suggests a

preference for a conservative capital structure – a gearing ratio that is below the maximum level that it could be.

In section 3.2, the connection between the under-investment problem and the over-investment problem is developed to highlight the origins of the transfers in value. In section 3.3, the over-investment problem is reviewed, and the results of an experiment are reported to demonstrate how investors might react when faced with a company that seeks to switch value between debt-holders and equity holders by deception. In section 3.4, several solutions for the management of capital structure are proposed that can manage the problems of asymmetric information that avoid the consequences predicted by the pecking order theory. In section 3.5, the results of a test of the pecking order theory are reported (essentially a modification of the test in Shyam-Sunder and Myers (1999)) that provide no support for the pecking order theory.

The proposed solutions suggest a number of hypotheses which are tested, and evidence is presented that companies use short-term financing for investment so that gearing increases (at the time of investment) but that this is followed by a reduction in gearing in subsequent periods. This is support for one of the solutions proposed to manage the problem of asymmetric information. Conclusions are in section 6.

3.2 The connection between under-investment and over-investment

The over-investment problem (as described in Jensen and Meckling (1976)) is the dual or converse of the under-investment problem in Myers (1977). In the case of the under-investment problem, the company may have a profitable investment opportunity but, as debt-holders will capture some of this value, the company may decide against the project as the reduced equity returns could render the investment opportunity uneconomic.

The converse case, the over-investment problem, arises where the company may decide to go ahead with an unattractive investment opportunity as it can achieve a subsidy (by means of a transfer of value from the debt-holders to the equity holders) that covers the shortfall in the returns of the investment opportunity. This is the reverse transfer in value to that arising in the under-investment scenario.

The connection between these two problems allows the analysis in Chapter 2 to be extrapolated to the over-investment problem. In the extended Myers' (1977) model in Chapter 2, two main scenarios were considered: first, scenario 1, where volatility was kept constant and enterprise value allowed to vary (and both internal and external financing were considered); and secondly, scenario 2, where enterprise value was kept constant and volatility allowed to vary (where only internal financing needed to be considered).

In the case of scenario 1, it was shown that the under-investment problem derived from changes in capital structure caused by the method of financing the investment rather than the investment itself. This method of transferring value from debt-holders to shareholders to support over-investment is considered in section 3.2.1. Scenario 2 (where volatility varies) corresponds to the asset substitution scenario which is considered in section 3.2.2.

3.2.1 Changing capital structure to support over-investment

In Jensen and Meckling (1976), only asset substitution was considered (see section 3.2.2 below). However, the analysis of scenario 1 (in Chapter 2) can be extended directly to the over-investment problem. The argument would be to consider a company faced with a negative net present value investment opportunity looking to achieve a subsidy from the debt-holders by financing the investment in a way that reduced the value of existing debt (for example by using a large proportion of debt that increased overall gearing and thereby reduced the value of existing debt). This would create the circumstances of the over-investment problem. The analysis in Chapter 2 indicates that the transfer in value is due to the mix of financing (as between debt and equity) rather than the investment itself: the analysis also indicates that where there is a positive net present value project that in some circumstances (depending on the new gearing level) the debt-holders do not capture all the benefit (of a positive net present value project) but that the shareholders do get some proportion of the surplus.

By analogy, faced with an investment opportunity with a negative net present value, not all the loss in value associated with the investment opportunity would be suffered by the debt-holders in every circumstance. Section 2.2.4 of Chapter 2 demonstrates the argument for a positive net present value project financed using a mix of debt and equity that is equal to the capital structure prior to the investment. The same argument applies to a negative net present value project. In case 1, scenario i) gearing rises but the loss of value associated with the negative net present value investment opportunity is shared between both debt-holders and shareholders. In case 1, scenario ii) where gearing is unchanged after investment, there is still a sharing of the loss associated with the negative net present value project. In these cases, the transfer in value from debt-holders to shareholders is not sufficient to convert an unprofitable project into a profitable one.

To achieve a transfer in value that is sufficiently large, there needs to be a more significant change in gearing that causes a large reduction in value of the existing debt. As with under-investment, this analysis shows that it is the financing method that causes the transfer in value.

The under-investment problem can be managed by using short maturity debt and/or less debt as this certainly minimises any value transfer, but these are extreme solutions and would be difficult and costly to implement. Better solutions are proposed in Chapter 2 such as recapturing value transferred by subsequent adjustments to capital structure that avoid making significant changes in capital structure such as reducing debt or reducing maturity.

This approach can be extended to the over-investment problem. By using longer debt maturity and/or by using more debt, there would be more scope to achieve a transfer in value from debt-holders to shareholders to support a negative net present value investment opportunity. The juxtaposition of two quite different capital structure policies confirms that they are unrealistic solutions. A company could not adopt both such extreme capital structures unless it was sure that the next investment opportunity represented under-investment or over-investment. The company might need to make significant changes in capital structure between strategies to overcome both over-investment and under-investment problems.

The empirical inverse relationship between the market to book value ratio and both debt maturity and gearing was confirmed in Chapter 2 and is widely confirmed in the literature (see the Appendix to Chapter 2). It could be argued that this empirical relationship supports the solution to the over-investment problem.

If companies do prefer longer maturity or greater leverage to be able to obtain subsidies from debt-holders, then such a policy will be associated with low market to book value ratios (implying their investment opportunities are unprofitable). This implies the same inverse relationship between the market to book value ratio and i) maturity and ii) gearing as summarised in the Appendix to Chapter 2.

However, those relationships were explained in Chapter 2 in ways that did not validate the support for Myers' (1977) solution of the under-investment problem and equally provide no support the converse solution for over-investment.

There are plenty of examples where such changes in debt values have been observed. Myers (2001) describes how the bond issues of RJR Nabisco fell in price by more than 10% on the announcement of the leveraged buy-out which had the effect of reducing the credit quality of the existing debt issues. This is a directly comparable situation where an event occurred which reduced the value of the debt issues (and transferred a benefit to the shareholders). Leveraged buy-outs can lead to transfers of value. Asquith and Wizman (1990) estimated that the announcement of a leveraged buy-out led to a loss in value for bonds without covenant protection (that is mechanisms to protect debt investors in the loan agreement) of approximately 5.2%. Alexander, Edwards and Ferri (2000) examined the returns of traded high yield bonds and found evidence of a negative correlation between bond returns and share returns around the announcement of events such as leveraged buy-outs (of which RJR Nabisco is an example).

Switching value from debt-holders to shareholders is such an obvious strategy that some companies could be tempted to adopt it without the cover of an investment opportunity. As such a switch can increase shareholder value, then a company is almost compelled to adopt it.

The ability of a company to switch value between stakeholders is something that will have an impact on the debt investors and they will react and learn. It may not be easy for a management team to achieve this without alerting debt investors to their true intentions. The perspective of debt investors has a major impact on the ability of a company to change its capital structure and this is explored in section 3.3.

3.2.2 Asset substitution

One way in which the over-investment problem does not mirror the under-investment problem is the assumption that the company can raise capital by deceiving investors. This is a step further than simply damaging the value of existing debt as it involves misleading new investors in debt.

To achieve this, Jensen and Meckling (1976) argue that management will issue debt claiming that project 1 is the investment objective but then substitute project 2 (with greater risk but the same expected return as for project 1). This switch will produce lower expected returns (given the higher risk, the returns will not be sufficient compensation) and hence a reduction in enterprise value. However, the intended reduction in value of the debt is designed to be greater than the overall reduction in enterprise value so that shareholders will enjoy an overall increase in their value. It is therefore possible to argue that management could pursue projects with negative net present values and still benefit equity holders: this is the essence of the risk-shifting version of the over-investment problem. The debt-holders are in effect, subsidising shareholders.

If the switch in project involved investing in an activity that is different to the company's existing underlying business, then it is likely that there would be a reduction in the overall variance of the enlarged business. The difference in activity would give rise to a correlation between the new and existing activities that is less than 1. Thus, overall variance for the enterprise would be reduced: a reduction in variance would be beneficial for the existing debt investors as credit quality would improve (because variance had reduced) and so existing debt values would rise to reflect the reduced risk. This is the advantage of a conglomerate where the spread of activity reduces overall variance and hence credit risk. In this case, the effect of a switch would be counterproductive and would damage the interests of shareholders. There would be a shift in value from shareholders to debt-holders.

The shift in value would need to work in the other direction. The management would need to represent to potential debt investors that it intended to diversify with the expectation that variance would reduce. Then once the debt issue was completed, the management could then make the switch. This would then produce the desired reduction in debt values and the holders would certainly feel cheated. It might not be easy to represent to debt investors exactly what the effects of the diversification would be until a precise acquisition had been identified so that this factor would be considered in the pricing of the debt.

Although the model in Jensen and Meckling (1976) assumes that the management switch project, switching from one project to another especially after making representations in a debt prospectus would not be easy especially if it led to a significant shift in value. Such a blatant disregard for representations made to raise debt could lead to law suits and a seriously damaged reputation. There are also regulatory restrictions that prevent such behaviour. Also, some lenders use secured debt to improve their position and the process of taking security on real assets would make it hard for asset substitution to occur. Hart and Moore (1995) argue that secured or hard claims and long-term debt constrain management incentives to pursue investments with negative net present values.

A subtler approach is for management to indicate a lower variance by understating the risk characteristics of the investment being financed. This would avoid the confrontational aspects of contradicting statements made to lenders. But this would not be easy since debt buyers would be able to form a reasonable assessment of variance independently by looking at the market and examining comparable companies. Only in the rare situation of a new activity where the market was short of comparable companies might this strategy work but then this would imply that the new activity had a low correlation to the existing business and this would lead to a benefit for debt-holders.

The over-investment problem is the converse of the under-investment problem as the value-recapture solution to the under-investment problem can be used to create the circumstances of the over-investment problem. However, an important relevant consideration is the likely reaction of debt investors to a company employing value recapture to obtain benefits for shareholders at the expense of debt-holders or pursuing asset substation strategies that damage debt values.

The response of debt investors is modelled in the next section. The hypothesis is that investors are likely to observe when they are being exploited and take appropriate action so that the strategy of transferring value between stakeholders will not be tolerated by investors without consequences.

3.3 Investors and transfers of value

This section describes an experiment that has been designed to test the hypothesis that debt investors will not continue to buy bonds from companies that seek to mislead them in a way that transfers value from debt-holders to shareholders. This experiment has been designed to test investor behaviour and follows the broad structure of the experiment in Cadsby, Frank and Maksimovic (1990).

It is likely that debt investors will become aware of companies seeking to transfer value to shareholders at the expense of debt-holders – investors will identify such behaviour with companies and its management team. Such investors, if they behave rationally, will take the risk of such behaviour into account when considering acquiring debt instruments in companies where the risk value transferring events is high. The experiment is designed in the context of the Kahneman and Tversky (1979) work on behavioural finance (decision making under risk) and loss aversion in Tversky and Kahneman (1991).

The above analysis shows that value can be transferred from debt-holders to shareholders. However, it may not be so easy to repeat this process as the debt investors are likely to react to the first transfer of value by re-evaluating the risks of their investments and are likely to consider the possibility of a recurrence of such a transfer with further debt issues.

Investors will learn, and the possibility of a recurrence will be factored into the value of the debt. If investors consider there is a high risk of a repeat transfer of value away from debt-holders, then the value of the debt is likely to fall below the level that would be suggested by a simple consideration of gearing. The value of the debt would need to incorporate the risk of a further transfer of value. This perception will increase the cost of debt finance for the company. This increase in cost could outweigh the benefit of the initial transfer.

The experiment aims to test the ability of participants to forecast the behaviour of management when issuing debt securities. The experiment is designed to see how potential investors behave when a company’s actions lead to a transfer value from debt investors to shareholders. The objective of the experiment is to identify whether potential investors i) can identify value transferring activities; and ii) whether the potential investors modify their behaviour in a way that affects the company's ability to issue debt or the cost at which it issues debt. If potential investors can identify this type of behaviour and respond appropriately, then the strategy of transferring value from bond-holders to equity holders will be constrained.

The hypothesis is that value transferring activities are not easy to perpetrate as lenders have memories. While a company may be able to achieve a transfer of value once, doing so repeatedly ought to be harder as the market will remember the past behaviour of the borrower and either seek tighter protections or higher returns or both.

3.3.1 Experiment design

The experiment design broadly follows the framework in Cadsby, Frank and Maksimovic (1990).

The potential investors are students studying for a one-year Masters degree in Investment Management at Cranfield Business School (in 2012/2013): most have little real-world experience and so they are suitable candidates to test whether there is any evidence of learning. The experiment is conducted early in their course before issues such as capital structure and information asymmetry are covered. The experiment is organised as a bond trading game. The objective is to make money by buying bonds. Money can be made in two ways: first, by holding the bond for a period, the holder receives a unit of interest; and secondly, there is an opportunity for a capital gain if the rating of the bond improves – or a loss if the rating of the bond falls.

The experiment is organised over several discrete time intervals, each described as coinciding with a period of 6 months. Some 10 periods are considered but the experiment is conducted over the last 8 periods, the first two periods being used to demonstrate to participants how to make investment decisions.

There are 4 companies, 50 students and 8 trading events. This provides a sample of reasonable size. Each company publishes a statement on its capital structure or debt policy. These statements are the key information resource used by the subjects to evaluate the debt investment opportunity. These are either a specific policy or a statement of no policy. This provides some guidance to participants. However, more detailed information is provided at the end of each trading period. Each company provides the following information:

1 a comment on the trading period;

2 the revised rating for its bonds (revised to reflect the information in item 1); and

3 a forecast, made by the company, of the rating of its bonds at the end of the next period.

Using this information, participants are then invited to bid for the company's bonds. Bids are recorded on an answer sheet. Once bids are made, the bids are published via a show of hands. This introduces transparency into the process and reflects more closely to the operation of a market. This design is to ensure that participants cannot simply bid a low price. There needs to be an element of competition.

Each of the major rating bands are split into upper and lower sub-bands. Bond prices are allocated depending on the rating of bonds with the higher prices reflecting better ratings.

Participants then bid a price for the bonds based on the information they have. Once the bids are made there is a clearing mechanism whereby the bids are published via raised hands – visible to all participants – and then a price is set by the experimenter which is a price which reflects the bids of the majority of participants.

Book building is the most common method of equity and debt issue process (see Ritter (2003)). This process is designed to elicit information and opinions on the value of the securities on offer. However, some investors choose to provide no opinions on value but simply register interest in an amount or quantity, relying on the investment bank to price the securities on a basis that leaves some profit for the investors. Such investors avoid the cost of valuation and are free-loading on others doing such work.

In the experiment, free-loading was avoided to ensure that participants were required to perform the investment appraisal and make a judgement. So, participants pay the price they bid and not the clearing price. The clearing price determined only those who got bonds – a bid price that was lower than the clearing price meant no bonds were allocated to that participant. Participants were not required to bid – but only on 2 occasions did a participant choose not to make a bid for a company's bonds. After all, a low-price bid represented low risk – a doubtful investor could be protected by a low price. However, this reflects real world decisions when investors sometimes prefer higher quality to lower quality at any price. This is like the traditional flight to quality and corresponding loss of liquidity in lower quality instruments that is usually seen at times of economic turmoil.

One issue is whether participants accurately displayed their written bid. Participants might perceive a benefit if they were to display a bid price lower than their written bid. This would have the effect of encouraging the experimenter to set too low a clearing price – participants would be able to buy bonds at lower prices than if they had correctly displayed their bid. This would need to be undertaken on a significant scale to have an effect. However, it is possible to restate the results using different clearing prices – based more closely on the written bids.

The different types of rating forecast included short statements such as: "rating outlook stable"; "rating expected to fall to the next band"; "acquisition expected to lower rating". The forecast usually gives either a clear indication or a slightly fuzzy indication. Of the 4 companies, one company is deliberately setting out to mislead bond investors by optimistic forecasts: that company forecasts an upturn in rating and yet achieves a downturn. This behaviour becomes clearer as the game is played and more disappointments are observed by participants.

In the real world, some forecasts are not achieved for reasons beyond the control of management. So, included in the track record of the company with the most reliable forecasting history is an unexpected event (litigation) which causes a loss of value to bond holders.

Finally, to test the ability of participants to make judgements about individual forecasting ability, there is a change of management. The CEO of the company seeking to transfer value moves to another company. Also, a new chairman is appointed to the board of one company which then announces a change in debt policy. To some extent, these events crystallise or confirm what the participants (or some of them) may have identified. So, forecasting ability is tested before and after these events. The key measure is how accurately the investors learn or identify optimism in management's statements and whether they reflect this knowledge in their bid prices. This process is not unlike book building (see Ritter (2003)).

3.3.2 Results of the experiment

The establishment of the clearing price by observation of the experimenter was tested in the following way. First, the number of bids that became eligible because of this process was measured and compared against total bids. This was then compared with the result that would be achieved if the average of bid prices was used – rounded down to the nearest whole price or rounded up. A comparison was also made with a clearing price that was a unit higher than that determined by the experimenter. These comparisons are summarised in Table 3.1.

Table 3.1 Comparison of success rates for bids
This table sets out the results of successful bids analysed according to different pricing approaches

Row	Acceptance or cut-off price	Proportion of bids accepted
1	Clearing price determined by experimenter as a result of observation of bids	83.2%
2	Clearing price determined as the average of all bids	54.0%
3	Clearing price determined as the next whole number less than the average of all bids	96.0%
4	Clearing price determined as the average price + 1	3.7%
5	Clearing price determined as 1 + the clearing price determined by the experimenter	14.6%

Row 1 indicates that the price determined by the experimenter had the effect of including most bids but not all. Thus, the concern about under-pricing the displayed bids described above might have been misplaced. This is confirmed in the other rows of data.

Row 2 indicates that if the average bid price was used as the cut-off point that just over half of bids would have succeeded – as would have been expected. Row 3 sets the cut-off price as the next whole number less than the average bid price. This increases the success rate to 96% which demonstrates that bids at prices below the average bid price were very closely clustered around the average bid price.

Similarly, row 4 demonstrates that bids at prices above the average bid price are closely clustered around the average bid price. Only 3.7% of bids are more than a unit above the average bid prices.

Finally, row 5 confirms that if a price of a unit above the experimenter's price was used the success rate would have fallen to 14% demonstrating that the bids at prices above the experimenter’s price were closely clustered around the experimenter's determined prices.

So, the conclusion is that the establishment of a clearing price at the time of the auction is unlikely to have introduced any bias into the process by which participants determined the level of their bids.

The key test is how accurately the participants could determine the likely level of bond prices. The task for participants was to determine the price that would ensure that they obtained a bond and that the price reflected the likely future value of the bond. The test is designed to seek evidence that participants can learn from the results and to reflect that acquired knowledge in their bids. This process is not very different to that of book building (see Ritter (2003)) which involves feeding back pricing information to participants and thereby enable them to reconsider the pricing of their bids.

The average results of the participants can be correlated against the actual results: the correlation coefficient is 0.77 – a high degree of correlation. However, this is to be expected as for most of the experiment, the companies behaved broadly in line with their forecasts. One company (company C) behaved in a contrary fashion – its forecast was not achieved, in fact the opposite occurred. For this company, forecasting was more difficult. Correlations of actual results against individual company forecasts made by the participants were as follows.

Table 3.2 Correlation of actual results
This table sets out the correlation statistics for the actual prices set by the experimenter compared to the prices bid by the participants for each individual company

	Company A	Company B	Company C	Company D
Correlation coefficient	0.30	0.87	0.20	0.75

These results confirm that participants had difficulty in forecasting company C's bond ratings compared to company B or D. Company A also posed difficulties as that company suffered an unexpected reduction in rating (ahead of period 6) because of litigation. Had this not occurred, the correlation coefficient would have been significantly higher. This demonstrates one of the difficulties of this process – can any evidence of learning be discerned when other effects that are unconnected (i.e. random) are present? In any event, there are only a small number of data items when averages for the data set are used. In this case, there are only 8 items of data being used to compute the correlation coefficient on an individual company basis.

The performance of participants can be measured in terms of errors (the difference between the prices participants bid and the actual prices determined by the experimenter): these errors are set out in Table 3.3.

Table 3.3 Average errors of participants' prices
This table sets out the average errors of participants' prices compared to actual prices (a positive number indicates that the average participants' forecasts were lower than the outcome)

	Company A	Company B	Company C	Company D
Period 1	1.55	1.73	-0.16	0.64
Period 2	1.23	1.45	0.59	1.02
Period 3	0.98	0.91	0.25	0.93
Period 4	1.45	2.23	-0.80	1.70
Period 5	0.16	1.18	0.20	2.02
Period 6	1.68	1.25	-0.16	0.98
Period 7	1.23	0.84	1.98	0.30
Period 8	1.09	1.09	1.21	0.07
Average error	1.17	1.34	0.39	0.96

By inspection, the errors in the company C prices broadly reduce over time although there is an increase at the time when there is a change in management (ahead of period 7). Clearly, some participants were troubled by the implications of this change.

The average error figures included in the Table 3.3 above suggest that the participants were closest to the outcome for company C. This is not quite what might have been expected. Company C presented a more challenging task for participants and yet the average error is lowest. Company D included a change in management which might have affected the results, so consider only companies A and B. Here, there is a larger average error than with company C. One possible explanation is that the participants were seeking to bid the lowest possible price consistent with obtaining bonds. So, in the case of companies A and B, they were successful in obtaining bonds at a lower price. If this process were followed for the other two companies, then participants were seeking to minimise the price paid. So, the low average error term for company C might simply imply that the pricing process demonstrated in the results for company A and company B was applied but that as the outcome was always less favourable than the company forecast, that the profit made by the participants was lower.

It is possible that the objective of maximising profit might make it difficult to identify any evidence of learning. It was apparent in comments made that some participants considered that the forecasting record of company C was poor (one student commented that the management are "liars") – so it was at least clear to some participants. This is evidence of an ability to learn and others would learn indirectly from those able to learn directly. This supports the hypothesis that investors would learn about management's plans to transfer value from debt-holders to shareholders and take appropriate evasive action.

Accordingly, a redesigned experiment was conducted. In the second experiment, the objective of participants was restricted to forecasting the bond rating. This meant that the element of price and the auction process was excluded. Participants merely had to provide their own estimate of the future bond rating based on the same information as provided in the previous experiment (the individual company forecasts and the track record). This meant that the forecasting ability could be tested more directly.

Although pricing was not included per se, the cost of debt is directly linked to the bond rating, so price and cost of debt is very much part of this redesigned experiment. Where subjects are forecasting lower ratings, they are implicitly signalling higher debt funding costs for the company. The process of book building still applies (see Ritter (2003)) but instead of price, a bond rating is used as a proxy for price.

One fewer company was used but otherwise a similar series of rating forecasts were made by the individual companies as with the previous experiment. With this revised experiment, the distance between the participant's forecast and the outcome could be measured. This permitted an average difference to be calculated for the group of 50 Masters students. The results are set out in Table 3.4.

Table 3.4 Average errors of forecasts
This table sets out the average errors between the forecasts of bond ratings by all participants for each company and the actual rating announced by the experimenter

Time period	Company A	Company B	Company C
1	0.04	1.36	0.40
2	0.28	1.10	0.38
3	0.12	1.88	0.10
4	0.86	1.44	0.04
5	0.50	1.20	0.10
6	0.52	1.18	1.46
7	0.18	0.20	0.70
8	0.32	0.68	1.34
Overall average	0.35	1.13	0.57

Table 3.4 shows the average errors made by participants in their estimates of each company's credit rating. Broadly, there is a steady reduction in the average error rate over time. However, a more sophisticated test is to examine how the range of the participants' forecasts vary over time and whether accuracy increases – this is described below.

The middle column of Table 3.4 contains the results for the company which consistently misled the market until a change of management in period 8 occurred. What can be seen is that the difference declines steadily over time. The blip in period 3 coincides with an adverse rating movement over 2 bands. The size of this movement was not anticipated only the direction. If 1.0 was deducted from this difference, the downward trend in the difference would be re-established. Possibly because of this unexpectedly large adverse movement, subsequent estimates were slightly inflated, but the downward trend was then evident again until after the change of management when there was a slight increase.

These results indicate that relatively naïve investors with very little information can interpret and assess the quality of information provided by companies. Several additional tests on the data were performed to assess the ability of participants to learn. The distribution and standard deviation of the participants' results were examined. The distribution of the scores of the participants is set out in Table 3.5.

Table 3.5 Distribution of forecasts
This table sets out the distribution of forecasts ranked according to overall score

Scores	11	13	15	18	20	30
Cumulative	6	14	24	38	43	50
Non-cumulative	6	8	10	14	5	7

Here, the low scores represent the smallest difference between the participants' forecasts and the actual results. Broadly, the results are distributed with some central weighting and smaller tails on either side. As the sample size is small, it is not possible to be very precise as to the nature of the distribution. A key test is whether the results are due to chance.

One measure of learning is the actual range of participants' forecasts. If there was a narrowing in the range of the forecasts over time this might indicate that participants learned to improve their forecasts. A test was also made to see if there was any difference in terms of the distribution according to results. In other words, did high scoring participants show a much narrower range of possible results (compared with lower scoring participants)? The sample was divided into two groups according to the scores and the standard deviation of the range of results computed for each forecast. These results together with the results for the whole group are set out in Table 3.6.

Table 3.6 Standard deviation analysis
This table sets out the standard deviations of results analysed according to the scores achieved by the top and bottom scorers (respectively those closest and furthest from the actual outcomes) shown together with the results for the whole group

Time period	Top group			Bottom group			Whole group		
	Company A	Company B	Company C	Company A	Company B	Company C	Company A	Company B	Company C
1	0.20	0.83	0.56	0.19	1.20	0.66	0.20	1.04	0.61
2	0.56	0.76	0.61	0.52	1.15	0.58	0.54	0.98	0.60
3	0.33	0.91	0.00	0.32	1.19	0.42	0.32	1.07	0.30
4	0.28	0.76	0.00	0.40	0.97	0.27	0.35	0.88	0.20
5	0.63	0.61	0.20	0.58	1.00	0.39	0.61	0.83	0.31
6	0.57	0.87	0.78	0.75	1.08	1.07	0.67	0.98	0.94
7	0.28	0.28	0.76	0.71	0.77	1.10	0.55	0.59	0.95
8	0.33	0.37	0.53	1.23	1.46	1.09	0.92	1.09	0.87

In terms of the company B attempting to mislead investors, the standard deviation appeared to reduce slowly over time rising only slightly at the time of the change in management. This pattern was repeated for both the top scoring group and the bottom scoring group.

It is to be expected that the top scoring group would demonstrate a narrower range of forecasts – obviously being closer to the actual outcome so the standard deviation would be expected to be smaller in value. However, the results do demonstrate evidence of learning – to avoid or reduce losses (see Tversky and Kahneman (1991)).

A significance test can be performed to check that there is evidence of learning. The ability of the subjects to improve their forecasting ability can be tested by comparing their performance in the second half of the experiment with their performance in the first half. This is a crude approach since learning occurs throughout the experiment as students can compare company forecasts with actual outcomes.

A simple measure of forecasting ability can be used that compares the subjects' forecasts with the actual outcome: the difference between the subject's forecast and the actual bond rating can be defined as the "error". Where the forecasts were more than one rating band away from the actual rating they are recorded as an error of one whereas forecasts that are within one rating band are counted as zero

Company A behaved very much in line with the indications provided to the subjects so most of the time, the subjects could forecast the rating with accuracy within one rating band.

This classification approach can be applied to company B and the errors measured. In the first half of the experiment (the first four periods), the subjects made 101 errors out of a total of 200 forecasts. This is just more than 50%. This compares with company A where the error rate was less than 2%.

In the second half, the errors for company B reduced to a total of 46, an error rate of 23%. This demonstrates a good deal of learning by the subjects between the two periods. The significance of this result can be tested using the binomial distribution. If the average error rate achieved in the first half of the experiment were to apply in the second half of the experiment (the null hypothesis) then the probability of obtaining an error rate in the second half of 23% (based on the average error rate in the first half) is less than 0.1%. This result is therefore statistically significant evidence of learning.

These results confirm support for the hypothesis that investors would be able to identify managerial behaviour likely to lead to a loss of value for debt investors (by means of a transfer to shareholders) and that they would be able to take appropriate action to alleviate this situation.

Larger samples or repeats of the tests would usefully improve confidence in identifying learning. A further experiment (in the style of Cadsby, Frank and Maksimovic (1990)) could be introduced to see if investors punished such companies. The time period in the above experiment was quite short. Faced with a persistently misleading management team, the investors might begin forecasting ratings that were below the actual outcome. The experiment was not designed to show whether the behaviour of investors might include not bidding for the company's bonds. Clearly, if a poor reputation was generated, rational investors might decide that it was either too difficult to make a forecast and so not bid for any new bonds, or, that the only compensation for the risk of poor company information was a low price. This might increase the risks of default – which it is argued is not the intention of management rather opposite.

It can also be argued that rational investors faced with a company that consistently misrepresented its prospects would learn to interpret such forecasts appropriately. Similarly, companies that had a track record that implied that forecasts were made randomly would also teach investors how to interpret their forecasts. Analysts, acting rationally would be able to measure accuracy in forecasts or other financial information and so companies would not be able to mislead the market. Faced with rational investors, companies could not easily misrepresent the risk characteristics of the companies' bonds consistently. It might be possible for the company to succeed once or twice but the market would learn and respond appropriately.

A further option for investors faced with a company that consistently misleads investors, would be to seek protective covenants such as downgrade provisions. These are covenant provisions which trigger an increase in interest rate in the event of a downgrade in the rating of the bond. This might be the only mechanism available to a company when faced with investors unwilling to purchase bonds.

3.3.3 Implications

The option to mislead investors such as investors in bonds exists. However, the ability of a company to do this consistently is in doubt. Investors are not blind to this type of behaviour. The experiment demonstrated that rational investors can learn from the behaviour of management and can respond in a way that protects their own interests. This ability to learn should prevent a company from being able to mislead investors repeatedly. Indeed, the possibility of such misleading behaviour might lead to the following problems.

1 Investors stage a strike and refuse to buy bonds.

2 Investors demand a premium price to compensate them for the risk of a downgrade.

3 Investors demand protective covenants in the event of a downgrade such as an uplift in coupon.

Obviously, a combination of 2 and 3 is also possible.

It is therefore quite possible that a company that is perceived as a candidate to transfer value from the debt-holders to the shareholders will be obliged to pay a higher cost of debt than otherwise might be the case for a company that was not so perceived. So, the advantage of this transfer of value might not be positive overall. The market price for the debt will be already discounting a further transfer of value.

A better strategy for a company might be to maintain a constant ratio of debt to equity. This avoids the risk of suggesting to the market that a transfer of value is a possibility. If the market is confident that there won't be any erosion of value by that transfer mechanism, then the company won't be penalised by a cost of debt that discounts further value erosion.

A track record of a stable capital structure (as reported in Lemmon, Roberts and Zender (2008)) should encourage bond investors to believe that "event risk" is small and so they would be less likely to penalise the company with a higher cost of debt. A track record would help convince bond investors and the company might signal its intentions by publishing its capital structure policy as some companies do

If indeed companies do maintain steady or constant capital structures, then if gearing changes, (i.e. gets out of line with the long run target) then such a change should be followed by a change in the reverse direction. So, there ought to be a negative correlation between successive such changes (although the reversion may not happen immediately). Similarly, if the market to book value ratio changes, because this quantity is also stable over time, a positive change should be followed by a negative change. Both these effects were identified and recorded in Chapter 2.

Such a policy is suggestive of a company that continually manages its capital structure towards a target. The literature on partial adjustment models is relevant here where such studies have sought to identify evidence that companies have target capital structures and seek to maintain such targets. Antoniou, Guney and Paudyal (2008) confirmed that firms in France, Germany, Japan, U.K. and U.S. have target capital structures as reflected in the coefficients of the lagged dependent variable (gearing) being highly statistically significant but that firms do not fully adjust to the target every year – consistent with the coefficient values being less than unity. See Tables 2.10 and 2.12 in Chapter 2 where the coefficient of the lagged value of gearing was statistically significant.

The conclusions of Flannery and Rangan (2006) are that firms do have target capital structures and that firms close the gap on target by about one third each year. However, Hovakimian and Li (2012) challenge the soundness of the partial adjustment approach by reporting that firms do not always fully adjust even when they can.

While the analysis above suggests that companies should maintain a policy of stable capital structures to avoid persuading debt investors to take punitive action against the company to protect themselves against possible transfers of value, this does not necessarily imply that companies need to be very rigid. Capital structure policies often target a range rather than a precise or specific target (see Graham and Harvey (2001)).

The purpose of a range is to allow the company a degree of flexibility as to the gearing level and as to timing of adjustments. Debt investors are likely to tolerate slow adjustment speeds providing they are confident that adjustments will eventually occur.

DeAngelo and Roll (2015) comment that capital structure stability is the exception rather than the rule, that it is usually temporary and that there is substantial instability in gearing.

If the market to book value ratio increases following the acquisition of a significantly positive net present value project, then the argument in Myers (1977) implies that debt and/or debt maturity would be reduced. However, if the policy of the company is either: i) to recapture value transferred to the debt-holders; or (equivalently) ii) to maintain a constant debt equity ratio; then an increase in the market to book value ratio would cause a reduction in gearing which should then be followed by an increase in gearing to recapture the value transferred – this is the opposite to that suggested in Myers (1977) and reported in empirical studies. Therefore, changes in gearing and debt maturity should be positively associated with positive change in the market to book value residual. This was also observed in Chapter 2 where a negative relationship was identified between changes in gearing (measured using market values) and changes in the market to book value residual in the same year. This relationship became positive when gearing (measured using book values) was used.

3.3.4 Risk mitigation by investors: contracting issues

The experiment described above shows that investors learn and take appropriate action. This knowledge or learning is already reflected in the structure of debt instruments which contain mechanisms such as loan covenants to protect the position of debt-holders. These mechanisms are examined in this section in the specific context of the problems of asymmetric information.

Investors in debt instruments are aware that circumstances can arise leading to a switch in value between debt-holders and equity holders and precautions to prevent such changes in value usually exist in the form of restrictive covenants in the loan documentation. Investors in debt instruments are concerned about corporate events which can adversely affect debt values. Investors describe the risk of such adverse movements in value as "event risk" – for example the reduction in debt values in the RJR Nabisco leveraged buy-out reported in Myers (2001). That is an extreme example but there are many examples of bonds reducing in value for example by moving out of one credit rating class to the next lowest class. This is usually called transition or migration risk and may be triggered by an event such as those described above. Risks or probabilities of such migration in ratings can be measured using historical data and are published by the rating agencies.

Debt-holders are aware of the potential for adverse changes in debt value caused by changes in the variance of the underlying business or other corporate events. In some cases, appropriate structural protections are sought in the contractual terms of loan instruments. These include (but are not restricted to) the following:

- Negative pledge: which restricts the borrower from giving priority to another lender ahead of or *pari passu* to the existing debt (or restricting the amount of such security);

- Security/priority: which prevents another lender getting an equal position with existing lenders;

- Financial covenants: these are intended to signal problems early (in terms of a credit ratio such as interest cover or the gearing ratio) so that the lenders can step in and take control before a major loss of value occurs;

- Debt maturity limitations: lenders extend maturity but only if the credit quality is acceptable;

- Change of control clause: this is standard in bank lending agreements and triggers early repayment if the borrower is subject to a takeover – an event that could damage the credit quality of the existing debt.

The presence of suitable covenants and other contractual obligations tends to be linked to the overall credit risk. High gearing tends to be associated with highly restrictive loan covenants whereas low gearing tends to be associated with less restrictive covenant structures. The imposition of restrictive covenants is negotiated between borrower and lender. Where a company is highly geared, lenders will seek to impose greater restrictions to obtain better protection. Where the borrower has low gearing, the lenders are likely to be content with a loose set of protections but will nevertheless seek to prevent major shifts in credit quality occurring usually by means of a negative pledge.

A further factor which affects the overall credit quality of debt providers is the absolute level of gearing. A lowly geared company without any restrictive covenants in place would probably be regarded as a reasonably good credit risk as the probability of default could be low. Credit quality will involve a judgement of several factors including:

- The structural protections available (restrictive covenants, priority, security);
- The absolute level of gearing;
- Industry and company specific features (such operational gearing, competition etc.);
- Maturity; and
- Quality of management – is the management team likely to seek to transfer value from the debt-holders to the equity holders?

But even with low gearing, event risk could still be a problem for debt investors. In such a case, the market will take a view on the likelihood of an event damaging the interests of the debt-holders. The market price will factor in the probability of an adverse credit event (which is clearly more probable in the absence of protective covenants) into the pricing of the debt.

From the perspective of the company, restrictive covenants can reassure debt investors and the advantage is that the price of the debt would be lower than in the absence of the covenants. However, the disadvantage is that the restrictions can also limit the company's flexibility. This is something regarded as very important from a strategic aspect. In Graham and Harvey (2001), the survey identified financial flexibility (the ability to raise capital quickly in a way that does not involve burdensome restrictions imposed by lenders) as a very important factor affecting capital structure decisions.

Management obviously prefer that there are no or few covenants as this will always maximise the flexibility of the company , but the price could be a higher cost of borrowing. Lenders may be prepared to lend only if either there is a suitable covenant structure in place or, in the absence of such protections, are compensated by a higher return to the investors. Very tight restrictions would limit the company's flexibility and would be resisted by the borrower. There is a clear trade-off between costs and flexibility.

Nash, Netter and Poulsen (2003) examined the relationship between the presence of covenants in bond contracts and investment opportunities. They find that there is no difference in covenants between firms with high or low investment opportunities except that high-growth firms tend not to have restrictions on dividends or the issuance of further debt. However, restrictions such as negative pledges, merger restrictions or asset sales are included. This suggests that covenants are designed with company features in mind and to provide flexibility to the company. Goyal (2005) confirms that lenders discipline bank risk-taking by writing restrictive covenants into subordinated bank debt contracts.

Billett, King and Mauer (2007) find that covenant protection increases with growth opportunities, debt maturity and gearing. This suggests that debt providers view companies with high growth opportunities (or companies with longer maturity debt) as riskier than companies with low growth opportunities (or shorter maturity debt): it is obviously the case that more gearing is associated with more risk for lenders. They conclude that firms use covenants to control conflicts between shareholders and debt-holders. This is like the argument in Myers (1977) that short maturity debt manages under-investment risk. The covenants in the debt agreement are sought by the debt providers and are not proposed by borrowers. It is the debt providers that are seeking to obtain protections as the experiment above demonstrates.

Reisel (2014) documents a reduction in the cost of debt of between 35 and 75 basis points where there are covenant restrictions on investment activities or the issuance of higher priority claims (this is what the negative pledge is designed to restrict). This is confirmation that the type of behaviour that debt investors might resort to when faced with risk includes higher debt costs. Bradley and Roberts (2015) confirm the negative relationship between cost of debt and the presence of covenants. They also conclude that protective covenants are more likely when the borrower is small, has high growth opportunities or is highly geared. This suggests that lenders view companies with growth opportunities as risky and hence this would create a negative relationship between gearing and the market to book value ratio as documented in the Appendix to Chapter 2.

These studies confirm that the contractual arrangements embedded in the loan documentation are an important component of the nature of the debt and the ability of the company to take advantage of debt providers. Characterising debt in terms only of maturity and amount is unlikely to present the whole picture.

Despite these arrangements to protect debt-holders, there is evidence of companies over-investing although this does not necessarily involve obtaining a subsidy by means of a transfer from debt-holders. Richardson (2006) identifies evidence of over-investment in the sense that companies invest more than would be suggested by a model that predicts future investment based on past behaviour and that such investment is concentrated in firms with the highest levels of cash flow. Harford (1999) also documents cash-rich firms as being more likely to attempt acquisitions and that such acquisitions are followed by abnormal declines in operating performance – a clear example of sub-optimal investing. Franzoni (2009) analyses share price reactions to the announcement of mandatory pension contributions which suggests over-investment in large firms compared with under-investment for the sample as a whole: for more financially constrained firms, mandatory pension contributions lead to a greater negative reaction than is the case for larger better financed firms and that this greater price reduction represents loss of investment opportunities – which is not an unreasonable conclusion but such projects could still be financed on a joint venture basis, or could be sold or could be financed if additional capital could be raised as discussed above under solutions to the under-investment problem.

Pan, Wang and Weisbach (2013) document a cycle of investment according to the tenure of the chief executive officer (CEO) reporting that disinvestment is high early in the period of office of the CEO but thereafter declines as investment increases. This result contrasts with the results in Jiang (2016) which reports higher over-investment in the early years (using the technique in Richardson (2006)). The results in Jiang (2016) also suggest that over-investment increases with internally generated cash flow. There are also examples of over-investment in relation to acquisitions where the benefits accrue to the target company shareholders rather than shareholders in the acquiring company – see Moeller, Schlingemann and Stulz (2003).

The next section examines how information asymmetry can be managed by suitable contractual arrangements and short-term debt financing.

3.4 Pecking order theory of capital structure

The pecking order theory as set out in Myers (1984) and Myers and Majluf (1984) provides a hierarchy of preferences for financing corporate investment and addresses an under-investment problem that arises from asymmetric information. This theory suggests that companies will use finance in the following order: internal funds; the issue of debt; and only after exhausting the first two options, the issue of equity.

The simple hierarchy in financing choices is motivated by the problem of asymmetric information where the company is reluctant to issues shares where the management consider that due to differences in perception of value, investors are unwilling to pay a price for shares that reflects the management's view of value. If the company were to issue shares at an under-valuation, then value would be transferred from the existing shareholders to the new shareholders. Such a transfer in value could be so significant as to render the investment opportunity unattractive and lead to the company foregoing the investment creating the possibility of under-investment: in that situation, the company may be able to use debt to finance the investment thus avoiding the problem of asymmetric information (although the debt issue may also be affected by the asymmetric information although to a much lesser extent than an equity issue).

The preference for debt over equity is easily established in the circumstances of asymmetric information. This is the reverse of the situation of under-investment described in Chapter 2 where the presence of existing debt creates the circumstances of the under-investment problem.

In this section solutions are developed to manage the problem of information asymmetry that enable the company to avoid the disadvantage of being unable to issue shares at times of information asymmetry (at least, for some companies) and thereby reduce the risk of under-investment.

3.4.1 The model in Cadsby, Frank and Maksimovic (1990)

In this section, the model in Cadsby, Frank and Maksimovic (1990) is modified by substituting alternative financing methods in place of the use of debt as in the pecking order theory. These alternative financing methods solve the problem of information asymmetry without any preference in favour of debt (although short-term or temporary debt is one of the alternative methods).

The basic model can be simplified. Suppose a company is one of two possible types. Either it is type H (high post-investment value) or type L (low post-investment value). Investors don't know the type of each company, so they assume that each company type is equally likely and so value each company on an average basis. The company type is not revealed until after the investment is made. So, the problem for company H is how to raise equity when the market does not reflect the company's true value. The advantage for company L is that investors are unaware of the company's true type.

Investors assume each company is of only two possible types with value H or L with equal probability. One solution is for investors to take a simple average and invest on that basis. This would benefit company L at the expense of company H whose shareholders would suffer a transfer of value from themselves to the new shareholders. Such a transfer would occur in the reverse direction for company L where value would be transferred to the old shareholders of company L from the new shareholders in company L.

The use of an average price may not prevent company type H going ahead since the average price could still represent an improvement in existing shareholder wealth (if the investment opportunity had a sufficiently large net present value). Cadsby, Frank and Maksimovic (1990) suggest that there is another situation in which company H might go ahead which is where company H uses the issue price that would apply if it were company type L (and the issue price reflected that knowledge) provided that the investment opportunity had such a large net present value that the existing investors suffered no disadvantage from such an issue price. However, these two solutions are not the optimum outcome since there is a loss of value for the existing shareholders.

If company H is not able or willing to issue shares at a price that represents some loss of value for its existing shareholders, then either it must pass up the investment opportunity (an example of under-investment); or it must use the alternative of debt finance by invoking the pecking order theory.

The model suggests that under-investment could arise for type H companies and over-investment could arise for type L companies.

For type H companies, some of the solutions to the under-investment problem described in Chapter 2 are relevant and can be considered here. These include selling the investment opportunity (if that is possible) or finding a partner with whom to joint venture (with the partner providing capital) and to whom information could be disclosed without disadvantage so that the problem of information asymmetry can be surmounted.

A further solution is suggested by the experiment described above which is for the management to provide a low-cost signal by simply stating publicly its views of the company's value including its investment opportunity. This would amount to an opinion without any verification. If investors believed the management then company type H can issue shares at the right price. If company type L were to make a similar claim (that it was of type H – which would amount to a breach of regulatory requirements to avoid a false market in the company's shares i.e. market abuse) then it would ultimately be discovered that the management had been dissembling. The reactions of investors as described in the above experiment in relation to debt would apply here making it difficult for the company type L to be believed again with the consequences of a higher cost of equity capital.

In the next section, alternative financing methods involving additional contractual arrangements are described which avoid both i) the problem of asymmetric information; and ii) the problem of misleading investors, in each case in ways that do not support the pecking order theory. Each of these solutions are proposed as alternative solutions to the preference for debt (as in the pecking order theory).

3.4.2 Resolving the problem of information asymmetry using appropriately designed contracts

The disclosure of information to the market is regulated closely by rules of the exchange on which the shares are listed and by rules of the regulator, via market abuse regulations. In broad terms listed companies have obligations under the exchange listing agreement to ensure that a false market in their shares is not created. Essentially this means that price-sensitive information needs to be disclosed in order that the market can properly assess share values. However, in some situations, it may not be in the company's interest (or the shareholders' interest) for certain price-sensitive information to be disclosed. This type of information could include details of litigation where disclosure might harm the company's legal position; or details of an investment opportunity such as that envisaged in the above model; or details of a potential acquisition where disclosure of the purchaser's interest might encourage a competitor to bid or might drive the price up or damage the target or produce another disadvantageous outcome.

In these situations, the rules affecting disclosure of price-sensitive information may permit the company to withhold such information provided of course the company or its directors do not deal in the company's securities.

Promoting fair and efficient capital markets is an important policy objective for government so ensuring that capital flows to companies at fair values is important both for the individual companies and for the economy as a whole. Hence the need for extensive regulation. For instance, in the case of a company issuing shares by means of a prospectus, there are significant penalties for errors and omissions from such documents that bite on the directors, the issuing company and in the US on the underwriters. The process of due diligence that is conducted ahead of the issue of shares is designed to check the accuracy and completeness of statements in prospectuses.

In Myers and Majluf (1984), the possibility of the company signalling its type was considered. However, in that model variation, the company can purchase a signal, but it is assumed that the cost of the signal is significant when compared with the company value. The model can be modified to include the cost of the signal which can be set against the value of the investment opportunity and its impact will obviously be negative.

Even if there are situations involving asymmetric information where the prices of securities can be affected, there are several ways in which the problems of asymmetric information can be managed. The following sections describe several possible solutions that can be adopted in the circumstances set out in the model described above that enable the company to manage the problems of asymmetric information in ways that avoid the risk of under-investment and do not involve a costly signal.

These solutions have been used in the capital markets in related situations where there are regulatory barriers to the issue of shares as opposed to information asymmetry. For example, if a non-US company wishes to acquire a US company but lacks a US listing for its shares, then it will not be able to issue its shares as consideration for the acquisition. This is not just a question of share values being affected by asymmetric information, the company does not have the option to issue shares at any price to the shareholders of the target company because of regulatory barriers. To manage this problem, several techniques have been developed and these can be adapted to manage the problem of information asymmetry as described below.

3.4.2.1 Managing the problem by adjusting the share price after issue

A contract can be designed to accommodate the uncertainty associated with information asymmetry. The type H company can execute an appropriately-designed contract for an issue of shares that specifies an issue price based on the company type being H subject to an adjustment in price once the company type is revealed. This adjustment mechanism would provide that if the company was revealed as type H then no further shares would be issued. This would amount to the optimum issue price for company type H. However, if the company type was revealed as type L, then additional shares would be issued by the company to the new investors to provide those investor with an issue price that reflected company type L. This would reflect the correct issue price for company type L. This method is potentially a two-stage equity issue and it involves an additional stage not envisaged in the original model in Myers and Majluf (1984) as modified in Cadsby, Frank and Maksimovic (1990).

In this way, the investor would be paying the price for the shares which related directly to the actual company type. The investor would avoid the problem of attempting to value the company with uncertain outcomes. The existing investors in the company would suffer no loss of value. The under-investment and over-investment problems would both be avoided.

The legal mechanism to give effect to this type of arrangement is relatively simple. The company can commit to issue a minimum number of shares subject to issuing a further tranche of shares if the company type is revealed as type L. The purchasers of the new shares would have rights to receive more shares if the company type was revealed as type L. Alternatively, the company can issue a single security such as a convertible bond or preference share instrument that would be convertible at a price that would be determined once the firm type is revealed. The conversion mechanism would be triggered once the company type was known – this conversion would be mandatory unlike a conventional convertible where the option to convert is with the investor.

Kahan and Yermack (1998) find that there is a "near-total absence" of restrictive covenants in publicly traded convertible bonds. They conclude that firms that wish to maximise flexibility (by avoiding restrictive covenants although there are likely to be such covenants in other non-convertible debt instruments issued by the firm) prefer convertibility as a method to reduce the agency costs of debt (although it is difficult to see how it would be effective). The advantage of a convertible bond for the investor is that some downside protection is provided (compared to an investment in equity) as there is a liability to repay the debt if it is not converted: at the same time, there is some upside potential if and when the share price rises to make the conversion option attractive.

A convertible bond could be used to implement the solution proposed above where there is a variable issue price. The company (type H or type L) would issue the convertible bond. This convertible bond would convert at a share price reflecting company type H (if it were subsequently revealed as such) or company type L. This would achieve precisely the correct issue terms thus overcoming the problem of information asymmetry.

This variable conversion price arrangement would also work for a convertible preference share.

This mechanism reduces uncertainty for both the company and the investors and provides no support for the pecking order theory.

A variation on the above mechanism is already in use in the context of acquisitions. A security known as a contingent value right (“CVR”) is sometimes issued to selling shareholders in the target company. This instrument then carries a future payment obligation that is contingent on the share price of the acquirer being less than a stipulated level at that future time. This mechanism supports the value of the CVR and overcomes the problem of information asymmetry since the value of the CVR is determined after a suitable time when the information asymmetry can be resolved. Chatterjee and Yan (2008) show that CVRs can help a type H firm to reveal its type when faced with information asymmetry and that firms with such a problem are more likely to offer CVRs. Once again, this provides no support for the pecking order theory of an automatic preference for debt when faced with information asymmetry.

3.4.2.2 Managing the problem by contracting with an investment bank

A common example where asymmetric information can be a problem relates to acquisition. Suppose a company wishes to make an acquisition but that it needs to raise external finance to complete the acquisition. Suppose further that it is unable to disclose details of its potential acquisition as such disclosure might jeopardise the success of the acquisition. For example, such disclosure could stimulate a competitor to make a bid for the target company possibly increasing the cost to the acquirer or risking losing the acquisition completely. In this way, a situation of information asymmetry could be created exactly comparable to that envisaged in the model.

The intervention of an intermediary – an investment bank – can help resolve the difficulty of information asymmetry. The investment bank contracts with the company along the following lines:

- the investment bank commits to keep information provided by the company confidential (this enables the company to share information about the potential acquisition with a potential source of finance without making a public disclosure and risking the possible adverse consequences): there is no information asymmetry between the company and the intermediary;

- the investment bank researches the feasibility of either providing the finance or underwriting the provision of the necessary finance, whether debt or equity or both;

- once the feasibility research has been completed, the investment bank, if it wishes to proceed, will enter into a financing or underwriting contract with the company and the company will simultaneously enter into a contract to make the acquisition: the acquisition and financing can then be announced.

The company reveals its type to the investment bank without risking public revelation and the adverse consequences. These arrangements will allow the company to obtain the terms of financing which take into account the actual company type but without the risk of disclosing information that could be disadvantageous to the company's interests.

Such an arrangement would avoid the risk of transaction failure. A condition can be included in the contract with the investment bank that is linked to the overall success of the transaction to avoid the unnecessary issue of securities when the transaction aborts. Shares would not be issued if the transaction did not proceed – an important objective to avoid unnecessary dilution of shareholders.

This solution amounts to using the investment bank to give a signal of the company type that can be believed by investors. It would be known by investors that the contract between company and investment bank included clauses protecting the bank if the management was misleading the bank. This would create confidence that the signal provided by the involvement of the investment bank was reliable.

One problem that can arise with the issues of shares as in the above mechanisms, is that it is usually difficult for a company to issue shares at a price more than the current market price. In the Cadsby, Frank and Maksimovic (1990) model, investors price the shares based on their expectation of the outcome which is an average price. It is certainly rare for a company to issue shares at a price higher than the current market price as this mechanism implies.

The company would prefer to issue shares at a price which reflects the additional value associated with the investment opportunity. This extra value will only be reflected in share prices once it is revealed to the market.

This problem could be accommodated in both the two-stage equity method (as envisaged in the solution in section 3.4.2.1) and with the involvement of an investment bank. In the latter case, the investment bank would reveal the company type once it was known and the terms of the issue would be adjusted to reflect that information and then announced to the market.

3.4.2.3 Managing the problem by using bridge financing

One method that takes into account the difficulty of arranging simultaneously the negotiation of an acquisition and the issue of a range of financial instruments in different markets (e.g. different types of bonds in different markets coupled with an equity issue) is bridge financing.

Combining a range of different transactions adds considerable complexity. For example, the company may wish to issue equity or long-term bonds to finance the acquisition but as the acquisition is not certain, it does not wish to commit to issue those securities if the transaction does not go ahead. Here the issue of securities would need to be conditional upon the successful completion of the acquisition. This example has obvious similarities to the type H and type L company in the Cadsby, Frank and Maksimovic (1990) model. In the acquisition example, the information asymmetry is the completion of the acquisition which is an uncertain event and occurs only after the financing is in place.

Short-term bridge financing is debt of an amount that is sufficient to enable the company to complete the acquisition and announce it to the market. The term of the financing is usually 12 months (but can be longer) and it is designed to give the company time to refinance the debt with the company's long-term desired financing arrangements such as equity and/or bonds and for problems of information asymmetry to be resolved.

This arrangement addresses the problem of information asymmetry and the difficulty identified by Myers and Majluf (1984) that, so they argued, leads to a preference for debt over equity. Here, bridge financing is exactly that but with one important difference. The bridge financing is a stopgap debt financing until permanent financing is put in place. The use of bridge finance does not indicate a preference for debt over equity in the long-term but only until it is refinanced.

The bridge financing arrangement has one further important advantage in the context of acquisitions namely speed. A bridge financing can be put in place quickly and certainly much more quickly than an equity issue. This speed can be particularly important in acquisitions where the timetable may be set by another party.

So, the bridge financing would be followed by further issues of securities e.g. long-term bond issues and/or equity issues after the asymmetry of information was corrected. The company would be able to benefit from any positive market reaction to the announcement of the acquisition. For instance, if the acquisition created positive value then this might be reflected in better issue terms for the securities issued, both debt and equity. This mechanism addresses precisely the concerns about information asymmetry.

Alternatively, if the acquisition was not received in a positive way, there could be a reduction in the value of the company's securities and the terms of subsequent issues of securities would reflect this. The investment bank by underwriting a bridge financing would be protected against any adverse share price reaction to the acquisition and so might prefer this two-stage process particularly when it is difficult to assess exactly how the market might react. A bridge financing avoids the valuation problems arising from the information asymmetry.

One important requirement for a bridge financing to work is that the investment bank or lender must feel very comfortable that the company will be able to refinance the bridge financing within the 12-month timetable. The ability of a company to refinance will depend on its capital structure and it may also depend on its company type. If the company type cannot be known at the time of the bridge, then the lenders will assume company type L, so the overall capital structure of the company could be a very important determinant in the availability of bridge finance. Obviously, a strong company balance sheet will facilitate the provision of bridge finance and vice versa. So, to manage information asymmetry, a company should manage its capital structure so that it is always able to access bridge finance. This dictates a conservative capital structure.

The problem of asymmetric information can also affect issues of debt. If the market is unaware of the true position of the company, then the terms of a debt issue will not reflect the management's own private knowledge of its prospects. A long-term debt issue on terms based on information asymmetry will lead to a loss of value – shareholders will suffer a transfer of value to the holders of the new debt issue once the information asymmetry is corrected. Halov and Heider (2011) present evidence that firms avoid issuing debt when the outside market is likely to know little about the risk. Goyal and Wang (2013) present evidence that the maturity of debt issues is connected to their private information about company prospects. Berger, Espinosa-Vega, Frame and Miller (2005) identify a link between debt maturity and information asymmetry noting that companies prefer shorter maturities when there is a situation of information asymmetry.

To manage a problem of information asymmetry ahead of a debt issue, the company can resort to bridging or short-term financing so that the cost of issuing debt on terms that could become unfavourable are minimised by the shorter maturity. Once the information asymmetry is corrected, it will be possible to refinance with longer maturity debt on terms that reflect the management's knowledge that is no longer private.

3.4.2.4 Issuing equity to existing shareholders

In many jurisdictions, there are legal restrictions on the issue of new shares for cash. Such shares must first be offered by a company to the existing shareholders. This is known as the right of pre-emption. The existing shareholders are legally entitled to subscribe pro rata for any new shares issued for cash. The rationale for the pre-emption arrangement is simply to ensure that existing shareholders have the right to maintain their proportionate shareholding – although they must subscribe for the new shares to avoid being diluted.

So, a typical equity cash raising mechanism is to issue shares, usually at a discount, to existing shareholders in proportion to their holdings (a rights issue). This approach can avoid the problems motivating the pecking order as discussed in Myers and Majluf (1984).

Faced with a situation of information asymmetry, the company could offer shares to its shareholders at a price equivalent to that implied by company type L or even at a lower price. The offering document would provide the information on the two possible company types. By offering the shares at a low value to existing shareholders, the possible adverse loss of value arising from issuing at an average price is not avoided but the value that is transferred to the new investors is transferred to those existing shareholders subscribing for the new shares. Once the company type is revealed, the shares will reflect that information and the shareholders will benefit if the company type is H but will suffer no loss if the company type is L.

Obviously, for those existing shareholders unable or unwilling to subscribe for new shares, there will be a transfer of value to those subscribing. But the company will have done its best to protect its existing shareholders. The shareholders unable to subscribe would not be any worse off than if they had simply sold their shares at the market price that reflected the uncertainty – this is why regulators seek to promote fair markets where information is disclosed to avoid share prices being inaccurate.

The rights issue mechanism could be used by any company regardless of jurisdiction to solve the asymmetric information problem. If the timetable for the revelation of company type is known then, if feasible, the rights issue could be organised so that the company type is revealed prior to the end of the offering period. Such a timing will allow those shareholders unable to subscribe to sell their rights at a price which reflects the company type.

If the timing of revelation of company type is not expected to occur within the usual timetable for a rights issue, then a bridge financing should be organised followed by a rights issue at the appropriate time.

3.4.2.5 Selling the investment opportunity

As mentioned above, another method of avoiding the difficulties of issuing equity in a situation of information asymmetry is for the company to seek to sell the investment opportunity to a third party. It might be possible to approach possible buyers on a confidential basis in a way that did not jeopardise the value of the opportunity.

Alternatively, the company could seek a joint venture partner who could be invited to invest allowing the company to retain an interest.

Both these options could be pursued on a confidential basis to limit the risk of information disclosure which might jeopardise the value of the investment opportunity.

Also, if the company type could not be known within a reasonable timeframe, one of the contractual provisions described above (such as the terms and price of the share issue being adjusted depending on the company type, once revealed) could be incorporated into the joint venture agreement to protect the joint venture partner.

3.4.3 Implications for the pecking order theory

The discussion above demonstrates that the problem posed in the Myers and Majluf (1984) paper can be managed in several ways that do not support the pecking order theory. In summary, these are as follows.

1. The company makes a two-stage equity issue. The first issue assumes a price based on company type H but, if the company type is subsequently revealed as type L, then a further issue of shares to the new investors is made to give an effective price based on the correct company type. Otherwise no further shares are issued. The mechanism used can be a convertible bond, convertible preference share or a CVR (contingent value right).

2. The company uses an intermediary to underwrite a securities issue until the company type can be revealed to the market. Here, the intermediary’s reputation is a further signal to convince investors of its true type.

3. The company arranges a bridging finance or other short-term finance until the company type is revealed when more permanent capital raising arrangements can be put in place including equity.

4. Shares can be issued to existing shareholders at a discount. This avoids the problem of issuing shares at an undervaluation at least for those existing shareholders able to subscribe to the issue.

5. The company seeks a sale or partial sale of the investment opportunity to a third party to whom confidential details are disclosed; or uses a costless signal such as a statement by management.

All the above techniques provide ways of addressing the asymmetric information problem. The only solution that has a link to the pecking order theory is technique 3. This involves using short-term bridging finance from an intermediary until other arrangements can be put in place at a time when the information asymmetry problem has reduced. Such other arrangements may or may not include debt – there is no preference implied by the bridge financing. The choice of financing method may be determined in advance but is only executed after the asymmetric information problem has passed i.e. once the company type is revealed.

Once the company type is revealed, the company has the option to restructure its debt/equity mix. Problems of asymmetric information can at most affect capital structure decisions over the time until the information asymmetry is resolved.

The conclusion is that if the problem of asymmetric information can be managed by one or more of the solutions describe above then there is no support for the pecking order theory. The only connection between the idea of pecking order theory and information asymmetry is that one of the solutions, bridge financing, involves short-term debt that is subsequently refinanced (a type of short-term pecking order theory).

Subject to one important qualification, the analysis above of the problem of information asymmetry provides no insight into what the company's capital structure might be or should be. The company could pursue any capital structure objective with occasional temporary use of bridge financing without supporting any preference for debt over equity. However, there is one important qualification which is that for the company to overcome the problem of information asymmetry by using bridge financing or other short-term debt financing, the company must have a balance sheet that is sufficiently conservative to be able to support bridge financing which could represent a temporary but substantial increase in gearing. The bridge financing solution requires a conservative balance sheet. So, there is an implication for capital structure choice.

3.5 Empirical evidence

In this section, the empirical literature on pecking order theory is reviewed and some alternative hypotheses are developed and tested which do not provide support for the pecking order theory but instead suggest support for the temporary or short-term bridge financing approach described above.

3.5.1 Empirical literature

Shyam-Sunder and Myers (1999) examined in a comparative way the pecking order theory and the static trade-off model. They concluded that the pecking order is an "excellent descriptor" of corporate financing behaviour for their sample of mature companies.

The analysis below follows in part the approach in Shyam-Sunder and Myers (1999). That study employed Compustat data that were complete for the entire period (1971 – 1989) and where there was no takeover activity – as such activity can lead to significant changes in gearing. Because of this constraint, their data set was restricted to a sample of 157 firms which were mainly mature companies. This bias in their data set may affect the results.

The main result of the Shyam-Sunder and Myers (1999) study is a regression test on the following equation.

$$\Delta Totdebt_{i,t} = \alpha + \beta_1 \times Totfindef_{i,t} + \varepsilon_{i,t} \qquad (3.1)$$

where $\Delta Totdebt_{i,t}$ is the change in total debt over the year and $Totfindef_{i,t}$ is the total financing deficit arising during the year. The idea of this test is to examine whether there is a relation between the company's need for external financing (the total financing deficit) and the issue of debt securities. Clearly, the deficit must be financed by either debt and/or equity, so the equation has an element of circularity. While Shyam-Sunder and Myers (1999) argue that the equation is not an accounting identity, the circularity can be articulated. Obviously, the financing deficit must balance with changes in the external sources of finance – debt and equity. So, their equation is as follows.

$$\Delta Totdebt_{i,t} = \alpha + \beta_1 \times (\Delta Totdebt_{i,t} + \Delta Totequity_{i,t}) + \varepsilon_{i,t} \qquad (3.2)$$

where $\Delta Totdebt_{i,t}$ is the change in total equity over the year.

This regression equation effectively examines the split between debt and equity in terms of their use to finance the deficit. A coefficient of unity would imply that firms finance their deficits entirely with debt finance – which is the explanation put forward in the pecking order theory. This would imply that changes in equity were zero.

The coefficient value identified by Shyam-Sunder and Myers (1999) in their study based on changes in net debt was 0.75. So, the coefficient value while not very close to unity, does indicate that more debt is used than equity.

The equation in Shyam-Sunder and Myers (1999) can be reorganised as follows.

$$\Delta Totdebt_{i,t} \times (1 - \beta_1) = \alpha + \beta_1 \times \Delta Totequity_{i,t} + \varepsilon_{i,t} \qquad (3.3)$$

and equivalently,

$$\Delta Totdebt_{i,t} = \alpha/(1 - \beta_1) + (\beta_1/(1 - \beta_1)) \times \Delta Totequity_{i,t} + \varepsilon_{i,t} \qquad (3.4)$$

Hence, if the value of β_1 is 0.75, then this implies a value for $\beta_1/(1 - \beta_1)$ of 0.75/0.25 which is 3. This implies that deficits are financed as to one quarter with equity and three quarters with debt. However, it is difficult to argue that this supports the pecking order theory. The evidence implies only that changes in debt issued appear to be more common than raising capital by equity issues.

For large mature slower growing companies (which may include those in the dataset in the Shyam-Sunder and Myers (1999) study), debt issues that match the growing equity base are to be expected. The incidence of such companies in the dataset will tend to produce a high value for β_1. But this may not provide evidence to support the pecking order theory.

Such companies clearly prefer debt in the sense that they prefer not to issue equity which would have the effect of reducing gearing. Such companies could be said to have a target gearing ratio. As they have only modest investment requirements (that can be accommodated by increasing debt slowly as the equity base grows) there will be no real need for equity issues. The Shyam-Sunder and Myers (1999) results may therefore provide support for a theory of capital structure that involves a target gearing ratio for slower growing companies and not necessarily for the pecking order theory in general. This could be an example of the narrow sample effect described in Graham and Leary (2011).

It is not obvious that the Shyam-Sunder and Myers (1999) results can be interpreted as providing support for the pecking order theory in a very meaningful way. In fact, a similar analysis can be performed for changes in equity in the same way as performed in respect of changes in debt.

The analogous equation for changes in equity financing is as follows.

$$\Delta Totequity_{i,t} = \gamma + \delta_1 \text{ x } (\Delta Totdebt_{i,t} + \Delta Totequity_{i,t}) + \varepsilon_{i,t} \qquad (3.5)$$

This equation can be derived from the Shyam-Sunder and Myers (1999) equation by subtracting each side of the above equation from "Total financing deficit".

This second equation could be tested in the same way as in Shyam-Sunder and Myers (1999) and is likely to produce a coefficient as indicated above. Using the argument in Shyam-Sunder and Myers (1999) but applying it in reverse, such a coefficient could suggest a preference for equity over debt – the exact converse of the pecking order theory.

Chirinko and Singha (2000) questioned the testing methodology in Shyam-Sunder and Myers (1999) and pointed out that the regression coefficient could be significantly less than one even if the companies pursued the pecking order theory and that incorrect inferences about financing being consistent with the pecking order theory could be drawn even if companies pursued financing in fixed proportions of debt and equity. The criticism in Chirinko and Singha (2000) is essentially that the test lacks sufficient power and so cannot provide evidence of companies demonstrating a preference for debt over equity since the data include both debt and equity financing without any way of determining preference. While there could be a preference for debt (over equity) up to a point after which equity is preferred or vice versa, the regression coefficient cannot distinguish between these two alternative preferences.

Other studies have provided less supportive evidence for the pecking order theory. Frank and Goyal (2003) concluded that the pecking order better describes the behaviour of large companies rather than small. Fama and French (2005) observed that during the period 1973-2002, more than half of the companies within their sample issued or retired equity in a way that violated the pecking order theory: they identified “pervasive contradictions” in the model. Bharath, Pasquariello and Wu (2009) argued that firms with low levels of information asymmetry account for the bulk of the failings of the pecking order theory while Jung, Kim and Stulz (1996) concluded the opposite. Hennessy, Livdan and Miranda (2010) develop models that show that asymmetric information can lead to financing policies other than the pecking order theory.

The wide range of results has prompted some to modify the original pecking order theory – Leary and Roberts (2010) equate a simplistic version of the pecking order theory (first internal funds; and secondly debt, but no equity) as a "practical irrelevance" so modifications to the pecking order theory have been developed. In their study, Leary and Roberts (2010) show that by including factors associated with alternative theories, the predictive accuracy of their model increases classifying over 80% of the observed debt and equity issues.

Some companies can expand by relying only on debt and retained earnings without recourse to equity (although that might be needed to finance acquisitions). These can be described as self-sustainers since the new sources of capital exclude equity but instead are generated internally or by increasing the amount of debt in a way that does not increase gearing. For some mature companies, modest growth can be financed by a combination of retained earnings and increases in debt without increasing overall gearing. For such companies, there would be no need to make new issues of shares since there would be no requirement for further capital (except for acquisitions which were excluded in the Shyam-Sunder and Myers (1999) study).

Mature companies could be growing relatively slowly while maintaining constant gearing and so would not necessarily be providing evidence of a preference for debt over equity. Their capital structure is self-sustaining with growth being financed by retained profits and increases in debt supported by the retained earnings without the need for an issue of new shares.

For a company that pays out a constant proportion of earnings and has constant gearing, then it is easy to show that the growth rate that is achievable on a self-sustaining basis is given by the following formula:

$$\text{Self-sustaining growth rate} = (1\text{-Po}).(\text{WACC} - \text{Kd}(1 - t).G)/(1\text{-}G) \qquad (3.6)$$

where Po is the pay-out ratio; WACC is the weighted average cost of capital; Kd is the cost of debt; t is the corporate tax rate; and G is the gearing ratio (based on market values). The derivation of this deterministic model is set out in the Appendix to this Chapter).

Using some simple assumptions such as a pay-out ratio of 35%, cost of debt of 4% and a corporation tax rate of 35%, it is possible to compute some growth rates. Table 3.7 sets out growth rates implied by this combination of assumptions for a range of values for weighted average cost of capital and gearing.

Table 3.7 Rates of growth for self-sustainers
This table sets out the rates of growth implied by a self-sustaining strategy, based on a pay-out ratio of 35%, cost of debt of 4% and a corporation tax rate of 35%

		WACC	WACC	WACC
		8.00%	10.00%	12.00%
Gearing	10.00%	6.02%	7.58%	9.13%
Gearing	20.00%	6.55%	8.30%	10.05%
Gearing	30.00%	7.22%	9.22%	11.22%

It is apparent from the Table that relatively substantial growth rates can be achieved using only internally generated equity and a constant gearing ratio. This self-sustaining strategy will be appropriate for some large mature companies where acquisitions are not contemplated and where growth is sufficiently modest to permit growth based on a self-sustaining capital structure. If the sample comprised only self-sustaining companies, then the coefficient of the financing deficit in the regression equation would be unity.

However, this strategy does not provide evidence of a preference for debt over equity (or equally a preference for equity over debt) but there will be such self-sustaining companies included within the full sample. Those companies not pursuing a self-sustaining strategy (or those that are but wish to make acquisitions that can’t be financed by the self-sustaining approach) are a more suitable dataset for the analysis of financing preferences.

Lemmon and Zender (2010) test a modified version of the pecking order theory that takes account of credit or default risk. They split their sample into 3 groups reflecting the probability or actuality of having a bond rating. Companies in these groups differ by their ability to issue debt. The companies that are predicted not to face debt capacity constraints finance more of their deficits with debt than equity, but this is less the case with those companies where the ability to issue more debt is constrained. Lemmon and Zender (2010) include the squared financing deficit as an independent variable as the relationship between the amount of debt used and the financing deficit, so they argue, is not necessarily linear. They obtained a positive coefficient for the financing deficit and a negative coefficient for the squared financing deficit indicating that as the financing deficit increases the amount of debt financing used reduces at a faster rate. Lemmon and Zender (2010) conclude that the use of debt and equity conforms well with the pecking order theory after accounting for the effect of debt capacity. In other words, debt is used depending on its availability. This is support for a modified pecking order theory that takes account of existing capital structure.

Helwege and Liang (1996) study the financing of recent initial public offerings and find no relationship with the pecking order theory for such companies. Fama and French (2002) highlight the preference for equity financing on the part of high growth companies as a serious failing of the pecking order theory. Chang and Song (2013) address both smaller companies and high growth companies which do not appear to follow the pecking order theory suggesting that information asymmetry and supply constraints explain this anomaly – a possible narrow sample effect. Fulghieri, Garcia and Hackbarth (2013) construct a model in which companies with investment opportunities prefer equity until they are large enough to prefer debt.

3.5.2 Developing appropriate hypotheses

The analysis above suggests that the pecking order theory should be tested in a way that recognises capital structure or the determinants of capital structure. The hypothesis to be tested is that the proportion of the financing deficit that is financed using debt should also be affected by the company's capital structure.

A modified test along the lines of both Shyam-Sunder and Myers (1999) and Lemmon and Zender (2010) can be attempted where the sample is restricted to those companies with positive financing deficits (where companies need to raise external financing). The proportion of the deficit that is financed by debt is the dependent variable (as in Shyam-Sunder and Myers (1999) and Lemmon and Zender (2010)) but the independent variables can be extended to include not just the financing deficit but also the square of the financing deficit (as in Lemmon and Zender (2010) to take into account the non-linear nature of the relationship between the proportion of the financing deficit covered by debt and the amount of the financing deficit) and the lagged value of gearing (i.e. the gearing at the start of the year in which the financing deficit is generated – this takes direct account of the company's existing capital structure).

- Hypothesis 1: It is argued above that the pecking order theory need not apply as there are alternative financing solutions available to manage information asymmetry. So, there will not be an automatic preference for debt over equity. This in turn implies that the financing of the deficit would take account of other factors such as the amount of existing debt on the company's balance sheet. A high (low) pre-investment level of gearing is likely to suggest using low (high) levels of debt to finance the deficit. This implies, firstly, *that the proportion of debt used to finance the deficit will be negatively related to the gearing at the beginning of the year in which the deficit is generated*; and secondly, the option to use bridge financing suggests that *the proportion of debt used to finance the deficit will be positively related to the size of the financing deficit*.

So, if a company has high gearing at the beginning of the year in which the financing deficit is generated, the company will tend to use less debt to finance that deficit than a company that starts the year with less gearing. In other words, the company's preference for debt over equity (if there is such a preference) is constrained or affected by its existing capital structure.

If the alternative solution of short-term financing technique described above is used to manage information asymmetry, then it suggests that a temporary increase in debt could be followed by a refinancing that returns the company to its long run target capital structure. This arrangement creates time for the asymmetry of information to be corrected so that the company can issue shares at a share price that reflects more closely the company's view of its valuation and thus avoids issuing shares at an undervaluation which could damage shareholder value.

So, it is likely that where a company employs bridge financing or other short-term financing, it will increase its gearing and then, following the resolution of the information asymmetry there will be a refinancing to enable the company to reduce its gearing. Where gearing increases to finance the deficit, the company will move away from its target capital structure but that such an increase in gearing will be temporary and so will be followed by an adjusting decrease in gearing.

Of course, the bridge and its refinancing may occur within the same financial year, so such transactions will not be observable simply by examining changes from year to year. Equally, there may be delays in the refinancing and there may be a further reduction in gearing in the succeeding year. This is unlikely to be caused by bridging because there the timetable is usually just 12 months so unless the terms of the facility are breached, the bridge financing will be refinanced within that period and certainly at the latest by the next balance sheet date. However, it may be that part of the company's plan to reduce debt includes a disposal and that such disposal may take longer to complete than the timetable for the bridge so there might be some further debt reduction during the second year after the year of the financing deficit when gearing increased. Alternatively, the bridge might have been repaid but there was still some further debt reduction that was planned during the second year after the year of the financing deficit by way of a further equity issue or other transaction.

This can also be tested. The hypothesis is that there will be evidence of companies returning to their long run capital structure by means of a further reduction in gearing in the second year after the year in which the deficit was financed by an increase in gearing.

Various further hypotheses are suggested by this approach to information asymmetry. As before, the base year is defined as a year in which i) there is a positive financing deficit; and ii) such deficit is financed by an increase in gearing. If hypothesis 1 is correct and supported by the results, then this will suggest the use of bridge financing. If that is the case, then following the use of bridge financing there will be a reduction in gearing as the bridge is refinanced with equity (perhaps in part) in the period following the investment year.

The additional hypotheses are as follows.

Hypothesis 2: that after the base year (when the positive financing deficit is financed by an increase in gearing), there will be a reduction in gearing observable in the following year as the bridge debt is refinanced (at least in part) with equity: so, *the change in gearing during the year following the base year will be negatively related to the gearing at the end of the base year.*

As the bridge financing may not be repaid in the year following the base year, there will be a reduction in gearing in the second year following the base year, so a further hypothesis can be formulated.

Hypothesis 3: that in the second year after the base year, there will be a further reduction in gearing so that *the change in gearing in that year will also be negatively related to the gearing at the end of the base year* thus supporting the use of short term debt finance to cover the financing deficit that is subsequently refinanced with equity to reduce the temporarily increased gearing.

For robustness, instead of using gearing at the end of the base year, the change in gearing in the base year can be used as an independent variable. Hence two further hypotheses can be formulated:

Hypothesis 4: *that the change in gearing during the year following the base year will be negatively related to the change in gearing during the base year*: this replicates the idea in hypothesis 2 except that a different independent variable is used – the change in gearing rather than the absolute level of gearing; and

Hypothesis 5: *that the change in gearing in the second year following the base year will be negatively related to the change in gearing during the base year*: this replicates the idea in hypothesis 4 except that a different independent variable is used – the change in gearing rather than the absolute level of gearing.

These hypotheses are tested by restricting the sample to those companies with both a positive financing deficit and an increase in gearing during the year in which the deficit is generated. Since, the tests require three consecutive company-year observations for hypotheses 2 and 3 and four consecutive company-year observations for hypotheses 4 and 5, there is a commensurate reduction in sample size compared to the analysis for hypothesis 1.

This approach extends that described in Lemmon and Zender (2010).

Not all companies will be using bridge financing since not all will face problems of asymmetric information. Some companies may be in the nature of self-sustainers where the company has increased gearing slightly during the financing year and so become included within the sample (companies with both a positive financing deficit and an increase in gearing in the year). Clearly there are several different capital structure strategies that could be being pursued.

3.5.3 Data and Methodology

This section describes the data, the variables, the regression equations and the estimation methods.

The data are taken from Compustat for North American companies for the period 1995 – 2014 restricted to non-financial company data. The sample includes data where the company is not present for the full period thereby avoiding survivorship bias. Yield curve data are taken from the US Treasury website; US consumer price index data are downloaded from US Department of Labour website; and yields on corporate bonds by maturity are from Bank of America Merrill Lynch/Federal Reserve Bank of St Louis, Economic Data. A more extensive description of the data is contained in section 2.3.3 of Chapter 2 which employs the same data.

A total of 195,600 company-year observations in respect of 23,600 companies are included. However, not all company-year observations are complete and so the usable data are smaller in number: the sample size available varies between each regression depending on the variables employed. A further constraint is the requirement to use lagged values of the variables: this requires that each company-year observation has a corresponding value for the previous year. This requirement leads to a further reduction in sample size where there is no previous company-year value. For instance, using system GMM with two lags requires 3 consecutive company-year observations and so the sample size for this approach is smaller than for fixed effects modelling where only two consecutive company-year observations are required. For these reasons, the sample size varies between regression analyses.

The choice of data follows that in Lemmon and Zender (2010) (which covered an earlier period than in this case although with some small degree of overlap). The sample is more comprehensive than that employed in Shyam-Sunder and Myers (1999) which was restricted to 159 firms only. This sample includes some companies present for the whole sample period and others for shorter time frames thus avoiding survivorship bias.

The variables are defined in Table 3.8. Summary statistics of the data are set out in Table 3.9 except for those variables defined in Table 2.5 of Chapter 2 and that are summarised in Table 2.6. Table 3.10 contains the respective correlation statistics except for cross-correlations for those variables defined in Table 2.5 of Chapter 2 which are reported in Table 2.7.

3.5.3.1 Variables

The definitions of the independent variables are set out in Table 3.8 except for those variables already defined in Table 2.5 of Chapter 2.

Table 3.8 Definitions of the variables and expected signs of coefficients

This table sets out the definitions of all the variables used in the regression analyses and their expected signs

Debt proportion	The proportion of the financing deficit that is financed with debt and is the dependent variable as in Shyam-Sunder and Myers (1999).
Financing deficit	The annual increase in the total amount of debt and equity (restricted to positive values – negative values are omitted) expressed as a proportion of share capital and debt as in Lemmon and Zender (2010). The restriction to positive values for the financing deficit reduces the available sample size but is nevertheless large. This restriction is necessary to focus the analysis on companies needing to obtain external finance
Expected sign	"+" since the assumption is that more debt is used when financing a larger deficit.
Squared financing deficit	The square of the *financing deficit* (as the relationship is not linear) as described in Lemmon and Zender (2010).
Expected sign	"–" based on the results in Lemmon and Zender (2010).
Gearing (net book value)	The total amount of debt net of cash (since it is necessary to adjust for cash to get the correct relationship with the financing deficit which is also net of cash following Cooper and Lambertides (2016)) expressed as a proportion of the book value of total assets.
Expected sign	"–" since the amount of debt financing of the financing deficit must be constrained by existing gearing as hypothesised.

In addition to the above variables and to avoid under-specification biases, those explanatory variables included in the regression equations in Chapter 2 are included: the definitions of these variables are set out in Table 2.5 and are listed below together with the expected signs .

The market to book value ratio	Expected sign: "+" to reflect the results of Chapter 2.
Regulation dummy	Expected sign: "+" to reflect the results of Chapter 2.
Size	Expected sign: "–" to reflect the results of Chapter 2.
Commercial paper dummy	Expected sign: "+" to reflect the results of Chapter 2.
Abnormal earnings	Expected sign: "+" to reflect the results of Chapter 2.
Average asset life	Expected sign: "–" to reflect the results of Chapter 2.
Fixed asset ratio	Expected sign: "+" to reflect the results of Chapter 2.

In addition to the company specific variables and to reflect debt market conditions, the following variables are included as in Chapter 2 and the definitions of these variables are set out in Table 2.5.

Yield curve, *Bond spread*, *Inflation* and *Short-term real interest rate* are included and the expected sign of each of these variables is "–".

As in Chapter 2, to take account of a policy of adjusting capital structure to a target, lagged values of the dependent variables are included as explanatory variables.

3.5.3.2 Model equations

The regression equation used to test each hypothesis is set out below under each of the hypotheses.

Static models do not provide for delays in adjusting capital structure as is argued above in relation to the uses of bridge financing. Accordingly, a lagged value of the dependent variable is included as an explanatory variable. The subscripts indicate firm (i) and time (t).

- Hypothesis 1: The proportion of debt used to finance the deficit will be negatively related to the capital structure at the beginning of the year in which the deficit is generated and positively related to the financing deficit.

$$Propdebt_{i,t} = \alpha + \beta_1 Propdebt_{i,(t-1)} + \beta_2 Findef_{i,t} + \beta_3 Findef2_{i,t} + \beta_4 Gearing_{i,t-1} + \beta_5 MTBV_{i,t} + \beta_6 Reg_{i,t} + \beta_7 Size_{i,t} + \beta_8 CPD_{i,t} + \beta_9 Abegs_{i,t} + \beta_{10} AAL_{i,t} + \beta_{11} FAR_{i,t} + \beta_{12} Ycurve_t + \beta_{13} Bondspread_t + \beta_{14} Inflation_t + \beta_{15} Shortint_t + \varepsilon_{i,t} \quad (3.7)$$

Dependent variable: $Propdebt_{i,t}$ = proportion of debt used to finance the financing deficit.

Independent variables: 1) $Propdebt_{i,(t-1)}$ = lagged value of $Propdebt_{i,t}$; 2) $Findef_{i,t}$ = the financing deficit; 3) $Findef2_{i,t}$ = financing deficit squared as in Lemmon and Zender (2010); 4) $Gearing_{i,t-1}$ = lagged gearing (ie the gearing at the beginning of the year of the financing deficit, which is similar to the approach in Lemmon and Zender (2010) which recognises that factors that affect gearing will influence the method of financing the deficit and hence why the following additional control variables are included; 5)

$MTBV_{i,t}$ = market to book value ratio; 6) $Reg_{i,t}$ = regulation dummy; 7) $Size_{i,t}$ = natural logarithm of the enterprise value; 8) $CPD_{i,t}$ = commercial paper dummy; 9) $Abegs_{i,t}$ = abnormal earnings; 10) $AAL_{i,t}$ = average asset life; 11) $FAR_{i,t}$ = fixed asset ratio; 12) $Ycurve_t$ = yield curve; 13) $Bondspread_t$ = bond spread; 14) $Inflation_t$ = inflation; and 15) $Shortint_t$ = short-term interest rate. The error term is $\varepsilon_{i,t}$.

- Hypothesis 2: After an increase in debt in the base year (when the deficit is financed by an increase in gearing), there will be a reduction in gearing observable in the following year: so, the change in gearing during the year following the base year will be negatively related to the gearing as the end of the base year;

$$\Delta Gearing_{i,t+1} = \alpha + \beta_1 \Delta Gearing_{i,t} + \beta_2 Gearing_{i,t} + \beta_3 MTBV_{i,t} + \beta_4 Reg_{i,t} + \beta_5 Size_{i,t} + \beta_6 CPD_{i,t} + \beta_7 Abegs_{i,t} + \beta_8 AAL_{i,t} + \beta_9 FAR_{i,t} + \beta_{10} Ycurve_t + \beta_{11} Bondspread_t + \beta_{12} Inflation_t + \beta_{13} Shortint_t + \varepsilon_{i,t} \quad (3.8)$$

Dependent variable, $\Delta Gearing_{i,t+1}$ = change in gearing in the year following the year of the financing deficit.

Independent variables: 1) $\Delta Gearing_{i,t}$ = lagged value of the dependent variable (ie the value in the year of the financing deficit); 2) gearing; and the other independent variables as per the equation for hypothesis 1. The error term is $\varepsilon_{i,t}$.

- Hypothesis 3: In the second year after the base year, there will be a further reduction in gearing so that the change in gearing in that year will also be negatively related to the gearing at the end of the base year.

$$\Delta Gearing_{i,t+2} = \alpha + \beta_1 \Delta Gearing_{i,t+1} + \beta_2 Gearing_{i,t} + \beta_3 MTBV_{i,t} + \beta_4 Reg_{i,t} + \beta_5 Size_{i,t} + \beta_6 CPD_{i,t} + \beta_7 Abegs_{i,t} + \beta_8 AAL_{i,t} + \beta_9 FAR_{i,t} + \beta_{10} Ycurve_t + \beta_{11} Bondspread_t + \beta_{12} Inflation_t + \beta_{13} Shortint_t + \varepsilon_{i,t} \quad (3.9)$$

Dependent variable, $\Delta Gearing_{i,t+2}$ = change in gearing in the second year following the year of the financing deficit.

Independent variables: 1) $\Delta Gearing_{i,t+1}$ = lagged value of the dependent variable (ie the value in the year following the year of the financing deficit); 2) $Gearing_{i,t}$ and the other independent variables as per the equation for hypothesis 1. The error term is $\varepsilon_{i,t}$.

- Hypothesis 4: The change in gearing during the year following the base year will be negatively related to the change in gearing during the base year; and

$$\Delta Gearing_{i,t+1} = \alpha + \beta_1 \Delta Gearing_{i,t} + \beta_2 MTBV_{i,t} + \beta_3 Reg_{i,t} + \beta_4 Size_{i,t} + \beta_5 CPD_{i,t} + \beta_6 Abegs_{i,t} + \beta_7 AAL_{i,t} + \beta_8 FAR_{i,t} + \beta_9 Ycurve_t + \beta_{10} Bondspread_t + \beta_{11} Inflation_t + \beta_{12} Shortint_t + \varepsilon_{i,t} \quad (3.10)$$

Dependent variable, $\Delta Gearing_{i,t+1}$ = change in gearing in the first year following the year of the financing deficit.

Independent variables: 1) $\Delta Gearing_{i,t}$ = lagged value of the dependent variable (ie the change in gearing in the year of the financing deficit.); and the other independent variables as per the equation for hypothesis 1. The error term is $\varepsilon_{i,t}$.

- Hypothesis 5: The change in gearing in the second year following the base year will be negatively related to the change in gearing during the base year.

$\Delta Gearing_{i,t+2} = \alpha + \beta_1 \Delta Gearing_{i,t+1} + \beta_2 \Delta Gearingi_{,t} + \beta_3 MTBV_{i,t} + \beta_4 Reg_{i,t} + \beta_5 Size_{i,t} + \beta_6 CPD_{i,t} + \beta_7 Abegs_{i,t} + \beta_8 AAL_{i,t} + \beta_9 FAR_{i,t} + \beta_{10} Ycurve_t + \beta_{11} Bondspread_t + \beta_{12} Inflation_t + \beta_{13} Shortint_t + \varepsilon_{i,t}$ (3.11)

Dependent variable, $\Delta Gearing_{i,t+2}$ = change in gearing in the second year following the year of the financing deficit.

Independent variables: 1) $\Delta Gearing_{i,t+1}$ = lagged value of the dependent variable (ie the change in gearing in the first year following the year of the financing deficit); 2) $\Delta Gearingi_{,t}$ = the change in gearing in the year of the financing deficit; and the other independent variables as per the equation for hypothesis 1. The error term is $\varepsilon_{i,t}$.

These hypotheses are tested by restricting the sample to those companies with both a positive financing deficit and an increase in gearing during the year in which the deficit is generated. So, while the same sample is used as in Chapter 2, this restriction reduces the available company-year observations.

3.5.3.3 Methods of estimation

A more detailed description of the selection of estimation procedures is set out in section 2.3.3.3 of Chapter 2.

The two methods highlighted in Flannery and Hankins (2013) as the most efficient, namely fixed effects and system GMM, are used here and the procedure in relation to system GMM used in that paper (using Stata's “xtdpdsys” command, two steps, with all the independent variables specified as "predetermined" and the maximum number of lags restricted to two or, in some cases, more where it is necessary to increase the number of lags to generate satisfactory AR(2) statistics) is followed.

3.5.3.4 Descriptive statistics

Summary statistics are set out in Table 3.9 and correlation statistics in Table 3.10.

Table 3.9 Summary statistics 1995-2014

	Observations	Median	Mean	Std. Dev.	Variance	Skewness	Kurtosis	Minimum	Maximum
Debt proportion	95,284	0.052	0.054	0.456	0.208	-2.080	16.181	-2.508	1.636
Financing deficit	94,493	0.150	0.246	0.341	0.116	1.274	8.397	-0.922	1.765
Squared financing deficit	94,493	0.052	0.176	0.421	0.177	4.709	29.556	0.000	3.114
Lagged net gearing (book value)	149,989	0.098	0.141	0.772	0.596	4.420	31.901	-0.964	5.839
Change in gearing	149,068	0.002	0.015	0.315	0.099	0.486	12.793	-1.335	1.544

The definitions of the variables are set out in Table 3.8. Those variables not included in the above table are defined in Table 2.5 and summary statistics and correlation statistics are set out in Tables 2.6 and 2.7 respectively.

Table 3.10: Correlation statistics 1995-2014

	Debt proportion	Financing deficit	Financing deficit^2	Net gearing	Difference in gearing
Financing deficit	0.320***				
Financing deficit^2	0.136***	0.749***			
Net gearing	-0.003	-0.094***	-0.128***		
Difference in gearing	0.302***	0.055***	0.059***	-0.225***	
Market to book value ratio	-0.055***	-0.027***	-0.049***	0.243***	0.218***
Regulation	0.032***	-0.044***	-0.053***	0.084***	-0.005**
Abnormal earnings	-0.025***	-0.055***	-0.060***	0.136***	0.058***
Fixed asset ratio	0.097***	-0.062***	-0.103***	0.119***	0.066***
Natural log of size	0.087***	0.071***	0.077***	-0.060***	-0.021***
Term spread	0.017***	-0.090***	-0.051***	0.021***	-0.003
Bond spread	0.000	-0.083***	-0.046***	0.024***	-0.013***
Inflation	-0.044***	0.038***	0.022***	0.002	-0.037***
Short-term real rate	0.006*	0.107***	0.055***	-0.016***	-0.001

The definitions of the variables are set out in Table 3.8. Additional cross correlations are set out in Table 2.7.

3.5.4 Results

Table 3.11 reports the results of the test of hypothesis 1 that the proportion of debt used to finance the deficit is negatively related to the gearing at the beginning of the year of the financing deficit. The results support the hypothesis.

Both fixed effects and system GMM results are reported: however, in this case, the dependent variable may not have the characteristics of either gearing or debt maturity in displaying reversion towards a target. It may be that such an assumption is inappropriate. To address this, the fixed effects regression has been performed in two ways, in column 1 of Table 3.11 without the lagged value of the dependent variable being included as a dependent variable and in the middle column where the lagged value of the dependent variable is included. In system GMM, lagged values (both one and two lags) of the dependent variable are included. Interestingly, the coefficient of the once-lagged value of the dependent variable is negative and statistically significant although small.

The coefficients are all highly significant except for the regulation dummy (in system GMM); the yield curve (in system GMM – it is significant under fixed effects); and the constants (under both estimators).

The coefficient of the financing deficit is 0.88 (fixed effects, including the lagged value of the dependent variable) which is not so far from the results of Shyam-Sunder and Myers (1999) which reported a coefficient of 0.76 for a narrower sample although they did not include the square of the financing deficit in their regression. This coefficient is also similar to the results in Lemmon and Zender (2010) for those companies in their sample with the best access to debt where the coefficient reported was 0.79.

Also, in common with Lemmon and Zender (2010), there is a negative coefficient for the square of the financing deficit indicating that as the size of the financing deficit rises, less debt is used as hypothesised indicating that the debt proportion of the financing deficit is directly affected by the company's existing capital structure – more existing gearing is associated with a lower proportion of debt financing of the deficit. The relationship between gearing and the financing deficit is not linear but quadratic or parabolic which is confirmed by the sign of the coefficient of the square of the financing deficit.

The other coefficients are as predicted. These results support the idea that the debt proportion of the financing deficit is linked to the independent variables that explain gearing as well as the financing deficit (and its square) and to existing gearing. At the very least, the pecking order theory needs to be modified to explain these wider factors.

The coefficient of the market to book value ratio is positive as hypothesised and consistent with the analysis in Chapter 2 contradicting the idea that less debt is used to manage under-investment problems linked to higher market to book value ratios.

The coefficient of the abnormal earnings variable is positive indicating that the larger the value (and hence the greater the information asymmetry) then the larger will be the debt financing proportion. This supports the idea that motivates the pecking order theory that when faced with problems of asymmetric information that could render an equity issue unattractive for existing shareholders that the company will resort to debt. However, this result is also consistent with the idea that the company can manage the problem of information asymmetry by using short-term debt that can be put in place until the asymmetric information problem has reduced, and an equity issue can be made as proposed in the bridge financing solutions for asymmetric information described above.

Interestingly, the coefficients of the variables representing debt market conditions are negative (as expected), large and statistically significant. The dependent variable may represent a movement away from target gearing to finance a deficit on a short-term basis as proposed in the bridge finance solution and that this deviation is sensitive to debt market conditions.

Table 3.11 Determinants of the debt proportion of the financing deficit

This table sets out the regression results of the debt proportion of the financing deficit (dependent variable) against the variables in the left-hand column (hypothesis 1).

	Fixed effects (1)	Fixed effects (2)	System GMM
Lagged dependent variable (one lag)		-0.0492***	-0.0451**
		(-5.031)	(-2.447)
Lagged dependent variable (two lags)			-0.0200***
			(-2.895)
Financing deficit	1.030***	0.884***	0.778***
	(44.49)	(22.28)	(14.51)
Squared financing deficit	-0.244***	-0.220***	-0.172***
	(-13.38)	(-5.535)	(-2.598)
Lagged gearing	-0.0195***	-0.0182***	-0.0314***
	(-7.976)	(-8.594)	(-9.456)
Market to book value ratio	0.00595***	0.00627***	0.00784***
	(12.37)	(13.44)	(14.27)
Regulation dummy	-	-	-0.0671
			(-1.255)
Abnormal earnings	0.00465***	0.00306***	0.00320***
	(4.998)	(3.340)	(3.102)
Fixed asset ratio	0.241***	0.228***	0.368***
	(16.27)	(15.78)	(15.75)
Average asset life	-0.000182***	-0.000145***	-0.000234***
	(-6.430)	(-4.458)	(-4.826)
Natural logarithm of size	-0.00769***	-0.0126***	-0.0246***
	(-3.677)	(-5.761)	(-9.145)
Commercial paper dummy	0.0252*	0.0223	0.130***
	(1.856)	(1.464)	(4.924)
Yield curve	-2.393***	-1.701***	-0.394*
	(-10.45)	(-7.103)	(-1.720)
Bond spread	-0.0716	-0.359**	-0.377**
	(-0.421)	(-2.172)	(-2.228)
Inflation	-3.329***	-2.634***	-1.452***
	(-15.93)	(-11.88)	(-6.357)
Short-term interest rate	-3.298***	-2.997***	-0.908***
	(-18.25)	(-15.16)	(-5.158)
Constant	0.00518	0.0269*	0.0144
	(0.337)	(1.765)	(0.927)
F test	350.6***	153.8***	
Adjusted R squared	0.425	0.332	
Hausman p value	0.00***	0.00***	
Wald test p value			0.00***
Arellano-Bond AR(1)			0.00
Arellano-Bond AR(2)			0.81
Sargan statistic			0.0
Observations	51,043	33,334	22,544
Number of firms	11,514	9,699	7,386

Robust t-statistics in parentheses. *** p<0.01, ** p<0.05, * p<0.1. The Sargan test result is unreliable here - as pointed out in Roodman (2009b) it is not infallible and cannot be relied on too faithfully. The Hansen test statistic is not reported here as it is not available in xtdpdsys – see discussion in section 2.3.3.3. To test for collinearity, the variance inflation factors were computed and were all less than 10. The definitions of the variables are set out in Table 3.8. Fixed effects (1) excludes the lagged value of the dependent variable as an explanatory variable but is included in Fixed effects (2).

Table 3.12 sets out the regression results for the test of hypothesis 2 that following an increase in gearing in the year of the financing deficit, there will be a reduction in gearing. The dependent variable is the change in gearing in the year following the year of the financing deficit and the independent variables include the gearing at the end of the year of the financing deficit. The result provides some degree of support for the hypothesis.

Here, for system GMM to produce acceptable AR(2) statistics, it has been necessary to specify 6 lags rather than 2 (as in Flannery and Hankins (2013)). The coefficients have been omitted from the Table for those lags which were not statistically significant. In the case of fixed effects, the procedure described in respect of Table 3.11 has been followed although the impact of the additional analysis is marginal.

The coefficient of gearing in the year of the financing deficit is negative and statistically significant suggesting the negative relationship hypothesised. However, the constant is positive (and significant) suggesting that for some small values of gearing, there could still be a positive increase in gearing in the year following the financing deficit. small changes in gearing in the year of the financing deficit, there could be an increase in gearing in the subsequent year. For large increases in gearing during the year of the financing deficit, the results above suggest that the increase is reversed in part in the subsequent year supporting the idea that bridge financing or other short-term financing has been used.

The coefficient of the change in gearing in the deficit year is positive in contradiction to the hypothesis suggesting that in increase in gearing is followed by a further increase. However, this result is reversed when gearing is omitted from the regression equation as reported in Table 3.13 below.

The coefficient for the market to book value ratio is positive, as before, supporting the results in chapter 2. The signs of the other coefficients are largely as expected except for the following variable coefficients. The abnormal earnings coefficient is negative suggesting that gearing reduces in the year after the period when management becomes aware of an increase in earnings which is consistent with management seeking to avoid transfers of value to debt-holders. The coefficient of the fixed assets ratio is negative which is somewhat counter-intuitive, but this coefficient is not statistically significant under the fixed effects estimator. Of the debt market conditions, only the bond spread variable has a coefficient with a positive sign contradicting the idea that, faced with a high bond spread, borrowers should reduce maturity to minimise borrowing costs. However, changes in gearing do not necessarily reflect changes in maturity.

Table 3.12 Determinants of changes in gearing in the year after the year of the financing deficit

This table sets out the regression results of the change in gearing after the year in which the financing deficit is generated (dependent variable) against the variables in the left-hand column (hypothesis 2).

Variables	Fixed effects (1)	Fixed effects (2)	System GMM (6 lags)
Change in net gearing in the deficit year		0.169***	0.433***
		(4.669)	(4.136)
Gearing at end of deficit year	-0.262***	-0.292***	-0.385***
	(-19.10)	(-18.13)	(-8.218)
Market to book value ratio	0.00568*	0.00362	0.0224***
	(1.840)	(1.114)	(4.800)
Regulation dummy	-	-	0.359**
			(2.477)
Abnormal earnings	-0.00619	-0.00650	-0.0204**
	(-1.098)	(-1.133)	(-2.369)
Fixed asset ratio	-0.0803	-0.0693	-0.179*
	(-1.522)	(-1.274)	(-1.774)
Net average asset life	-7.43e-05	-0.000107	-0.000127
	(-0.987)	(-1.536)	(-1.002)
Natural logarithm of size	0.00489	0.00434	-0.0336***
	(0.886)	(0.796)	(-2.593)
Commercial paper dummy	-0.00688	-0.00542	0.0689
	(-1.122)	(-0.847)	(1.621)
Yield curve	-1.955***	-1.947***	-3.837***
	(-4.375)	(-4.483)	(-4.693)
Bond spread	0.663*	0.687**	1.468***
	(1.900)	(2.004)	(3.258)
Inflation	-0.495	-0.621	-2.140***
	(-1.237)	(-1.602)	(-2.731)
Short-term interest rate	-0.931***	-0.945***	-1.982***
	(-2.733)	(-2.861)	(-3.062)
Constant	0.156***	0.142***	0.347***
	(3.275)	(2.947)	(3.142)
F test	44.2***	37.7***	
Adjusted R squared	0.170	0.167	
Hausman p value	0.00***	0.00***	
Wald test p value			0.00***
Arellano-Bond AR(1)			0.00
Arellano-Bond AR(2)			0.127
Sargan statistic			0.00
Observations	21,421	20,825	10,115
Number of firms	7,654	7,420	4,157

Robust t-statistics in parentheses. *** p<0.01, ** p<0.05, * p<0.1. The Sargan test result is unreliable here - as pointed out in Roodman (2009b) it is not infallible and cannot be relied on too faithfully. The Hansen test statistic is not reported here as it is not available in xtdpdsys – see discussion in section 2.3.3.3. To test for collinearity, the variance inflation factors were computed and were all less than 10. The definitions of the variables are set out in Table 3.8. 6 lags are used here to generate a satisfactory AR(2) statistic but the coefficients after lag 2 are not shown – they were not statistically significant. Fixed effects (1) excludes the lagged value of the dependent variable as an explanatory variable but is included in Fixed effects (2).

Table 3.13 sets out the regression results of the test of hypothesis 3. This suggests that there is a further reduction in gearing in the second year following the year of the financing deficit. Here, the dependent variable is the change in gearing in the second year following the year of the financing deficit and the independent variables include the gearing at the end of the year of the year of the financing deficit as before. The results support the hypothesis.

Table 3.13 documents negative coefficients for the relationship between changes in gearing in the second year following the financing deficit year and gearing at the end of the year of the deficit and which is statistically significant in both fixed effects and system GMM. The constant term is positive but not significant (although it is much smaller than the constant in Table 3.12).

The coefficient of the market to book value ratio is positive and statistically significant (in system GMM) again contradicting the solution for the under-investment problem in Myers (1977). Little statistical significance for the other coefficients is found.

These results suggest that there is further adjustment to capital structure that occurs in the second year after the year of the financing deficit. If this behaviour is evidence of the company adjusting to its target gearing ratio, then the implication is that the process of adjustment is at least a full year in length.

Table 3.13 Determinants of changes in gearing in the second year following the financing deficit

This table sets out the regression results of the change in gearing in the second year after the year in which the financing deficit is generated (dependent variable) against the variables in the left-hand column (hypothesis 3).

Variables	Fixed effects (1)	Fixed effects (2)	System GMM
Change in net gearing after deficit year		-0.375***	-0.276***
		(-16.72)	(-11.23)
Change in net gearing in the deficit year			-0.153
			(-1.418)
Net gearing at the end of the deficit year	-0.120***	-0.226***	-0.0736**
	(-8.484)	(-15.24)	(-1.980)
Market to book value ratio	0.00308	0.00488	0.00898**
	(1.053)	(1.634)	(2.298)
Regulation dummy	-	-	0.0790
			(0.538)
Abnormal earnings	-0.00713	-0.00875	0.00233
	(-1.166)	(-1.616)	(0.322)
Fixed asset ratio	0.0409	0.00659	0.0977
	(0.767)	(0.130)	(1.320)
Net average asset life	0.000120	8.70e-05	0.000145
	(1.177)	(0.706)	(0.838)
Natural logarithm of size	-0.000124	0.00117	-0.00945
	(-0.0212)	(0.194)	(-0.750)
Commercial paper dummy	0.00452	0.00222	-0.0349
	(0.695)	(0.347)	(-0.946)
Yield curve	-0.320	-0.863*	-0.737
	(-0.672)	(-1.938)	(-0.419)
Bond spread	0.101	0.263	0.510
	(0.273)	(0.731)	(1.246)
Inflation	0.622	0.490	0.788
	(1.410)	(1.238)	(0.881)
Short-term interest rate	0.373	0.168	0.0187
	(1.018)	(0.451)	(0.0170)
Constant	0.0214	0.0791	0.0351
	(0.409)	(1.553)	(0.567)
F test	9.91***	38.59***	
Adjusted R squared	0.0399	0.160	
Hausman p value	0.00***	0.00***	
Wald test p value			0.00***
Arellano-Bond AR(1)			0.00
Arellano-Bond AR(2)			0.71
Sargan statistic			0.00
Observations	18,570	18,570	18,061
Number of firms	0.0214	0.0791	0.0250

Robust t-statistics in parentheses. *** p<0.01, ** p<0.05, * p<0.1. The Sargan test result is unreliable here - as pointed out in Roodman (2009b) it is not infallible and cannot be relied on too faithfully. The Hansen test statistic is not reported here as it is not available in xtdpdsys – see discussion in section 2.3.3.3. To test for collinearity, the variance inflation factors were computed and were all less than 10. The definitions of the variables are set out in Table 3.8. Fixed effects (1) excludes the lagged value of the dependent variable as an explanatory variable but is included in Fixed effects (2).

The tests of hypotheses 4 and 5 essentially repeat the two regressions above (hypotheses 2 and 3 respectively) but gearing at the end of the year of the financing deficit is omitted as an explanatory variable. Hypotheses 4 and 5 are supported by the results.

Table 3.14 reports the results of the test of hypothesis 4 that changes in gearing in the year following the year of the financing deficit are negatively related to the change in gearing during the year of the financing deficit (which in the sample selected is positive). Here, it is not appropriate to include a further column of fixed effects results excluding the lagged value of the dependent variable since that is the subject of the hypothesis.

Table 3.14 confirms the hypothesised negative relationship between changes in gearing in the year following the deficit and changes in gearing in the deficit year: the coefficient of changes in gearing in the deficit year is negative and significant. This reversed the result in Table 3.12 where this coefficient was positive – the difference being the exclusion of gearing at the end of the year of the financing deficit (as an independent variable) which is negatively correlated with changes in gearing.

The coefficient of the market to book value ratio is negative under the fixed effects estimator and positive under system GMM. Here the two-year gap between the changes in gearing and the change in gearing in the deficit year is longer than in the previous hypotheses so the link between the dependent variable and the independent variables (with a lag of 2 years) is likely to be weakened.

These results are largely unexceptional except for the coefficient of abnormal earnings which is again negative as in Table 3.12, supporting the result there and suggesting that management appear to reduce gearing in the year after becoming aware of a pending upswing in earnings.

Of the variables representing debt market conditions, all are significant under one (or more) of the estimators and three of them are positive contrary to the expectation. However, this result does not impact on the hypothesis.

Table 3.14 Determinants of changes in gearing in the year after the year of the financing deficit

This table sets out the regression results of the change in gearing after the year in which the financing deficit is generated (dependent variable) against the variables in the left-hand column (hypothesis 4).

Variables	Fixed effects	System GMM
Change in net gearing in the deficit year	-0.287***	-0.0294*
	(-11.30)	(-1.945)
Change in net gearing in the year preceding the deficit year		-0.0484***
		(-3.604)
Market to book value ratio	-0.00463***	0.00280**
	(-2.882)	(1.972)
Regulation dummy	-	0.0867
		(1.451)
Abnormal earnings	-0.0112**	-0.00840**
	(-2.575)	(-2.471)
Fixed asset ratio	-0.187***	-0.0298
	(-5.020)	(-0.674)
Average asset life	7.84e-05**	-1.97e-05
	(2.133)	(-0.319)
Natural logarithm of size	0.0147***	-0.00242
	(4.256)	(-0.849)
Yield curve	-0.590*	-0.287
	(-1.787)	(-1.354)
Bond spread	0.520**	0.256*
	(2.106)	(1.751)
Inflation	0.260	0.326**
	(1.110)	(2.189)
Short-term interest rate	0.284	0.432**
	(0.959)	(2.310)
Constant	0.0447	0.0222
	(1.553)	(1.056)
F test	31.4***	
Adjusted R squared	0.045	
Hausman p value	0.00***	
Wald test p value		0.00***
Arellano-Bond AR(1)		0.00
Arellano-Bond AR(2)		0.88
Sargan statistic		0.00
Observations	32,435	16,297
Number of firms	9,719	6,797

Robust t-statistics in parentheses. *** p<0.01, ** p<0.05, * p<0.1. The Sargan test result is unreliable here - as pointed out in Roodman (2009b) it is not infallible and cannot be relied on too faithfully. The Hansen test statistic is not reported here as it is not available in xtdpdsys – see discussion in section 2.3.3.3. To test for collinearity, the variance inflation factors were computed and were all less than 10. The definitions of the variables are set out in Table 3.8.

Table 3.15 sets out the regression results for the test of hypothesis 5 that changes in gearing in the second year following the year of the financing deficit will be negatively related to the changes in gearing in the year of the financing deficit. The results support the hypothesis.

Here, a further column of fixed effects results has been included which contains a once-lagged value of the dependent variable (in addition to the twice-lagged value which is the subject of the test).

The results in Table 3.15 indicate that the coefficient of the change in gearing in the year of the financing deficit is negative and statistically significant (in fixed effects but not system GMM). The coefficient of the change in gearing in the year following the year of the financing deficit is also negative and statistically significant (in both fixed effects and system GMM).

The coefficient of the market to book value ratio is negative and significant under the fixed effects estimator but positive and significant under the system GMM estimator.

Few of the other control variables provide statistically significant coefficients except for the average asset life which is positive but very small and economically insignificant. Several of the variables representing debt market conditions have positive and significant coefficients as in Table 3.14.

These results provide support for the idea that companies use short-term increases in gearing to finance investment and that such increases are reduced at least in part in the following two-year period. This is consistent with the idea of using bridge financing to manage problems of information asymmetry. To be able to use bridge financing or other short-term financing, a company needs to be able to borrow sufficient to make the investment financed entirely with debt which suggests a conservative capital structure. Such a capital structure would not be consistent with the trade-off theory which includes only tax and distress costs in the trade-off equilibrium.

This conservative approach is consistent with results such as Opler, Pinkowitz, Stulz and Williamson (1999) where firms that do not have the greatest access to capital (such as large firms and those with a credit rating which have ready access) hold higher ratios of cash (in proportion to total assets). Such companies are managing their capital structure and access to capital in a way that reflects their need to be able to continue investing.

Table 3.15 Determinants of changes in gearing in the second year succeeding the year of the financing deficit

This table sets out the regression results of the change in gearing in the second year after the year in which the financing deficit is generated (dependent variable) against the variables in the left-hand column (hypothesis 5).

Variables	Fixed effects (1)	Fixed effects (2)	System GMM
Change in gearing in the year after the deficit year		-0.255***	-0.154***
		(-14.58)	(-5.461)
Change in gearing in the year of the deficit	-0.209***	-0.287***	-0.0285
	(-7.764)	(-11.35)	(-1.151)
Market to book value ratio	-0.000432	-0.00190	0.00146
	(-0.262)	(-1.146)	(0.748)
Regulation dummy	-	-	(-1.151)
			-0.0237
Abnormal earnings	-0.00428	-0.00669	0.00435
	(-0.909)	(-1.511)	(1.103)
Fixed asset ratio	-0.0293	-0.0777**	-0.0466
	(-0.798)	(-2.093)	(-1.059)
Average asset life	9.54e-05**	0.000114**	7.09e-06
	(2.189)	(2.437)	(0.123)
Natural logarithm of size	0.00305	0.00740**	-1.03e-05
	(0.842)	(1.984)	(-0.00287)
Commercial paper dummy	-0.00532	-0.0105	-0.0129
	(-0.834)	(-1.612)	(-0.966)
Yield curve	-0.388	-0.404	-0.440*
	(-1.138)	(-1.210)	(-1.806)
Bond spread	0.150	0.267	0.273*
	(0.558)	(1.011)	(1.772)
Inflation	0.524*	0.651**	-0.266
	(1.660)	(2.186)	(-1.311)
Short-term interest rate	0.235	0.413	0.0502
	(0.952)	(1.622)	(0.282)
Constant	0.0286	0.0322	0.0318
	(0.917)	(1.031)	(1.221)
F test	7.59***	29.5***	
Adjusted R squared	0.019	0.0815	
Hausman p value	0.00***	0.00***	
Wald test p value			0.00***
Arellano-Bond AR(1)			0.00
Arellano-Bond AR(2)			0.19
Sargan statistic			0.00
Observations	28,212	28,212	15,514
Number of firms	8,565	8,565	6,413

Robust t-statistics in parentheses. *** p<0.01, ** p<0.05, * p<0.1. The Sargan test result is unreliable here - as pointed out in Roodman (2009b) it is not infallible and cannot be relied on too faithfully. The Hansen test statistic is not reported here as it is not available in xtdpdsys – see discussion in section 2.3.3.3. To test for collinearity, the variance inflation factors were computed and were all less than 10. The definitions of the variables are set out in Table 3.8. Fixed effects (1) excluded the lagged value of the dependent variable as an explanatory variable but is included in Fixed effects (2).

3.6 Conclusions

The contributions identified in this Chapter are listed at the beginning of this Chapter and in Chapter 1. Here, the main findings are presented more briefly with more emphasis on the empirical tests conducted.

The key contribution is to show i) that transfers in value from debt-holders is not sustainable as a strategy since debt investors will react to a strategy that seek to disadvantage them by demanding either higher returns or greater restrictions on the company or both; and ii) that information asymmetry that restricts the issue of new shares (at a price that represents an under-valuation) can be managed by using a number of alternatives to conventional debt such as bridge financing in a way that removes the rationale for the pecking order theory. This result is supported empirically.

It is also shown that the over-investment problem is the converse of the under-investment problem in the sense that under-investment can occur because of the possible transfer of value from shareholders to debt-holders and that over-investment can occur where the reverse transfer (from debt-holders to shareholders) can subsidise a negative present value investment opportunity.

One of the methods proposed in Chapter 2 to reverse or recapture a transfer of value (from shareholders to debt-holders) is to increase gearing after investment in a way that reduces the value of pre-investment debt. This creates a transfer of value that if it were large enough could create the circumstances of the over-investment problem.

This is a simple way of creating the circumstances of the over-investment problem without resorting to asset substitution as in Jensen and Meckling (1976).

This suggests that a strategy that companies should pursue to maximise shareholder value is to implement value transfers from debt-holders to shareholders. However, it is demonstrated by a simple experiment that investors will be able to detect such behaviour and will respond appropriately. Investors learn about the behaviour of management that seeks to deceive investors as in the experiment performed to test the ability of subjects (Masters students) to learn about the veracity of statements made by management. There is clear evidence of learning – the subjects identify the behaviour of management teams seeking to mislead investors and respond appropriately.

This reaction will not be beneficial for the company or its shareholders. It might restrict access to debt and such restriction might represent a serious competitive disadvantage – this is not in the interests of management where there are advantages for managers associated with being able to raise debt easily and cheaply to compete as buyers in competitive auctions for the sale of companies. These advantages are discussed more fully in Chapter 4. There is also the possibility that debt investors seek a higher rate of return for the perceived risk.

Given such advantages, it is unlikely that companies will adopt a policy to deceive debt investors. Indeed, this analysis suggests that the companies should take steps to assure debt investors of their intentions to respect their rights and to protect their investment so that the cost of debt is minimised and a good way to achieve this is with a policy that maintains a stable capital structure with only temporary deviations from such a policy. Managers should adopt a policy of signalling to investors their intention to behave in a way that prejudices neither debt-holders nor shareholders. This will reduce the risk of debt investors seeking a premium cost of debt to compensate for any perceived risk of value transfers.

The technique of deceiving the debt investors is an example of information asymmetry – the problem that motivates the pecking order theory. The preference implied in the pecking order theory is that management are unwilling to issue shares at a time when the issue price of the shares does not reflect the management's view of their value. To avoid this problem, the pecking order theory suggests that the company will prefer to finance with debt.

This Chapter identifies one group of companies for whom new issues of equity are not needed other than for acquisitions: these are the self-sustaining companies. It could be argued that such companies provide evidence for the pecking order theory in that they make no equity issues and are self-sustaining in terms of generating capital for investment without the need to issue equity. No problems of information asymmetry arise as these companies simply have modest requirements for new capital which is the direct consequence of modest growth and that such requirements can be satisfied by a combination of retained profits and increased debt (generated by increases in retained profits and at the same time) without increasing overall gearing. A simple model demonstrates that given some basic assumptions, modest growth rates can be sustained without raising new equity. These companies are labelled self-sustainers – they can develop without requiring access to equity although that might be needed for large investments such as acquisitions. The absence of a need for equity does not provide support for the pecking order theory since their capital structure policy is to maintain a constant ratio of debt to equity.

Solutions are presented that are alternatives to the debt solution proposed in Myers and Majluf (1984). These solutions include the use of debt financing on a short-term bridge basis – i.e. to enable the investment to be pursued prior to resolution of the information asymmetry that would damage the interests of the company: there is an overlap between this solution and the pecking order prediction for a preference for debt over equity since the bridge finance option involves using debt. However, in the solution proposed, bridge financing is temporary with the objective of refinancing at a time when the information asymmetry problem has been resolved.

The solutions proposed resolve the problems raised in the justification for the pecking order theory and allow the company to pursue capital structure choices in an unconstrained manner subject to one qualification. If a company wishes to have the option to use bridge financing when faced with a situation of information asymmetry, then it must have a balance sheet that can support the amount of debt that might be envisaged in such an investment opportunity or acquisition. This provides an explanation for capital structure that does not exploit to the full the potential to reduce tax by maximising interest payments. A conservative balance sheet is needed to provide a platform for substantial short-term debt financing.

This analysis shows that the motivation for the pecking order theory of capital structure is limited to a preference for short-term bridge financing (as one of several possible financing solutions). The company is free to pursue any long-term capital structure policy without any preference for debt over equity or vice versa.

This Chapter also reports empirical results for a sample of companies with both positive financing deficits and increases in gearing (in the same year). These results document changes in gearing in the years following the year of the financing deficit. The results indicate that in each of the two years following the year of the financing deficit, there are reductions in gearing. This suggests that such companies are adopting increases in gearing in the year when the financing deficit arises but that such increases are temporary as there are reductions in each of the two following years.

This supports the idea that companies use short-term bridging finance which is then refinanced. This is consistent with one of the solutions proposed to manage information asymmetry. The solutions proposed to manage information asymmetry and the empirical results obviate the need for the pecking order explanation of capital structure.

Appendix to Chapter 3: Derivation of the expression for the rate of growth of a self-sustaining capital structure

Derivation of the growth rate formula for self-sustainers (companies that can finance their growth by maintaining a constant capital structure and generating additional capital from retained profits and additional debt that is associated with the retained profits by maintaining a constant gearing ratio. The self-sustaining growth rate is given by the following formula:

$$(1\text{-}Po).(WACC – Kd(1 – t).G)/(1\text{-}G)$$

Where:

WACC = weighted average cost of capital;

Po = pay-out ratio to equity holders;

t = corporate tax rate;

G = gearing based on market values;

Kd = cost of debt; and, for convenience in the manipulation of expressions, let EV = enterprise value (sum of the market value of debt and equity).

Income after tax but before interest will be given by the product of the enterprise value and the weighted average cost of capital = EV x WACC. The interest cost will be given by the product of the amount of debt (itself the product of the enterprise value and the gearing) and the interest rate which net of tax will amount to: EV.G.Kd.(1-t). Hence the net income to equity holders is given by: total income less the net of tax cost of interest = EV.WACC – EV.G.Kd.(1-t) =

$$EV.(WACC - G.Kd.(1\text{-}t))$$

If it is assumed that a proportion Po of the net profits are paid out as dividend, then the amount retained will be given by:

(1 – Po).EV.(WACC - G.Kd.(1-t)).

This amount will generate some additional debt such that the additional debt maintains the same gearing ratio as the pre-investment gearing ratio. If the additional debt so generated amounts to ΔD then the gearing ratio calculated by reference to the new investment will be additional debt/(additional debt + retained profits) = G which can be expressed as:

ΔD/(ΔD + retained profits) = G which is easily reorganised to give:

ΔD = retained profits.G/(1 – G)

and the total amount invested will be given by:

ΔD + retained profits = retained profits.(1 + G/(1 – G)) = retained profits/(1 – G)

Hence the incremental gross profits in the year following the year in which the retained profits are generated will be the additional amounts earned on the new investment (the product of WACC and the incremental investment) which will be:

WACC.retained profits/(1 – G)

and the growth rate will be the incremental profits divided by the previous year's gross income which is EV.WACC

Hence growth is given by:

(WACC x (1 – Po).EV.(WACC – G.Kd.(1-t))/(1 – G))(EV.WACC) which simplifies to the expression above.

Growth in the equity income will be given by the same formula.

CHAPTER 4 A STRATEGIC APPROACH TO CAPITAL STRUCTURE

4.1 Introduction

In this Chapter, the impact of the personal objectives of managers on capital structure decisions is examined including strategic considerations such as the relevant position of the company in relation to the structure of competitors in the sector in which the company operates and the feasibility of growing by acquisition. The title of this Chapter refers to the impact on capital structure of a desire by management to be able to make acquisitions. Managers have an interest in expanding by acquisition which is facilitated by a conservative balance sheet.

The research question addressed in this chapter investigates how the ambitions of managers to grow their company by acquisition impact on the decisions they take regarding their choice of capital structure. In particular, the impact of the competitive structure or degree of concentration of the sector in which a company operates on a company's capital structure is examined.

The conclusions of Chapter 2 suggest that transfers of value from shareholders to debt-holders can be reversed by subsequent adjustments to capital structure. But in Chapter 3, it was shown that transfers from debt-holders to shareholders could lead to investors requiring higher returns for the risk which would increase the company's cost of debt. To avoid such an outcome, companies can adopt a capital structure policy that aims to maintain a constant gearing ratio. Such a policy addresses agency costs but provides no guidance as to the level at which the constant gearing ratio should be set.

The analysis in Chapter 3 in relation to asymmetric information problems identified several techniques to manage this problem one of which is the use of bridge financing thus providing no support for the pecking order theory. Bridge financing requires a balance sheet with unused borrowing capacity – reserve borrowing capacity. This strategy does provide some guidance on the level at which the gearing ratio should be set. This suggests that companies should not be aiming at the gearing level implied by the trade-off theory.

This Chapter extends the rationale for companies to maintain reserve borrowing capacity by considering a company's interest in being able to acquire other companies. It is shown that managers have an incentive to pursue acquisitive growth strategies as this has two important benefits: first, an expanding company pays expanding salaries and other personal benefits: Conyon and Murphy (2000) document a positive relationship between company size and the compensation of the chief executive officer; and secondly, by acquiring other companies and expanding, managers reduce the chances of their employing company being acquired and thereby reduce the risk of career damaging events associated with being an acquisition target of a larger company and becoming a source of cost-cutting after acquisition.

There is a further benefit for chief executive officers as they are usually paid a cash bonus for completing an acquisition transaction as reported in Grinstein and Hribar (2004).

Management interest in expanding or empire building is not necessarily beneficial for shareholders. There is evidence that acquisitions do not always generate positive returns for the acquirer's shareholders: Moeller, Schlingemann and Stulz (2003), identify substantial negative announcement returns and substantial losses for large acquiring firms, especially for acquisitions occurring after 1997.

A strategy to grow by acquisition is facilitated by reserve borrowing power enabling the company to use bridge financing in an acquisition scenario. This strategy avoids the risk of being unable to make an equity issue (either at all or quickly enough) at the time of an acquisition or finding that at the time of acquisition, a competitor company without the need to issue equity can appear to be a more desirable suitor for the target company and thereby reduce the chances of success for a company needing to issue shares.

This approach implies that capital structure is it not solely a question of balancing tax shelter against financial distress costs as in the trade-off theory. The capital structure decision is more complex and involves several additional considerations including the relative strategic position of the company within the sector in which it operates as well as the personal objectives of managers who have an interest in growing the scale of the company by acquisition which can be facilitated by a capital structure that supports bridge financing and hence requires reserve borrowing capacity (the ability to increase borrowings significantly for a short-term period until refinancing can be completed).

The incremental contributions of this Chapter show that:

- management have an incentive to engage in empire building for two reasons: first, a bigger company leads to bigger remuneration; and secondly, growing larger reduces the risk of becoming a target for a competitor that grows faster (with the downside of management of the acquired company becoming a cost saving with obvious implications for personal welfare);

- to be successful in making acquisitions, buyers must compete with other potential purchasers: this process is facilitated by a balance sheet that can provide financing for acquisitions easily and quickly. Bridge financing (described in Chapter 3 as a tool to manage problems with asymmetric information) can be deployed quickly to finance acquisitions providing the balance sheet is sufficiently conservative to support the debt;

- company gearing will reflect a company's acquisition ambitions and the availability of opportunities in the sector in which it operates: so, in a highly fragmented sector, company gearing is likely to be low to provide the platform to launch acquisitions and vice versa;

- thus, company gearing is related to measures of concentration of other companies in the sector in which it operates. This is a factor that is external to the company but affects its decisions about capital structure. This provides an additional factor that explains capital structure decisions. A measure of concentration is developed to assess the ability of a company to finance acquisitions which combines size and balance sheet – the firepower index – derived from the Hirschman-Herfindahl index;

- the hypothesised relationship is tested empirically using firepower (and more conventional measures of concentration using market values and sales) and both gearing and relative gearing (gearing relative to the other companies in the sector). The results provide support for the hypothesised positive relationship between company gearing (and relative gearing) and the firepower measure of concentration in the sector in which the company operates.

Section 2 discusses the impact of the following strategic factors on capital structure decisions: liquidity; flexibility; acquisitions; management remuneration and personal objectives; and competition. In section 3 a particular strategic factor, firepower, is developed. Firepower is a measure that seeks to combine the impact of the relative market power and financial power of the companies operating in a sector. It is based on the Hirschman-Herfindahl (HH) measure of concentration and is calculated using a measure that incorporates both the company's size and its capital structure (this is the best measure of firepower). HH measures are also calculated using market values and market shares. Conclusions are in section 4.

4.2 Strategic advantages of debt

4.2.1 Literature review

Frank and Goyal (2008) ask why debt was used prior to the introduction of corporation tax in the United States? Their question is simply that as tax shelter did not exist prior to the creation of corporation tax, why did companies borrow at all? This question suggests that tax is a major driver for borrowing as it generates a tax shield. Graham

(1996, 1996a, 1996b, 1999, 2000, 2003 and 2006) studies this problem in the context of marginal tax rates and concludes that companies with high marginal tax rates tend to issue more debt – see also Graham and Tucker (2006).

However, Graham and Leary (2011) surveys empirical capital structure research and in respect of tax, highlight the problem that companies do not always use the amount of debt implied by the trade-off model. Even allowing for non-income statement items such as pension costs, capital expenditure or the exercise of stock options (see Shivdasani and Stefanescu (2010) and Graham, Lang and Shackleford (2005)), the incremental tax benefits of higher gearing appear to be substantial suggesting that debt and tax shelter is not being traded off against the costs of default. Similarly, Strebulaev and Yang (2012) document that between 1962 and 2009, on average 10.2% of large US firms have zero debt and almost 22% have less than 5% gearing (based on book values). These results imply that for at least some companies there is significant reserve borrowing capacity which is consistent with the idea of managing capital structure in a way that facilitates the availability of bridge financing and does not support the trade-off theory.

The negative relationship between profitability and gearing is also presented as evidence that does not support the trade-off model. Frank and Goyal (2015) describe this inverse relationship as a serious defect (for the trade-off model) and offer a simple explanation that when profitability rises, share prices rise and companies borrow to retire equity and vice versa thus generating the observed negative relationship.

Regardless of tax shelter, debt is very useful for managing liquidity. Cash flows are not predictable with precision. Therefore, a company needs to manage its cash flows with a margin for error. This safety margin could be financed by equity, but it would be costly. The problem with liquidity management is that the company needs a safety margin so access to cash must be available although it might not be used. If this safety margin were to be funded with equity, it would be necessary to pay the cost of equity for this capital for all time even if the cash were deposited in a bank. This would reduce the overall return earned by the company although it would also reduce risk. The deposit rate for these funds would not be as high as an investment made by the investor in a bond issued by the company or other comparable fixed income investment. The company would need to deposit surplus cash in a way which provided immediate access – as a result, the interest rate earned would not be high.

The problem the company needs to solve is to minimize the cost of financing variations in working capital requirements. As an alternative to bank deposits, the company could purchase treasury bills or other securities but to obtain immediate cash, sales of these securities would necessitate transaction costs and reduce the amount earned. It is more cost effective if the financing shortfall can be covered by bank finance or other capital market debt instruments than to employ equity capital for such a purpose. There is also a maturity impact. The expected period of the shortfall will also affect the company's decision as to how it should be covered. A permanent shortfall might need to be covered by equity capital but occasional shortfalls (such as working capital variations) can be more easily and efficiently accommodated using banking facilities with short-term maturities.

Debt and equity have important differences. Perhaps the most obvious is that debt must be repaid – it is not permanent capital as is equity capital. Debt can take on the characteristics of permanence if there is confidence that debt can be refinanced. If there is certainty that debt can always be replaced with new debt, then it could be reasonably regarded as permanent. But such certainty does not exist. There is always some risk associated with the refinancing of debt. This means that debt must be managed by companies in a manner that ensures that the refinancing risk is reasonable which can be achieved by a modest level of gearing that provides flexibility to the borrower.

One way to manage this risk is to spread maturities of debt over time. In this way, all a company's borrowings will not mature at a single point in time. This makes the refinancing task more easily achievable. By reducing the proportion of total debt that falls to be refinanced in any one year, the risk of a problem in the debt markets in any one year affecting the ability of the company to refinance is reduced. The actual spread of maturities selected will also depend on the nature of any funding shortfall expected over time. The diversification of debt maturities benefits lenders which are also exposed to refinancing risk and for the borrower also spreads interest rate risk over different maturities.

Warner (1977) points out that larger firms are less exposed to default risk and hence are likely to be able to borrow more and so have better access to debt capital. Faulkner and Petersen (2006) provide evidence that firms with better access to public debt markets generally have higher gearing ratios: they show that when they create a proxy for the company's access to debt markets (by attempting to measure its visibility to capital markets) that the inclusion of this proxy in the regression renders the size effect insignificant. This suggests that access is linked closely to size. So, access is enhanced by size and therefore growing a company by acquisition increases size and therefore access to debt markets which facilitates further acquisitions. This enhanced access is a further benefit to management of increased scale. Li, Carline and Farag (2016) report that larger and better performing firms are particularly likely to undertake repeat acquisitions.

For a highly geared company, an additional debt issue may not be easy to arrange – the contractual arrangements with existing lender might have to be renegotiated (to overcome limitations or restrictions in such agreements) or even refinanced in extreme cases. Here, monitoring by new lenders would be intense. But for a large lowly-geared company, large amounts of additional debt can usually be comfortably arranged.

A company wishing to maintain its ability to mount a significant acquisition at relatively short notice and without the complication of an equity issue would aim to ensure that it can arrange large debt facilities at short notice. The need to enter an acquisition auction and at the same time avoid possible difficulties with an equity issue timetable means that a company needs to maintain a balance sheet that provides a substantial margin of unused or reserve borrowing capacity. Uysal (2011) finds that firms that are more highly geared relative to their target gearing are less likely to make acquisitions and less likely to use cash. Uysal (2011) also documents that firms adjust their gearing more quickly when they are highly geared than when they have lower gearing and that high gearing is an impediment to making acquisitions.

The availability of cash to acquirers affects their acquisition strategy. Harford (1999) reports that cash-rich firms are more likely than others to attempt acquisitions and that acquisitions by cash-rich firms are followed by abnormal declines in operating performance. Bates (2005) examines companies that make sales of subsidiaries to investigate how the proceeds of sale are utilised and finds that such firms invest at a greater rate compared to an industry benchmark. The proceeds are more likely to be reinvested than distributed to shareholders allowing the firm to bypass external capital markets which would necessitate greater scrutiny. This suggests that access to capital is an important strategic factor in financing acquisitions.

Harford, Klasa and Walcott (2009) studies large acquisitions (at least 20 per cent of the size of the purchaser) and the impact on capital structure reporting that where the purchaser pays cash, that there is a significant increase in gearing beyond the estimated target gearing ratio. They also report that purchasers reduce this deviation from target in the years following acquisition and that more than 75 per cent of the deviation is reduced within 5 years of the acquisition. This behaviour is consistent with the argument presented here that to be able to make acquisitions, companies need to manage their capital structure strategically.

DeAngelo and DeAngelo (2007) construct a model that incorporates flexibility with long-run low levels of gearing where debt issues are temporary deviations from target to meet unanticipated investment needs explaining why profitable firms pay dividends and maintain low gearing despite the tax benefits of debt. A similar model is described in DeAngelo, DeAngelo and Whited (2011).

This strategic approach enables the company to finance an acquisition with debt at short notice by utilizing access to debt which is quick, and which may represent an advantage compared to a competitor. Financing in this way enables the company to refinance after completing the acquisition and such refinancing could then involve equity at a convenient time. Such an equity issue could return the company to its long run target capital structure which might include maintaining reserve or unused borrowing capacity. The lenders need to consider the refinancing risk which will be included in their assessment of the overall risks. Bridge finance for acquisitions is usually provided by a small group of banks on a short-term basis which makes the arrangement process efficient and fast avoiding the marketing of debt or equity securities to investors in the public markets.

Other evidence for increases in gearing around the time of acquisition includes Ghosh and Jain (2000) who report that the average gearing of the combined entity (post-merger) is greater than the gearing of the two companies prior to the merger. They suggest that this demonstrates an increase in debt capacity which is likely given the increase in size, but it also signifies the use of debt to make the acquisition to avoid problems of information asymmetry in a way that is consistent with the idea of using debt either temporarily or permanently.

Refinancing risk is considered by short-term lenders considering supplying bridge finance so the borrower’s ability to access longer term financing is important. A visit to the capital markets amounts to a monitoring event as described in Easterbook (1984) commenting on dividends and their impact. Capital market access is facilitated by companies being well known to e.g. bond investors. It is much easier to sell new bonds to investors who already know the company. So, it is helpful if a company is a regular issuer in the capital markets. The regular issue of bonds and other instruments can facilitate subsequent capital market activity. A further factor is that the arrangement of debt capital is made easier if the borrower has low gearing otherwise the arrangement of additional debt may not be so straightforward, and it may take longer to find the providers. Low gearing is important as additional debt can create a conflict with existing lenders for example in the contractual protections in the loan agreements such as negative pledges or other restrictions on further borrowing. Low levels of gearing are consistent with low levels of protections for lenders thus facilitating bridge financing: Billett, King and Mauer (2007) report that covenant protection increases with growth opportunities, debt maturity and gearing

For reserve borrowing capacity to be effective and therefore valuable, several requirements must be satisfied:

1. amount: sufficient to make a substantial acquisition (where "substantial" is measured in terms of the size of the company and in terms of the potential candidates for such an acquisition – possibly other companies in the sector);

2. speed: the reserve borrowing capacity should be easy to arrange – this is facilitated where credit quality of the new facilities would be good;

3. such additional facilities should be able to be arranged without causing any conflict with existing borrowing arrangements and loan covenants; and

4. it should be apparent to outsiders that such debt is readily available – so the balance sheet will provide the necessary signal and reassurance to vendors.

If a company had such reserve borrowing capacity, then it would be a potential purchaser should a company become available for acquisition. This is particularly important if that opportunity had strategic advantages and/or was available at an attractive price. For a different company in that sector without that reserve borrowing capacity – perhaps a company with much greater gearing – then it could be at a strategic disadvantage in terms of competing in the auction to buy the target. The more highly geared company would not be able to compete as strongly with the company with the reserve borrowing capacity. This disadvantage could be highly costly. Missing out on an opportunity to make a significant acquisition could affect the long-term value of the business and could affect management prospects significantly.

In summary, the ideal strategic position for a company is to have immediate or rapid access to substantial capital resources. Although the company usually can issue equity, access varies over time and may be constrained by issues of information asymmetry. Also, there are time constraints in that equity issues still take some time to arrange – more than for simple debt raising. As an alternative, the ability to fund a substantial acquisition entirely with debt with a view to subsequent refinancing (with debt and/or equity) can provide rapid access to capital without the uncertainty or time constraints associated with equity issues. It should also be borne in mind that acquisitions sometimes become available at times when trading is poor and equity markets are not in a condition to provide equity as readily as at other times. So, equity might not be available, or it might be available at a cost that the company considers too high. Hence at such times, debt, if it is available, is clearly a superior option. So, access to debt capital can be ensured when the company has low levels of gearing and the debt is provided in a way which does not impose onerous constraints (restrictive loan covenants) on the company's ability to pursue its strategic objectives.

This approach can be considered in terms of options – DeAngelo, DeAngelo and Whited (2011) consider the option to issue debt in their model of transitory debt. Where the company has access to substantial finance resources, it has an option to access capital that enables it to compete more effectively in the market place for opportunistic acquisitions or other investments. This is a valuable option. Such value could be computed by considering the possible additional value an acquisition might generate (the present value of synergies less the premium paid over the standalone value for the target) or the additional value that might accrue to managers via agency costs.

These considerations dictate a low gearing policy. The strategic approach requires there to be unused debt capacity. The bridge finance is debt, but this does not argue in favour of the pecking order theory since the bridge is constructed with refinancing in mind: the refinancing could be all debt, all equity or a combination and it could be arranged in stages over time as in Harford, Klasa and Walcott (2009).

The strategic approach also contradicts the trade-off theory as it implies that the balance sheet is under-geared as discussed above, see Shivdasani and Stefanescu (2010) and Graham, Lang and Shackleford (2005), in that it could support more debt (since it can support a bridge) that would generate further tax shelter implying also that the strategic advantages of the availability of the bridge finance option must be as valuable as the tax shelter foregone.

This approach to balance sheet management is perhaps more important at times when a sector has not yet reached maturity and when there are more acquisition opportunities. At sector maturity, there will still be acquisition opportunities but there are likely to be more during the earlier stages of sector consolidation. The stage of sector consolidation may affect the capital structure decision.

4.2.2 Personal motives of management

The pecking order and trade-off theories take no direct account of the personal objectives of management. The managers that are relevant are those individuals inside the company that control or influence policy decisions on capital structure – usually the most senior executives and directors. However, the arguments presented here apply to varying extents to other layers of management with influence.

Agency costs are associated with the role of managers who do not have identical interests to the shareholders – such managers are not significant shareholders. Jensen (1986a and 1986b) discusses the agency costs associated with free cash flow in the context of acquisitions. The differences in interests between managers and shareholders can impact on capital structure decisions. Jensen (1986b) mentions the use of debt in constraining such costs by committing the company to debt service but this is a solution under the control of those needing to be controlled. Low gearing will not provide the necessary control.

Guney and Ozkan (2005) report on the negative relationship between management share ownership and debt maturity. As they also report debt maturity as being highly correlated to gearing, there is an implied negative relationship between management ownership and gearing. Friend and Lang (1988) show that where managers have a degree of control (as defined as the managers having a shareholding above the median of 13%) then such companies tend to have lower book gearing ratios. This supports the hypothesis that shareholding managers prefer less gearing to more.

The remuneration and financial interests of managers is different to those of shareholders. This is acknowledged in the manner of structuring remuneration for non-shareholding managers. Share options are designed as an incentive for managers that aligns their interests more closely with the interests of shareholders. Similarly, annual bonuses linked to a performance metric such as earnings per share or growth in such parameters are intended to link management rewards to variables which enhance shareholder value. These arrangements attempt to close the gap between the interests of shareholders and the interests of managers that can otherwise give rise to agency costs.

However, the gap is not easy to close. While individual circumstances can vary, two types of manager can be considered. First, the manager with no direct or underlying financial interest in the company – i.e. only share options; and secondly, the manager with a significant shareholding in the company.

In the latter case, if the manager's shareholding represents a substantial proportion of his total wealth, perhaps because his shareholding arose because of building the business and so he has no other wealth, then from a portfolio risk management perspective, it would be sensible for that manager to adopt a low risk policy to manage his wealth. A large shareholding in a single stock has no diversification and spreading risk is difficult. An obvious strategy is to avoid introducing additional financial risk through gearing. The manager with a substantial investment in his employing company has an incentive to minimize financial risk to a level that compensates for the lack of diversification.

For the first group of managers, those without substantial shareholdings but with share options, the analysis is slightly different. If the share options are significantly valuable (e.g. deeply in the money) then the manager may take a view that is like the managers in the second group. But if the share options have yet to achieve value beyond their value at issue (say where the exercise price is close to the current share price) then the manager may consider the following analysis more appropriate. Suppose the manager's compensation package comprises those elements set out in the following Table. This is an illustration since individual remuneration packages vary. However, the approach can be applied to most remuneration packages.

Table 4.1 Welfare components for a manager with share options
This table sets out the benefits included in the compensation package for a manager with a description of the factors affecting the value of each component

Component of remuneration	Factors affecting component value
Share options: granted as a multiple of salary at the current share price	Granted over time with restrictions on vesting and exercise
Value of options based on an option pricing model taking account of volatility estimates, the term to exercise, and exercise price equal to the share price at issue, dividends and the risk-free rate	Option value = function of the exercise price, share price, volatility, term, dividend yield and the risk-free rate subject to restrictions on exercise
Pension benefits – to be received at a future date	Value is a function of current salary and prospects for future growth

The main components of the compensation packages that are available for the manager are set out in Table 4.1, above. The valuation of those benefits involves applying a suitable discount rate after making some assumptions about growth in salary. This analysis will also need to consider the risk of financial distress. For a given level of salary, lower risks of distress will increase the manager's welfare. If financial distress occurs, there may need to be a restructuring, or the company may be forced to accept a takeover to avoid financial distress later. In both situations, there could be career damage for managers leading to a loss of welfare.

The literature supports this argument: Gilson (1989) presents evidence showing that managers of financially distressed firms are more likely to lose their jobs and that such managers are not able to find new employment quickly in the three years after the event of distress. This is the perception that will encourage managers to prefer less gearing to more.

Also, managers view the loss of reputation or credibility as a significant financial blow. There is the loss of prestige, standing, social position etc. These are significant disadvantages which go beyond financial losses and are difficult to quantify. They provide more encouragement to the executive to prefer low gearing to high gearing. This is a behavioural issue and there is evidence that there are behavioural aspects influencing takeover activity. Roll (1986) developed the hubris hypothesis to explain the poor returns reported by acquirers (see Moeller, Schlingemann and Stulz (2003)). The explanation in Roll (1986) is that of overconfidence which was developed further in Malmendier and Tate (2005) in the context of corporate investment showing that managerial over-confidence leads to over-investment when they have abundant internal cash but curtail investment when they require external financing. This approach was extended to acquisitions in Malmendier and Tate (2008) where they report that over-confident managers pursued acquisitions that destroyed value and that such behaviour was facilitated by cash and untapped debt capacity.

These incentives are neatly summarised in the phrase “eat or be eaten” (see the title of Gorton, Kahl and Rosen (2009)).

The behavioural approach was extended in Aktas, de Bodt, Bollaert and Roll (2016) where narcissistic tendencies of the chief executive officer were linked to acquisition activity. Narcissism (measured as a function of the number of times the first person singular pronoun appears in speeches by the chief executive officer) although linked to overconfidence is different. They found that shareholders in the acquirer (with a narcissistic chief executive officer) reacted less favourably to takeover announcements suggesting a market perception equivalent to over-confidence: they also found that narcissistic chief executive officers are also marginally more likely to initiate deals.

The discussion above has been aimed at full-time managers. There are non-executive or independent directors present on company boards with a corporate governance role. These individuals do not have any interest in recommending increasing gearing if it puts the company at higher risk of financial distress. The independent directors have no shares and their remuneration is not linked to the company performance (by share options or bonuses). Their objectives will be to avoid risk and so they will not be uncomfortable with modest levels of gearing. Kolasinski and Li (2013) provide evidence that the presence of strong and independent boards helps constrain the enthusiasm of over-confident chief executive officers when making acquisition decisions.

Employees clearly prefer less gearing to more as less financial risk avoids risking their jobs. The influence of employees on the capital structure decision is much weaker than that of managers unless there is collective action or pressure that can be brought to bear.

The arguments above demonstrate that executives should prefer less gearing to more. But the analysis needs to include the impact of acquisitions on the managers' utility. The scope for consolidation within a sector depends on several factors including the stage of development reached. In the early years of development within a sector, consolidation is more likely but slows as maturity is reached. The process of consolidation can impact on managers' welfare directly.

If a company has the resources to make acquisitions, then it is more likely to grow faster than those companies unable to compete in the market for corporate control. There are two important consequences for managers: first, when acquisitions occur, the acquirer gets bigger and so the responsibilities of the managers also increase as do their salaries and hence their eligibility for further share option entitlements. Also, by increasing in size, the company increases its prospects of generating synergies and the greater scale makes further progress and acquisitions more likely.

Secondly, for those companies that are less able to make acquisitions because of a restricted balance sheet caused by higher gearing, they may become targets of acquirers. For the manager of such a company, being taken over may generate some value in terms of share options but it may also lead to being part of the cost savings that generate value for the acquirer. Managers in the target company may get fired. So, there are some negative aspects for the managers of those companies that are at greater risk of acquisitive action. They may suffer career damage as has already been argued. Aktas, de Bodt, Bollaert and Roll (2016) report that acquisition targets with narcissistic chief executive officers secure higher bid premia suggesting that such managers demand extra compensation for the damage to their ego associated with a loss of control.

Managers must also consider the impact of competition in the marketplace between companies and its impact on their personal position. If a company chooses to adopt an aggressive pricing strategy or increases competition in other ways, those companies with stronger balance sheets are better able to withstand such action and so the managers' utility will be greater. To the extent that such action can damage another company, the managers in that other company will suffer a loss of personal utility whereas the company causing the damage will be strengthened by the weakening of a competitor and so its managers will also benefit.

Another way to express this is that managers prefer to work in larger companies or companies that can get larger rather than in small companies that may exist only to make large companies larger.

The effects of these factors are summarised in Table 4.2.

Table 4.2 Comparative analysis of management utility or welfare
This table sets out a comparison of the benefits or welfare factors for managers employed by non-large companies with higher gearing than a large company with lower gearing. The comparison covers benefits such as: salary, share options, continuity of employment, pensions, risk of financial distress, risk of takeover, and benefits of takeover. The analysis compares the benefits in relative terms rather than absolute terms: so "less" means less than in the other column and similarly for "more".

Welfare factor for managers	Non-large company with higher gearing	Large company with lower gearing
Net present value of salary and pensions	Less	The same salary would be more valuable in this company type because the risk of financial distress would be less but in any case, the salary would likely be higher
Share option value	?	?
Ability to make acquisitions (and so increase salary, pension and option value)	Less	More
Likelihood of avoiding risk of takeover and damage to income	Less	More
Likelihood of avoiding damage to income through competition	Less	More
Ability to improve company and personal prospects through competitive success against smaller companies	Less	More
Risk of financial distress	More	Less

In only one respect does the higher gearing/smaller company combination produce a benefit for managers that is not obviously worse than in the lesser gearing/larger company. That exception relates to the value of the share options. Here, an argument could be made that for more highly geared companies, the equity volatility will be greater than for the larger but lowlier geared company all other things being equal.

So, share options could be more valuable ignoring other factors such as the extra risk of distress that would not support greater value. However, the manager will need to trade off extra option value against the welfare loss associated with greater financial distress risk. Sharpe (1994) and Hanka (1998) show that firms with higher gearing tend to pay lower wages and provide fewer pension benefits and less job security in downturns. This does not directly address the issue of the trade-off between option value and non-option value, but it does explain clearly that there is a reduction in welfare associated with the higher levels of gearing.

Share options do not usually vest immediately – they are granted over time and can only be exercised within a delayed time frame. This is likely to encourage the manager to take a longer-term view that matches the vesting timetable. While increased gearing can increase volatility (and hence the option value) there will be increased financial distress risks associated with the extended time frame of option exercise that mitigate these advantages.

Harford and Li (2007) report that even in acquisitions where shareholders in the purchaser are worse off, the chief executive officers are better off in 75 per cent of cases examined. This supports that argument that company management benefits from an active programme of acquisitions.

Other corporate objectives such as the need to maintain flexibility dictate a high level of conservatism. This objective coincides with the objective of executives to avoid unnecessary financial risk. The conclusion is that managers prefer less risk and hence a conservative capital structure that will facilitate acquisitions.

Morellec and Zhdanov (2008) develop a model in which the bidder with the lowest gearing wins the takeover contest which they compare with actual transactions confirming that successful bidders are under-geared by about 6-7%.

4.2.3 Other stakeholders

Managers will assess the employment risk they face on a personal level. They are in effect a supplier of services to the company. Other suppliers and customers (and other stakeholders) will also take a view on the risk associated with doing business with that company. Such stakeholders are likely to prefer lower counterparty risk to higher.

Banerjee, Kim and Dasgupta (2008) study companies that have important dependent relationships with suppliers or customers. In their study, “dependent” relationships between a customer and supplier arise where sales to the customer are more than 10% of the supplier’s total sales. For both customer and supplier in such an arrangement there are significant risks. Banerjee, Kim and Dasgupta (2008) find that i) where dependent relationships exist, both customers and suppliers tend to have lower debt ratios than companies without dependent relationships; ii) both relationships hold only for the durables sector; and iii) are strongest for small firms – which are of course poorer credit risks by virtue of their size.

Kale and Shahrur (2007) find that a firm’s gearing is reduced then it has entered into either a strategic alliance or joint venture with its suppliers or customers. Here they are defining a dependent relationship in terms of the presence of a close link with a customer or supplier. This supports the argument that a company's capital structure can affect relationships with both customers and suppliers and that decisions about gearing need to be taken in the context of the impact on all stakeholders. Kale and Shahrur (2007) also note that a company's gearing is lower when its customers operate in industries that have high research and development activities: such companies are poorer credit risks than companies with less research and development spending since their investment may be wasteful. This provides a further insight into the capital structure decision – the credit risk associated with suppliers and customers is an important input into the capital structure decision.

A weakening of the balance sheet may put the company at a competitive disadvantage that may adversely affect the company's development. The company may lose out on a significant investment opportunity. A range of adverse consequences could occur prior to formal financial distress. The managers would seek to avoid such problems to avoid any personal consequences.

4.2.4 Leveraged buy-outs as a counter example

Leveraged buy-outs provide a useful counter example. Such companies are financed with the maximum amount of debt that banks are willing to advance. The leveraged buy-out capital structure is quite different to that of a listed company. Axelson, Jenkinson, Strömberg and Weisbach (2013) report that leverage in large international deals is unrelated to factors suggested by traditional theories of capital structure (such as profitability, earnings volatility or growth opportunities) but rather it is prevailing conditions in the debt markets that explains gearing best: they find no relationship between gearing prior to buy-out and gearing post buy-out.

The leveraged buy-out capital structure is not consistent with the analysis above where it is argued that management prefer lower gearing to achieve personal welfare enhancement. The choice of capital structure is the prerogative of the buy-out investor rather than the management team.

These two different approaches to capital structure can be rationalised. The management incentive structures in place in leveraged buy-outs are quite different to those in a conventional listed company. The objective of a leveraged buy-out business plan normally includes achieving an exit within 5 years. This is usually arranged by selling the company which may involve a change of management and so the managers may be fired. Also, in the period until the investor exits, acquisitions are unlikely (although not impossible) – this is because of the lack of availability of additional finance (debt or equity).

This plan is quite different to that of a conventional listed company. However, in the leveraged buy-out company, managers are rewarded with substantial equity participation which compensates them in a way that enables them to accept the relatively short time horizon and the prospect of being replaced at the exit event with the need at that time to seek new employment. The equity benefits provided to managers in a buy-out are substantial and compensate them for what they would otherwise get as managers in a listed company. Mao and Renneboog (2013) report negative earnings manipulation ahead of management buy-outs and that this is much more likely than is the case for leveraged buy-outs (where incumbent management are less likely to be involved as equity participants). This finding demonstrates the interest of management in seeking a low entry price which will enhance the value of their equity participation.

In the leveraged buy-out company, management prefer high gearing because higher gearing contributes to their equity reward when the investor exits successfully. Managers readily trade-off the substantial equity rewards against the loss of personal welfare that derives from the lack of opportunity to expand the company significantly by acquisition and the possibility of being fired at the exit event.

The difference in incentive structure reinforces the argument that the personal welfare objectives of managers affect capital structure.

The leveraged buy-out example provides a comment on the trade-off theory. For the leveraged buy-out, debt is maximized. It is likely to be a good example of the trade-off between financial distress risk and tax shelter being optimized. The point of equilibrium is simply the point at which no more debt is available. This capital structure is very different to that of a listed company so clearly the capital structure of the listed company does not support the trade-off theory.

An interesting and relevant example is the acquisition of the British high street cosmetic and pharmaceutical retailer, Boots, by Kohlberg Kravis Roberts in the summer of 2007. Before the transaction, Boots had a total enterprise value of around £9 billion of which around £1 billion was debt. The company was purchased at a premium of 40% for around £13 billion of which £9 billion was debt (described in more detail in Slaughter and May (2007)). It is easy to see that the balance sheet of Boots could have supported more debt and that more tax shelter would have been generated.

Leveraged buy-out capital structures support the trade-off theory and, because of their management remuneration arrangements, explain why managers in listed companies do not follow the trade-off theory but opt for low risk balance sheets.

4.3 The effect of market concentration on gearing

4.3.1 Capital structure and competition

The above analysis suggests that management are incentivised to make acquisitions and that this is facilitated by low levels of gearing. The feasibility of acquisitions will be affected by the structure of the competitive landscape and the other competitor companies within a sector.

Capital structure is also influenced by competition within a sector. Graham and Harvey (2001) show almost 25% of companies surveyed identified the behaviour of competitors as an important factor in their financial decisions.

Companies with strong market positions combined with strong capital structures enable them to compete more effectively against smaller and more highly geared companies. Such companies (with stronger market and financial positions) will be the most likely acquirers of smaller companies.

The competitive landscape is also recognised by lenders as they prefer to lend to those companies with a competitive edge rather than lend to companies faced with strong competitors.

A strong balance sheet also provides support should the larger companies wish to promote competition by aggressive pricing. A strong balance sheet will enable a company to withstand better any adverse consequences arising from pressure on margins due to price competition. But competition could take other forms. Companies with stronger balance sheets might offer longer credit terms to customers – this would put pressure on those companies with weaker balance sheets less able to provide improved credit terms to their customers.

The smaller companies are less likely to need a balance sheet that should enable them to make acquisitions as they are less likely to be able to compete in the market for corporate control.

The threat of such pressure (actual or potential) should encourage smaller companies to select capital structures that can enable them to survive such competitive pressure. However, for some of the smaller companies, the need to make acquisitions will not be as significant as they may accept that they are more likely to be acquired than to be an acquirer. Such companies will nevertheless need to manage their capital structure in a way that does not put them at a disadvantage as regards their competitors (particularly the larger companies who are potential aggressors either by acquisition or by competitive threat in the marketplace).

Studies of capital structure have included industry effects (usually an industry dummy) in an attempt to distinguish differing characteristics. These studies (such as MacKay and Phillips (2005) generally compare company gearing with sector gearing. Parsons and Titman (2008) point out that measures such as profitability or size do not consider the presence of a predator or, more generally, the industry or sector structure and hence the nature and extent of competition in the sector.

It is already established that gearing is very stable over time. Lemmon, Roberts and Zender (2008) show that a firm's lagged gearing ratio (in some cases, lagged by up to 15 years) is a highly significant determinant of its current gearing ratio. However, at the same time, there are changes that occur within an industry. Hovakimian, Opler and Titman (2001) show that companies adjust their gearing ratios towards the industry median gearing ratio. This demonstrates that companies that have gearing ratios that are out of line with competitors tend to revert to the industry norm thus supporting the observation that companies tend to have long run stable gearing ratios. When a company's gearing ratio is higher than competitors, they may be at a competitive disadvantage so returning to a similar level of gearing reduces the impact of such a disadvantage.

Mimicking sector gearing is also consistent with signalling in that bad companies copy good companies which includes copying their policy on gearing.

MacKay and Phillips (2005) analyse movements within an industry observing that companies within the bottom quintile of gearing ratios adjust their gearing only when other companies within the same quintile make adjustments. This suggests that companies' capital structure decisions are influenced by the capital structure decisions of other companies in their industry.

The MacKay and Phillips (2005) study also highlights differences in gearing within an industry despite the general stability of gearing within an industry as observed in Hovakimian, Opler and Titman (2001).

Almazan and Molina (2005) studied dispersion in gearing ratios finding that concentrated industries and those where leasing is intense exhibit greater variations in gearing within the sector: they also identify similar dispersion in industries where incentive compensation is used less, where there are more insiders on the boards, are older and have larger capital expenditures.

This suggests that there is more dispersion in gearing ratios in mature industries and hence that there is less dispersion in less mature industries that are still consolidating. This could suggest that relative gearing is less (more) important in industries that are mature (not yet mature).

Studies of changes in capital structure also provide insights into industry effects and the interaction of capital structure with competition. Phillips (1995) examined how sharp increases in gearing affect pricing and production decisions in four industries. The sharp increases in gearing were triggered by leveraged buy-outs. The study examined output prices and quantities and the results indicated that debt positively influenced product prices and negatively affected output (with one exception).

Kovenock and Phillips (1997) extended this approach by examining how leveraged recapitalizations (a refinancing of an existing leveraged buy-out) affected company investment and plant closure decisions. They find that after recapitalisations, firms in concentrated industries are more likely to close production facilities and less likely to invest whereas for the rival firms the opposite is true particularly when the recapitalised business has a large market share (which is a common characteristic of leveraged buy-out investments). This result is in line with the investment philosophy of leveraged buy-out investors: their strategy is to trim off marginal production where that production is not sufficiently profitable and to retreat to the profitable core. This can be achieved by some closures and that may trigger competitors to compete for those marginal sales opportunities. This supports the idea that there can be an interaction between capital structure and the competitive structure within a sector.

Chevalier (1995a, 1995b) and Chevalier and Scharfstein (1996) studied leveraged buy-outs in the supermarket sector. They make several observations: first, that the buy-out tended to soften competition. This was reflected in a rise in the share price of rival companies around the time of the announcement of the transaction. However, this price movement might simply reflect the information content in the announcement of the actual buy-out investment. Secondly, they find that supermarket prices go up when a company that is competing with highly leveraged rivals itself undertakes a leveraged buy-out. This is the obvious strategy for such companies. However, where there is a single large competitor with very little debt, product prices were observed to decline. This shows that companies can modify their strategy in ways that seek to exploit a relative weakness arising from a capital structure decision of a competitor.

Dasgupta and Titman (1998) and Faure-Grimaud (2000) developed models to predict that under both Cournot and Bertrand type competition, gearing will encourage a company to engage in softer competition. These two types of competition predict different competitive responses. Softer competition induces the rivals in a Cournot market to increase output (because the products are strategic substitutes) whereas in a Bertrand market, rivals would increase prices (because the products are strategic complements).

de Jong, Nguyen and van Dijk (2008) examined market share and capital structure. They argued that a levered company in a Cournot market would suffer a reduced market share but that there would be no clear impact on a levered firm in a Bertrand market. Competition type is measured by the competitive strategy measure (CSM) developed originally by Sundaram, John and John (1996). The CSM is the correlation between the change in a company's profit margin and the change in the competitors' output. They measure market share using the Hirschman-Herfindahl index. Describing their results, the authors claim that in Bertrand/Cournot competition, leverage positively/negatively affects market share.

Leary and Roberts (2014) show that within a sector, corporate financial policies are highly interdependent and that smaller more financially constrained firms are more likely to mimic their peers.

These studies suggest that the competitive situation within a sector can impact upon a company's capital structure decisions. In one sense, the degree of concentration in a sector is a measure of the stage reached by the sector in its life cycle or development.

There are two factors that affect the extent of competitive threat: first, the degree of market power; and secondly, the degree of financial power – the ability to use debt finance to make acquisitions and to withstand (or promote) aggressive price competition.

These factors could be described as a company's competitive threat within a market sector. Of course, not all competitive factors are included here – for example, companies with products that have competitive advantages are not specifically included although company size tends to be associated with greater investment in research and development and so company size will tend to be a good proxy for many competitive factors including economies of scale which can enhance profitability in comparison with a smaller rival. Similarly, companies with competitive advantages tend to be more profitable and this will be reflected in higher market values and hence size.

The ability to compete, as represented by the factors above, represents a combination of market and financial power (which could be referred to as "firepower"). The hypothesis is that in any sector, there will be some companies with greater firepower (being larger in size and with stronger balance sheets than smaller companies) and that this is a deliberate strategic choice to enable them to maintain and enhance their competitive position including by acquisition, by the threat of acquisition or by the threat of competitive action such as pricing. The companies with large firepower are predators and the other companies in the sector with less firepower are the prey.

This hypothesis implies that larger companies tend to have less gearing to provide reserve borrowing capacity. This maximises their firepower to be able to acquire and intimidate smaller companies and so grow. The negative relationship between gearing and size was noted in Chapter 2. However, this approach does not include any attempt to measure the opportunities to make acquisitions that may encourage or support a strategy of acquisition.

The capital structure decision should reflect the nature of the degree of concentration in other companies in the sector. So, if the other companies in a sector are fragmented with a low degree of concentration then a company is more likely to have low gearing to be able to make acquisitions within a fragmented sector. Conversely, faced with a highly concentrated group of companies in a sector, an individual company is unlikely to have many acquisition targets or indeed an acquisition strategy and so is less likely to need reserve borrowing capacity, so its gearing will tend to be higher than for a company faced with low levels of concentration.

The hypothesis is therefore that gearing will be positively related to a measure of concentration of the other companies in the sector. This hypothesis is tested in the next section.

Companies with higher levels of firepower will have higher levels of profitability (in relation to companies with lesser firepower) and hence will represent better credit risks and so have better access to debt and so may have more gearing than smaller companies and yet represent lower credit risk. However, higher levels of firepower tend to be associated with size which is negatively related to gearing. Therefore, it is not so easy to predict the relationship between company firepower and its gearing.

4.3.2 Measurement of firepower

Market power is usually described in terms of market concentration – a measure of the relative market power of companies in a sector. The degree of concentration is usually measured using the Hirschman-Herfindahl (HH) index. Interestingly, Tobin's q which is related to the market to book value ratio has also been considered as a measure of market power (see Lindenberg and Ross (1981)).

This is defined as the sum of the squares of the market shares of the companies in a sector.

$$\text{HH index in sector “j”} = \sum_i (m_{ij})^2 \qquad (4.1)$$

where m_{ij} is the market share of company "i" in the "jth" sector and the summation is over the "i" companies in sector j.

The market share factors are squared. As the market shares are all less than one (by definition), the process of squaring the values has the effect of reducing the impact of small market shares much more than large market shares. The HH index will take larger values where there are companies with large market shares (and vice versa).

The HH index for the sector is a useful proxy for the degree of concentration in a sector or industry and hence of the stage of consolidation reached. A high HH index value suggests that the sector has already reached a relatively high degree of concentration whereas a low HH index value means there is more scope for consolidation.

The HH index is commonly used to measure market concentration where regulators are concerned to protect consumers by avoiding too high a level of concentration that might lead to consumer detriment. Where a merger would have the effect of increasing concentration to a level that might lead to consumer detriment, the regulator may consider imposing conditions on a merger such as requiring the acquirer to reduce its market power by disposal or even prohibiting the transaction.

For example, Guney, Li and Fairchild (2011) use the HH index (based on sales) and Tobin's Q to study gearing and product market competition among Chinese firms: they report an inverse relationship between intensity of competition and gearing showing that gearing is impacted by the competitive structure within a sector.

Although market shares are usually used to compute the HH index, it is also possible to use other measures of relative company size such as enterprise value. This can be computed by measuring the share of total sector enterprise value an individual company represents. The modified formula would be:

Modified HH index ("HH (enterprise value)") in sector "j" = $\sum_i (EV_{ij})^2$ (4.2) where EV_{ij} is the enterprise value of company “i” in the “jth” sector (expressed as a proportion of the total enterprise value in the sector) and the summation is over the “i” companies in sector j.

HH measures based on market values or market shares take no account of the company’s financial position. For example, suppose a company in a sector had a large market share and benefitted from economies of scale resulting from its size leading to better margins and hence profits. These factors would be captured in the HH index computed using the market value of the enterprise. Computing the HH index using only market shares excludes the element of profitability.

Hou and Robinson (2006) examine the relationship between share price returns and industry concentration using the HH index which is calculated using i) enterprise values; ii) equity values; and iii) market shares. The approach of using market values is to deal with data limitations particularly where market share information is not available. Although these measures of concentration are different to those computed using market shares, the authors point out that their modified HH values are highly correlated and provide support for the approach described above. Their main conclusions are that firms in highly concentrated industries earn lower returns. They also comment that average gearing does not vary much across different concentration levels.

Related to this comment is the observation in Frank and Goyal (2009) that gearing is relatively constant within a sector. If gearing does not vary much within a sector, then the firepower effect may not be easy to detect as it is internal to a sector and is dependent on the competitive conditions within the sector.

To examine the firepower hypothesis of capital structure, it is necessary to test the relationship between a specific company's firepower and its capital structure. But this relationship takes little direct account of the firepower of the other companies in the sector. So, two measures of market power could be considered – first, a specific value for each company; and secondly, a value for all the other companies in the sector.

This second measure involves computing the HH index to exclude the company. This enables the company's decision about its capital structure to be examined – a decision taken in the light of the concentration of firepower in the other companies in the sector. This is a subtler decision which looks at the relative position of the company within the competitive structure of the sector.

This second value can be defined as the "non-firm HH index value". Similarly, a value for the specific company can be defined as the "firm HH index value".

The firepower hypothesis suggests that there is a relationship between a company's gearing and the competitive structure within a sector measured by the non-firm HH value (the concentration measure of companies in the sector other than the subject company).

The above definitions of HH values are based on market values and sales and so take no direct account of gearing. The ideal measure of market power should combine both market share and financial power in a single value. Obviously, a sector with a high HH index value based for example on market values would be more (less) intimidating to a small participant where the large index value companies were also lowly (highly) geared.

This can be attempted by computing a further HH index value which takes account of both these factors. The idea is to scale the HH value by a factor which represents the company's ability to borrow. Such a value models market power but adjusts it for the relative ability of the company to borrow further.

A company with large market power and high borrowing power should have a larger HH value than a similar company with less borrowing power.

Borrowing power can be defined or measured as "1 – gearing ratio %". The gearing ratio itself can't be used directly as it can be zero so the reverse ratio (equivalent to equity gearing) is more suitable. High values indicate potential spare borrowing capacity and vice versa other things being equal. The idea is to scale the HH value based on market values by the equity gearing ratio. The HH index value that combines both market and financial power is defined as:

HH index of market and financial power in sector "j" = $\sum_i (EV_{ij} g_{ij})^2$ (4.3)

As above, EV_{ij} is the enterprise value of company "i" in the "jth" sector (expressed as a proportion of the total enterprise value in the sector) and g_{ij} is the equity gearing ratio for company "i" in the "j^{th}" sector and where the summation is over the "i" companies in sector j.

Three versions of the HH index can therefore be used:

HH based on the market values scaled by equity gearing hereafter referred to as HH (equity gearing) or firepower;

HH based on market values hereafter referred to as HH (market values); and

HH based on sales hereafter referred to as HH (sales).

This approach follows that of Hou and Robinson (2006) where sales, book values of total assets and book values of equity were used to calculate indices of concentration.

The HH index value can be computed in three different ways for each of the company; the sector and for that part of the sector that excludes the company (the non-firm HH index value: this computes for each company the HH index value that excludes the company value). This quantity is a proxy for the market and financial power that the company must compete against.

To compute the non-firm HH index value, the company's HH index value is deducted from the value for the sector. This produces a measure of the market and financial power of the companies in the sector other than the subject company and it is adjusted to ensure that it contains no input from the firm (which would otherwise be included in the denominator). This is to ensure that the non-firm HH value tests the effect of the concentration of other companies in the sector (the non-firm companies) on a company's capital structure decisions. The hypothesis is that a company will take account of the firepower of its competitors when making decisions on capital structure.

4.3.3 Developing hypotheses

The three different definitions of the HH index value can be used in separate specifications to test the hypothesis that company gearing is affected by the degree of concentration facing an individual company. Companies facing a low degree of concentration are more likely to have lower gearing to be able to make acquisitions whereas companies facing more concentration are less likely to see many acquisition opportunities and so may not choose a balance sheet with high borrowing capacity. Thus, gearing should be positively related to the level of concentration among other companies in the sector. Formally, the hypothesis can be stated as follows:

Hypothesis 1: Faced with a high level of concentration, a company will have few prospects for acquisition so that a low gearing policy to facilitate acquisition will be unnecessary with the result that gearing will be higher. However, for a company faced with low levels of concentration, there will be greater prospects for acquisition and so gearing will be lower to facilitate an acquisition policy. So, company gearing should be positively related to the degree of concentration faced by the company as measured by the non-firm HH index value (based on each of the three versions: equity gearing, market value and sales). Each of the three HH index values will be tested separately.

Frank and Goyal (2008) include a description of the established relationship between a company's gearing and industry or sector gearing. This relationship suggests that an individual company will select its gearing policy in a way that avoids the company being significantly more highly or lowly geared than the sector average – this is inconsistent with the firepower hypothesis which goes further in suggesting that decisions on gearing are taken in the light of the relative market positions of the companies in a sector as well as other factors including sector factors.

Two sector effects (the fixed asset ratio and average asset life) are included in the regression equations in Chapters 2 and 3. Both variables are sector specific. Companies in the same sector tend to have assets with similar lives and tend to have similar fixed asset ratios. These common factors explain why gearing within a sector tends to be similar across companies reflecting these common factors, but this does not mean that gearing is identical. Differences in gearing within a sector will also depend on differences in the structure of competition within the sector. A company's gearing decision will depend on both sector factors and competitive factors within the sector.

Consistent with Lemmon, Roberts and Zender (2008), Graham and Leary (2011) find that leverage varies more cross-sectionally than within firms estimating that approximately 60% of leverage variation is cross-sectional for gearing measured using both book values and market values. They also identify that of the cross-sectional variation, most is across firms within a given industry rather than between industries – a result consistent with that of MacKay and Phillips (2005). Graham and Leary (2011) estimated that intra-industry leverage variation is three times as large as inter-industry variation for gearing based on book values (as opposed to twice for gearing based on market values).

While sector characteristics such as asset life and the fixed asset ratio can explain sector gearing in part, the HH index values are trying to identify subtle differences in gearing between companies that arise from differences in firepower between companies within a sector. Some sector characteristics may also vary between companies within a sector. While it has been established that gearing is positively related to asset life and the fixed asset ratio, these quantities can vary within a sector. These considerations suggest that a subtler and more suitable approach is to examine relative gearing.

The firepower hypothesis seeks to explain differences in gearing within a sector rather than the absolute level of sector gearing. Sector gearing is more directly explained by variables such as asset life and the fixed asset ratio. The firepower hypothesis needs to be tested in a way that is independent of the effect of sector variables. This can be achieved if relative gearing is used in place of actual gearing in the above regression. Relative gearing is defined as company gearing expressed as a proportion of average sector gearing in each case measured using book values.

The use of relative gearing should reduce the effects of sector factors on gearing. For instance, if a sector employs assets with a long life, then as already established, there tends to be more debt and of a greater maturity. This is a feature of that sector. The fact that a sector has high or low gearing (in absolute terms) can be explained at least in part by sector factors (i.e. factors that are common to companies with that business activity such as asset life and the mix of assets). Relative gearing has the advantage of reducing the impact of sector factors.

Fosu (2013) used relative gearing in a study of South African companies seeking to identify a relationship between gearing and performance.

Relative gearing can be compared with the HH index values to judge how a company manages its relative gearing in the light of its own firepower and that of the other companies in its sector. Accordingly, hypothesis 1 can be reformulated to address relative gearing.

Hypothesis 2: Faced with a high level of concentration, a company will have few prospects for acquisition, so a low gearing policy to facilitate acquisition is less important with the result that relative gearing will be higher. Faced with low levels of concentration, there will be greater prospects for acquisition by a company and so relative gearing will be lower to facilitate an acquisition policy and the associated use of bridge financing will be lower. So, relative company gearing should be positively related to the degree of concentration faced by the company as measured by the non-firm HH index value (based on each of the three versions: equity gearing, market value and sales).

Each of the three HH index values will be tested separately. In this case, it is not necessary to include the debt market conditions as independent variables as such conditions apply to all companies in a sector and it is relative gearing that is being analysed.

4.3.4 Data and methodology

This section describes the data, the variables, the regression equations and the estimation methods.

The data are taken from Compustat for North American companies for the period 1995 – 2014 restricted to non-financial company data. The sample includes data where the company is not present for the full period, thereby avoiding survivorship bias. Yield curve data are taken from the US Treasury website; US consumer price index data are downloaded from US Department of Labour website; and yields on corporate bonds by maturity are from Bank of America Merrill Lynch/Federal Reserve Bank of St Louis, Economic Data. A more extensive description of the data is contained in section 2.3.3 of Chapter 2 which employs the same data.

A total of 195,600 company-year observations in respect of 23,600 companies are included. However, not all company-year observations are complete and so the usable data are smaller in number: the sample size available varies between each regression depending on the variables employed. A further constraint is the requirement to use lagged values of the variables: this requires that each company-year observation has a corresponding value for the previous year. This requirement leads to a further reduction in sample size where there is no previous company-year value. For instance, using system GMM with two lags requires 3 consecutive company-year observations and so the sample size for this approach is smaller than for fixed effects modelling where only two consecutive company-year observations are required. For these reasons, the sample size varies between regression analyses.

The choice of data follows that in Lemmon and Zender (2010) (which covered an earlier period than in this case, although with some small degree of overlap). This sample includes some companies present for the whole sample period and others for shorter time frames, thus avoiding survivorship bias.

The variables are defined in Table 4.3. Summary statistics of the data are set out in Table 4.4 except for those variables defined in Table 2.5 of Chapter 2 and that are summarised in Table 2.6. Table 4.5 contains the respective correlation statistics except for cross-correlations for those variables defined in Table 2.5 of Chapter 2 which are reported in Table 2.7.

4.3.4.1 The variables and expected signs of the coefficients

The dependent variable is gearing measured using book values (for hypothesis 1) and relative gearing measured using book value (for hypothesis 2).

The independent variables are the non-firm HH index value and the firm HH index value (in each case, computed in three different ways); and the additional control variables introduced in Chapter 2 and which are included since they clearly have an impact on gearing and to exclude them could cause under-specification bias. These additional control variables are as follows: the market to book value ratio; regulation dummy; abnormal earnings; fixed asset ratio; average asset life; size; yield curve; bond spread; inflation; and short-term interest rate. The full definitions of the control variables are set out in Table 2.5 of Chapter 2.

Table 4.3 contains definitions of the variables (or references to the variable definitions in other chapters) and their expected signs.

Table 4.3 Definitions of the variables and expected signs of coefficients
This table sets out the definitions of the variables and their expected signs

Gearing (book value)	The total amount of debt expressed as a proportion of the book value of assets.
Non-firm index value (as per the SIC code)	i) the HH value for the sector based on equity gearing that is derived from market-based enterprise values weighted by the equity gearing (being 1 minus the actual gearing) but excluding the subject firm for each sector
	ii) the HH value for the sector based on market-based enterprise values without any weighting but excluding the subject firm
	iii) the HH value for the sector based on sales but excluding the subject firm
Expected sign	"+" since the smaller non-firm HH index value reflects a fragmented (non-firm) sector which would encourage a company to pursue an acquisition strategy which would require a lowly geared balance sheet; and a highly concentrated (non-firm) sector which suggests that acquisitions are less likely and so there would be less need for a conservative balance sheet.
Firm HH index value (as per the SIC code)	i) the HH value for the firm based on equity gearing that is derived from market-based enterprise values weighted by the equity gearing (being 1 minus the actual gearing)
	ii) the HH value for the firm based on market-based enterprise values without any weighting but excluding the subject firm
	iii) the HH value for the firm based on sales but excluding the subject firm
Expected sign	"+/–" It is not so obvious how this relationship might work. For a company wishing to be acquisitive, it might be the case that gearing is positively related to firm HH index value since larger companies can support more debt although the sign of the coefficient of size is negative (as reported in Chapter 2).

In addition to the above variables and to avoid under-specification biases, those explanatory variables included in the regression equations in Chapter 2 are included here: the definitions of these variables are set out in Table 2.5 and are listed below together with the expected signs of their coefficients.

The market to book value ratio	Expected sign: "+" to reflect the results of Chapter 2.
Regulation dummy	Expected sign: "+" to reflect the results of Chapter 2.
Size	Expected sign: "–" to reflect the results of Chapter 2.
Commercial paper dummy	Expected sign: "+" to reflect the results of Chapter 2.
Abnormal earnings	Expected sign: "+" to reflect the results of Chapter 2.
Average asset life	Expected sign: "–" to reflect the results of Chapter 2.
Fixed asset ratio	Expected sign: "+" to reflect the results of Chapter 2.

In addition to the company specific variables and to reflect debt market conditions, the following variables are included as in Chapter 2 and the definitions of these variables are set out in Table 2.5.

Yield curve, *Bond spread*, *Inflation* and *Short-term real interest rate* are included and the expected sign of each of these variables is "–".

As in Chapter 2, to take account of a policy of adjusting capital structure to a target, lagged values of the dependent variable are included as explanatory variables.

Similar signs should be expected for relative gearing although the relationship between relative gearing and the control variables is likely to be weaker than for the relationship between a conventional measure of gearing and the control variables.

4.3.4.2 Model equations

The regression equation used to test each hypothesis is set out below under each of the hypotheses.

Static models do not provide for delays in adjusting capital structure as is argued above in relation to the use of bridge financing. Accordingly, a lagged value of the dependent variable is included as an explanatory variable. The subscripts indicate firm (i) and time (t).

Hypothesis 1: Company gearing is positively related to the non-firm HH index value (where the non-firm HH index value is calculated using i) equity gearing; ii) market-based enterprise values; and iii) sales);

$$Gearbk_{i,t} = \alpha + \beta_1 Gearbk_{i,(t-1)} + \beta_2 MTBV_{i,t} + \beta_3 Reg_{i,t} + \beta_4 Size_{i,t} + \beta_5 CPD_{i,t} + \beta_6 Abegs_{i,t} + \beta_7 AAL_{i,t} + \beta_8 FAR_{i,t} + \beta_9 Ycurve_t + \beta_{10} Bondspread_t + \beta_{11} Inflation_t + \beta_{12} Shortint_t + \beta_{13} NonFHH_{i,t} + \beta_{14} FHH_{i,t} + \varepsilon_{i,t} \quad (4.4)$$

Dependent variable: $Gearbk_{i,t}$ = gearing (measured using book values).

Independent variables: 1) $Gearbk_{i,(t-1)}$ = lagged value of $Gearbk_{i,t}$; 2) $MTBV_{i,t}$ = market to book value ratio; 3) $Reg_{i,t}$ = regulation dummy; 4) $Size_{i,t}$ = natural logarithm of the enterprise value; 5) $CPD_{i,t}$ = commercial paper dummy; 6) $Abegs_{i,t}$ = abnormal earnings; 7) $AAL_{i,t}$ = average asset life; 8) $FAR_{i,t}$ = fixed asset ratio; 9) $Ycurve_t$ = yield curve; 10) $Bondspread_t$ = bond spread; 11) $Inflation_t$ = inflation; and 12) $Shortint_t$ = short-term interest rate; 13) $NonFHHE_{i,t}$ = the non-firm HH index value calculated using i) equity gearing; ii) market-based enterprise values; and iii) sales as described above; and 14) $FHHE_{i,t}$ = firm HH index value calculated using i) equity gearing; ii) market-based enterprise values; and iii) sales as described above. The error term is $\varepsilon_{i,t}$.

Hypothesis 2: Relative company gearing is positively related to the non-firm HH index value (where the non-firm HH index value is calculated using i) equity gearing; ii) market-based enterprise values; and iii) sales);

$$RelGbk_{i,t} = \alpha + \beta_1 RelGbk_{i,(t-1)} + \beta_2 MTBV_{i,t} + \beta_3 Reg_{i,t} + \beta_4 Size_{i,t} + \beta_5 CPD_{i,t} + \beta_6 Abegs_{i,t} + \beta_7 AAL_{i,t} + \beta_8 FAR_{i,t} + \beta_9 NonFHH_{i,t} + \beta_{10} FHH_{i,t} + \varepsilon_{i,t} \quad (4.5)$$

Dependent variable: $RelGbk_{i,t}$ = gearing (measured using book values) and expressed as a proportion of sector gearing.

Independent variables: 1) $RelGbk_{i,(t-1)}$ = lagged value of $RelGbk_{i,t}$; 2) $MTBV_{i,t}$ = market to book value ratio; 3) $Reg_{i,t}$ = regulation dummy; 4) $Size_{i,t}$ = natural logarithm of the enterprise value; 5) $CPD_{i,t}$ = commercial paper dummy; 6) $Abegs_{i,t}$ = abnormal earnings; 7) $AAL_{i,t}$ = average asset life; 8) $FAR_{i,t}$ = fixed asset ratio; 9) $NonFHHE_{i,t}$ = the non-firm HH index value calculated using i) equity gearing; ii) market-based enterprise values; and iii) sales as described above; and 10) $FHHE_{i,t}$ = firm HH index value calculated using i) equity gearing; ii) market-based enterprise values; and iii) sales as described above. The error term is $\varepsilon_{i,t}$.

4.3.4.3 Methods of estimation

A more detailed description of the selection of estimation procedures is set out in section 2.3.3.3 of Chapter 2.

The two methods highlighted in Flannery and Hankins (2013) as the most efficient, namely fixed effects and system GMM, are used here and the procedure in relation to system GMM used in that paper (using Stata's “xtdpdsys” command, two steps, with all the independent variables specified as "predetermined" and the maximum number of lags restricted to two or, in some cases, more where it is necessary to increase the number of lags to generate satisfactory AR(2) statistics) is followed.

4.3.4.4 Descriptive statistics

Summary statistics are set out in Table 4.4 and correlation statistics in Table 4.5.

Table 4.4 Summary statistics
This table sets out the summary statistics for the HH firm and non-firm values and for relative gearing

	Obser-vations	Median	Mean	Std. Dev.	Var-iance	Skew -ness	Kur-tosis	Min-imum	Max-imum
HH equity gearing									
Firm value	114,838	0.000	0.033	0.134	0.018	5.350	32.653	0.000	0.936
Non-firm value	114,768	0.217	0.288	0.288	0.053	1.345	4.348	0.014	1.000
HH market value									
Firm value	115,389	0.000	0.031	0.126	0.016	5.387	33.148	0.000	0.888
Non-firm value	114,756	0.208	0.278	0.224	0.050	1.389	4.523	0.017	0.999
HH sales value									
Firm value	170,361	0.000	0.017	0.075	0.006	6.143	42.640	0.000	0.584
Non-firm value	170,298	0.161	0.218	0.189	0.036	1.810	6.458	0.126	0.963
Relative gearing	169,922	0.765	1.19	1.871	3.502	3.594	18.16	0.000	11.902

Definitions of the variables are set out in Table 4.3. Descriptive statistics of the control variables not listed above are in Table 2.6.

As is to be expected, the firm HH values and the range of values (as evidenced by the standard deviation) are significantly less than the non-firm HH values.

Correlation statistics for these variables with the other variables in the regression equation (see Table 4.3) are set out in Table 4.5.

Table 4.5 Correlation statistics
The table sets out the correlation statistics for relative gearing and the firm and non-firm HH values against the variables in the left-hand column below

	Relative gearing	Firm HH (equity gearing)	Non-firm HH (equity gearing)	Firm HH (market value)	Non-firm HH (market value)	Firm HH (sales)	Non-firm HH (sales)
Firm HH (equity gearing)	-0.033***						
Non-firm HH (equity gearing)	0.025***	0.226***					
Firm HH (market value)	-0.029***	0.965***	0.214***				
Non-firm HH (market value)	0.022***	0.294***	0.960***	0.291***			
Firm HH (sales)	-0.027***	0.819***	0.227***	0.844***	0.289***		
Non-firm HH (sales)	0.036***	0.276***	0.764***	0.276***	0.800***	0.258***	
Gearing (book values)	0.843***	-0.014***	-0.020***	-0.008***	-0.024***	-0.009***	-0.005**
Market to book value ratio	0.355***	-0.045***	-0.049***	-0.051***	-0.054***	-0.079***	-0.019***
Regulation	-0.019***	-0.031***	-0.113***	-0.035***	-0.125***	-0.042***	-0.154***
Size	-0.121***	0.221***	-0.064***	0.229***	-0.064***	0.234***	-0.081***
Short-term credit rating	-0.030***	0.189***	0.015***	0.199***	0.020***	0.187***	-0.006**
Abnormal earnings	0.182***	-0.052***	-0.003	-0.053***	-0.007**	-0.053***	0.021***
Average asset life	-0.089***	0.017***	-0.061***	0.019***	-0.063***	-0.020***	-0.092***
Fixed asset ratio	-0.008***	-0.001	-0.107***	0.002	-0.108***	-0.022***	-0.153***
Yield curve	0.014***	0.016***	-0.001	0.014***	-0.005*	0.018***	0.032***
Bond spread	0.017***	0.019***	0.010***	0.016***	0.005*	0.019***	0.023***
Inflation	0.004***	-0.008**	0.005	-0.006***	0.012***	-0.008**	-0.004
Short-term interest rate	-0.017***	-0.030***	0.016***	-0.028***	0.015***	-0.031***	-0.055***

*** p<0.01, ** p<0.05, * p<0.1. Definitions of the variables are set out in Table 4.3. Descriptive statistics of the control variables not listed above are in Table 2.6 and correlations in Table 2.7.

The alternative measures of the HH index are highly correlated as might be expected (firm values with firm values and non-firm values with non-firm values). There is a significant but lower degree of correlation between the firm and non-firm HH values for all three HH definitions. Where a company is facing higher non-firm HH values (ie more concentration) it is more likely that the firm itself is large and vice versa.

The non-firm value can be included in the regression equation explaining gearing that was tested in Chapter 2 in the context of the analysis of the coefficient of the market to book value ratio thereby ensuring that control variables figure in the model specification employed in this part of the thesis. For completeness, the firm HH value is also included.

The correlations between the HH index values and the other independent variables within the equation are, with a few exceptions, statistically significant although small in value (other than the HH values). The firm HH values are positively correlated with the size variable as is to be expected but the non-firm HH values are negatively related to company size.

The regulation dummy variable is negatively (and significantly) correlated with all the firm and non-firm HH values suggesting that regulated sectors are not highly concentrated.

The fixed asset ratio and average asset life show low levels of correlation with the firm HH values but larger negative correlation with non-firm HH values that are statistically significant.

4.3.5 Results

The three measures of the HH index are used in the regression analysis (using the equations described above).

The results of the regression testing hypothesis 1 that gearing is positively related to the non-firm HH values (based on the equity gearing version) are set out in Table 4.6. The results support the hypothesis.

In the case of the non-firm HH value (based on equity gearing), although the fixed effects method does not produce a significant coefficient, system GMM does (a more significant result) and it is a positive coefficient as predicted by the hypothesis and thus confirming that companies facing lower (higher) degrees of concentration have lower (higher) levels of gearing.

In the case of the firm HH values (based on equity gearing), the fixed effects coefficient is negative and significant (at the 5% level) but is not significant using the system GMM methodology. Where the results from fixed effects and system GMM are in conflict, the latter result is superior although this result is not directly related to the hypothesis.

However, the construction of the firm HH value based on equity gearing involves multiplying the firm HH value based on market values by the equity gearing ratio or "1-gearing ratio". So, in a regression equation where the dependent variable is gearing and one of the independent variables involves a product that includes the factor "1-gearing ratio", a negative coefficient is to be expected. So, this result must be treated with caution and more weight place on the other versions of the firm HH values that do not involve equity gearing.

The coefficients of the independent variables other than the firm HH and non-firm HH index values track the results in Table 2.12 in Chapter 2: this is to be expected since the model equations are identical save for the inclusion of the HH index variables.

Table 4.6 Determinants of gearing (equity gearing HH index case)
This table sets out the regression results of gearing based on book values against the variables in the left-hand column including the firm and non-firm HH values computed using the equity gearing version of HH (hypothesis 1)

Independent variables	Fixed effects	System GMM
Dependent variable (1-year lag)	0.495***	0.567***
	(44.15)	(33.15)
Dependent variable (2-year lag)		-0.0349***
		(-2.742)
Market to book value ratio	0.0207***	0.0160***
	(21.18)	(15.31)
Size	-0.0126***	-0.00857***
	(-6.287)	(-4.026)
Commercial paper dummy	0.0149***	0.00644
	(3.412)	(0.873)
Abnormal earnings	0.0127***	0.00597***
	(7.575)	(3.783)
Average asset life	-0.00391***	-0.00243***
	(-10.16)	(-5.194)
Fixed asset ratio	0.288***	0.378***
	(15.34)	(15.96)
Yield curve	-1.458***	-0.639***
	(-11.91)	(-7.029)
Bond spread	-0.121	-0.192***
	(-1.107)	(-2.632)
Inflation	-1.413***	-0.639***
	(-13.68)	(-7.752)
Short-term interest rate	-1.379***	-0.521***
	(-13.27)	(-6.891)
Firm HH value (equity gearing)	-0.0274**	0.00234
	(-2.399)	(0.147)
Non-firm HH value (equity gearing)	-0.00194	0.0318***
	(-0.286)	(4.077)
Regulation dummy	-	0.309***
		(5.677)
Constant	0.180***	0.0376***
	(13.77)	(2.953)
F test	309.6***	
Adjusted R squared	0.325	
Hausman p value	0.00***	
Wald test p value		0.00***
Arellano-Bond AR(1)		0.00
Arellano-Bond AR(2)		0.20
Sargan statistic		0.00
Observations	83,892	77,740
Number of groups	12,447	11,807

Robust t-statistics in parentheses. *** p<0.01, ** p<0.05, * p<0.1. The Sargan test result is unreliable here - as pointed out in Roodman (2009b) it is not infallible and cannot be relied on too faithfully. The Hansen test statistic is not reported here as it is not available in xtdpdsys – see discussion in section 2.3.3.3. To test for collinearity, the variance inflation factors were computed and were all less than 10. The definitions of the variables are set out in Table 4.3.

Table 4.7 sets out the results of the test of hypothesis 1 that gearing is positively related to the non-firm HH index values (calculated using market values) – a repeat of the regression analysis reported in Table 4.6 but with a different version of the HH index value. The results again support hypothesis 1.

In the case of HH values computed using market values, the fixed effects methodology reports no statistically significant coefficients for either firm HH value or the non-firm HH value. However, system GMM produces statistically significant coefficients for all independent variables. The coefficient of the non-firm HH index value is positively related to gearing as hypothesised. These results suggest that gearing increases as non-firm sector concentration increases (as hypothesised).

In the case of the firm HH index value, this is also positively (and significantly) related to gearing. This might reflect an increase in borrowing related to an increase in size since size and the firm HH index value are positively correlated (see Table 4.5). However, size is negatively related to gearing as reported in Table 4.6.

The coefficients of the independent variables other than the firm HH and non-firm HH index values track the results in Table 2.12 in Chapter 2: this is to be expected since the model equations are identical save for the inclusion of the HH index variables.

Table 4.7 Determinants of gearing (market value HH index case)
This table sets out the regression results of gearing based on book values against the variables in the left-hand column including the firm and non-firm HH values computed using market values (hypothesis 1)

Independent variables	Fixed effects	System GMM
Dependent variable (1-year lag)	0.495***	0.568***
	(44.11)	(33.09)
Dependent variable (2-year lag)		-0.0327**
		(-2.571)
Market to book value ratio	0.0207***	0.0161***
	(21.14)	(15.52)
Regulation dummy	-	0.293***
		(5.279)
Size	-0.0130***	-0.0086***
	(-6.437)	(-4.068)
Commercial paper dummy	0.0146***	0.00704
	(3.322)	(0.956)
Abnormal earnings	0.0128***	0.0062***
	(7.592)	(3.941)
Average asset life	-0.0039***	-0.0025***
	(-10.17)	(-5.153)
Fixed asset ratio	0.289***	0.379***
	(15.36)	(15.80)
Yield curve	-1.459***	-0.662***
	(-11.83)	(-7.342)
Bond spread	-0.124	-0.170**
	(-1.122)	(-2.347)
Inflation	-1.410***	-0.654***
	(-13.56)	(-7.954)
Short-term interest rate	-1.378***	-0.514***
	(-13.16)	(-6.895)
Firm HH value (market value)	0.0098	0.0364**
	(0.843)	(2.161)
Non-firm HH value (market value)	-0.0035	0.0392***
	(-0.438)	(4.836)
Constant	0.181***	0.0358***
	(13.69)	(2.782)
F test	308.3***	
Adjusted R squared	0.326	
Hausman p value	0.00***	
Wald test p value		0.00***
Arellano-Bond AR(1)		0.00
Arellano-Bond AR(2)		0.227
Sargan statistic		0.00
Observations	83,467	77,334
Number of groups	12,427	11,787

Robust t-statistics in parentheses. *** p<0.01, ** p<0.05, * p<0.1. The Sargan test result is unreliable here - as pointed out in Roodman (2009b) it is not infallible and cannot be relied on too faithfully. The Hansen test statistic is not reported here as it is not available in xtdpdsys – see discussion in section 2.3.3.3. To test for collinearity, the variance inflation factors were computed and were all less than 10. The definitions of the variables are set out in Table 4.3.

Table 4.8 sets out the results of the test of hypothesis 1 that gearing is positively related to the non-firm HH index values (calculated using sales) – a repeat of the regression analyses reported in Tables 4.6 and 4.7 but using a different version of the HH index value. The results support hypothesis 1.

The coefficient of the non-firm HH value (based on sales) coefficient is significant and positive but only in the system GMM analysis and not fixed effects. Significant and positive coefficients for the firm HH values based on sales in both fixed effects and system GMM analyses are produced.

The coefficients of the independent variables other than the firm HH and non-firm HH index values track the results in Table 2.12 in Chapter 2: this is to be expected since the model equations are identical save for the inclusion of the HH index variables.

Taking these results as a group, there is support for the hypothesised positive relationship between gearing and non-firm concentration. An alternative method to test the hypothesis is to consider relative gearing rather than absolute gearing. This approach is tested in the next three sets of results.

Table 4.8 Determinants of gearing (sales HH index case)

This table sets out the regression results of gearing based on book values against the variables in the left-hand column including the firm and non-firm HH values computed using sales (hypothesis 1)

Independent variables	Fixed effects	System GMM
Dependent variable (1-year lag)	0.495***	0.561***
	(44.18)	(32.30)
Dependent variable (2-year lag)		-0.0371***
		(-2.881)
Market to book value ratio	0.0207***	0.0164***
	(21.17)	(15.47)
Size	-0.0130***	-0.00942***
	(-6.469)	(-4.409)
Commercial paper dummy	0.0146***	0.00785
	(3.346)	(1.088)
Abnormal earnings	0.0127***	0.00571***
	(7.576)	(3.598)
Average asset life	-0.00389***	-0.00248***
	(-10.11)	(-5.176)
Fixed asset ratio	0.288***	0.372***
	(15.37)	(15.45)
Bond spread	-0.129	-0.166**
	(-1.177)	(-2.246)
Inflation	-1.407***	-0.614***
	(-13.56)	(-7.674)
Short-term interest rate	-1.376***	-0.457***
	(-13.04)	(-5.934)
Firm HH value (sales)	0.0324*	0.0890***
	(1.954)	(3.592)
Non-firm HH value (sales)	-0.00981	0.0642***
	(-0.906)	(4.400)
Regulation dummy	-	0.271***
		(5.195)
Yield curve	-1.453***	-0.606***
	(-11.82)	(-6.643)
Constant	0.181***	0.0404***
	(13.62)	(3.008)
F test	309.5***	
Adjusted R squared	0.325	
Hausman p value	0.00***	
Wald test p value		0.00***
Arellano-Bond AR(1)		0.00
Arellano-Bond AR(2)		0.188
Sargan statistic		0.00
Observations	83,900	77,747
Number of groups	12,447	11,808

Robust t-statistics in parentheses. *** p<0.01, ** p<0.05, * p<0.1. The Sargan test result is unreliable here - as pointed out in Roodman (2009b) it is not infallible and cannot be relied on too faithfully. The Hansen test statistic is not reported here as it is not available in xtdpdsys – see discussion in section 2.3.3.3. To test for collinearity, the variance inflation factors were computed and were all less than 10. The definitions of the variables are set out in Table 4.3.

Table 4.9~~12~~ sets out the results of the first test of hypothesis 2 that relative gearing is positively related to the non-firm HH index values (calculated using equity gearing) – a repeat of hypothesis 1 except that relative gearing rather than gearing is used. The results support hypothesis 2.

The impact of using relative gearing is that statistical significance increases for the coefficients of the non-firm HH factors which have the expected negative signs (under both fixed effects and system GMM). The firm HH coefficients are negative and statistically significant reflecting the presence of gearing on both sides of the regression as discussed in relation to hypothesis 1.

The coefficients of the independent variables other than the firm HH and non-firm HH index values track the results in Table 2.12 in Chapter 2: this is to be expected since the model equations are identical save for the inclusion of the HH index variables and the use of relative gearing rather than absolute gearing which produces larger coefficients.

Table 4.9 Determinants of relative gearing (equity gearing HH index case)
This table sets out the regression results of gearing based on book values against the variables in the left-hand column including the firm and non-firm HH values computed using equity gearing (hypothesis 2)

Independent variables	Fixed effects	System GMM
Dependent variable (1-year lag)	0.506***	0.592***
	(44.27)	(29.32)
Dependent variable (2-year lag)		-0.0350**
		(-2.419)
Dependent variable (3-year lag)		-0.0194*
		(-1.662)
Market to book value ratio	0.0778***	0.0625***
	(18.20)	(12.81)
Regulation dummy	-	0.577***
		(3.063)
Size	-0.0489***	-0.0375***
	(-5.533)	(-3.925)
Commercial paper dummy	0.0548***	0.0181
	(3.258)	(0.657)
Abnormal earnings	0.0538***	0.0178***
	(6.984)	(2.598)
Average asset life	-0.0141***	-0.00654***
	(-8.718)	(-3.326)
Fixed asset ratio	1.101***	1.030***
	(12.95)	(10.03)
Firm HH value (equity gearing)	-0.0908*	-0.157**
	(-1.784)	(-2.154)
Non-firm HH value (equity gearing)	0.122***	0.151***
	(3.171)	(3.281)
Constant	0.399***	0.167***
	(8.188)	(2.960)
F test	362.5***	
Adjusted R squared	0.307	
Hausman p value	0.00***	
Wald test p value		0.00***
Arellano-Bond AR(1)		0.00
Arellano-Bond AR(2)		0.103
Sargan statistic		0.00
Observations	83,873	70,622
Number of groups	12,447	10,898

Robust t-statistics in parentheses. *** p<0.01, ** p<0.05, * p<0.1. The Sargan test result is unreliable here - as pointed out in Roodman (2009b) it is not infallible and cannot be relied on too faithfully. The Hansen test statistic is not reported here as it is not available in xtdpdsys – see discussion in section 2.3.3.3. To test for collinearity, the variance inflation factors were computed and were all less than 10. The definitions of the variables are set out in Table 4.3. Here, a lag of 3 years for the dependent variable has been included to ensure a satisfactory Arrellano-Bond AR(2) statistic.

Table 4.10 sets out the results of the test of hypothesis 2 that relative gearing is positively related to the non-firm HH index values (calculated using market values) – a repeat of hypothesis 1 except that relative gearing rather than gearing is used. The results again support hypothesis 2.

The coefficients of the non-firm HH index values have the expected negative signs (under both fixed effects and system GMM) and are statistically significant as hypothesised. The firm HH coefficients are both positive but statistically significant only in system GMM.

The coefficients of the independent variables other than the firm HH and non-firm HH index values track the results in Table 2.12 in Chapter 2: this is to be expected since the model equations are identical save for the inclusion of the HH index variables and the use of relative gearing rather than absolute gearing which produces larger coefficients.

Table 4.10 Determinants of relative gearing (market value HH index case)
This table sets out the regression results of gearing based on book values against the variables in the left-hand column including the firm and non-firm HH values computed using market values (hypothesis 2)

Independent variables	Fixed effects	System GMM
Dependent variable (1-year lag)	0.507***	0.592***
	(44.42)	(29.44)
Dependent variable (2-year lag)		-0.0363**
		(-2.494)
Dependent variable (3-year lag)		-0.0184
		(-1.577)
Market to book value ratio	0.0780***	0.0634***
	(18.20)	(13.06)
Regulation dummy	-	0.537***
		(2.904)
Size	-0.0506***	-0.0389***
	(-5.669)	(-4.167)
Commercial paper dummy	0.0544***	0.0204
	(3.200)	(0.751)
Abnormal earnings	0.0541***	0.0188***
	(7.004)	(2.698)
Average asset life	-0.0142***	-0.00749***
	(-8.693)	(-3.830)
Fixed asset ratio	1.106***	1.040***
	(12.96)	(10.04)
Firm HH value (market value)	0.0767	0.182**
	(1.305)	(2.410)
Non-firm HH value (market value)	0.145***	0.220***
	(3.282)	(4.680)
Constant	0.394***	0.153***
	(7.935)	(2.686)
F test	363.9***	
Adjusted R squared	0.308	
Hausman p value	0.00***	
Wald test p value		0.00***
Arellano-Bond AR(1)		0.00
Arellano-Bond AR(2)		0.12
Sargan statistic		0.00
Observations	83,456	70,252
Number of groups	12,427	10,875

Robust t-statistics in parentheses. *** p<0.01, ** p<0.05, * p<0.1. The Sargan test result is unreliable here - as pointed out in Roodman (2009b) it is not infallible and cannot be relied on too faithfully. The Hansen test statistic is not reported here as it is not available in xtdpdsys – see discussion in section 2.3.3.3. To test for collinearity, the variance inflation factors were computed and were all less than 10. The definitions of the variables are set out in Table 4.3. Here, a lag of 3 years for the dependent variable has been included to ensure a satisfactory Arrellano-Bond AR(2) statistic.

Table 4.11 sets out the results of the test of hypothesis 2 that relative gearing is positively related to the non-firm HH index values (calculated using sales). The results support the hypothesis. The results in Table 4.11 indicate statistically significant and positive coefficients for the non-firm HH values based on sales in both fixed effects and system GMM. There is a positive and significant coefficient for the firm HH value under the fixed effects analysis.

Using the coefficients that have been estimated using fixed effects and assuming that the non-firm HH index value ranges between the 10^{th} and 90^{th} percentile, the impact on relative gearing is approximately 7% (based on equity gearing) rising to approximately 14% (based on sales values) demonstrating the economic significance of the relationship. (A change of one standard deviation in the non-firm HH index value (based on sales) produces a change of only 3% of one standard deviation of relative gearing but, that variable has a high standard deviation.)

As with the system GMM estimates of the coefficient of the non-firm HH values in the regression equation including absolute gearing, these results support the hypothesis indicating that companies faced with low levels of concentration are more likely to have lower levels of gearing and thereby have the opportunity to be able to pursue a strategy of acquisition.

The coefficients of the independent variables other than the firm HH and non-firm HH index values track the results in Table 2.12 in Chapter 2: this is to be expected since the model equations are identical save for the inclusion of the HH index variables and the use of relative gearing rather than absolute gearing which produces larger coefficients.

Table 4.11 Determinants of relative gearing (sales HH index case)
This table sets out the regression results of gearing based on book values against the variables in the left-hand column including the firm and non-firm HH values computed using sales (hypothesis 2)

Independent variables	Fixed effects	System GMM
Dependent variable (1-year lag)	0.505***	0.561***
	(44.26)	(25.60)
Dependent variable (2-year lag)		-0.0429***
		(-2.801)
Dependent variable (3-year lag)		-0.0203
		(-1.603)
Dependent variable (4-year lag)		-0.0132
		(-1.367)
Market to book value ratio	0.0781***	0.0686***
	(18.26)	(12.02)
Regulation dummy	-	0.686***
		(3.570)
Size	-0.0515***	-0.0488***
	(-5.808)	(-4.614)
Commercial paper dummy	0.0504***	0.00738
	(2.967)	(0.247)
Abnormal earnings	0.0529***	0.0132*
	(6.877)	(1.833)
Average asset life	-0.0141***	-0.00690***
	(-8.682)	(-3.360)
Fixed asset ratio	1.117***	1.106***
	(13.11)	(9.993)
Firm HH value (sales)	0.393***	0.241
	(3.922)	(1.028)
Non-firm HH value (sales)	0.334***	0.410***
	(5.250)	(4.590)
Constant	0.356***	0.182***
	(7.105)	(2.880)
F test	362.5***	
Adjusted R squared	0.307	
Hausman p value	0.00***	
Wald test p value		0.00***
Arellano-Bond AR(1)		0.00
Arellano-Bond AR(2)		0.23
Sargan statistic		0
Observations	83,856	62,764
Number of groups	12,447	9,848

Robust t-statistics in parentheses. *** p<0.01, ** p<0.05, * p<0.1. The Sargan test result is unreliable here - as pointed out in Roodman (2009b) it is not infallible and cannot be relied on too faithfully. The Hansen test statistic is not reported here as it is not available in xtdpdsys – see discussion in section 2.3.3.3. To test for collinearity, the variance inflation factors were computed and were all less than 10. The definitions of the variables are set out in Table 4.3. Here, a lag of 4 years for the dependent variable has been included to ensure a satisfactory Arrellano-Bond AR(2) statistic.

4.4 Conclusions

The contributions identified in this Chapter are listed at the beginning of this Chapter and in Chapter 1. Here, the main findings are presented more briefly with more emphasis on the empirical tests conducted.

The key contribution is to highlight the incentives that managers have to engage in empire building and that such a strategy is facilitated by a conservative capital structure that reflects the degree of concentration among the other companies in the sector: faced with a low (high) degree of concentration, companies have lower (higher) gearing. This result is supported empirically.

A conservative balance sheet facilitates debt financing on a short-term basis (to be followed by refinancing – as described in Chapter 3 in relation to the pecking order solution): this has two important advantages for management interested in pursuing acquisitions: first, speed and secondly the management of information asymmetry.

A lowly geared balance sheet means that the company can compete without any disadvantage for acquisitions within the sector in a way that enhanced the chances of the company to grow because growth provides two important personal advantages for managers: first, a successful acquisition is likely to lead to better remuneration due to the increase in size; and secondly, the increase in size reduces the risk of their employer becoming a target for another acquirer which can lead to some loss of welfare if the manager becomes a cost saving in a takeover of his employer.

Management also benefit in other ways from a conservative balance sheet. Less gearing enhances their personal welfare by reducing the risk of financial distress which can lead to reduced welfare.

Managers' personal welfare is also enhanced by making the company stronger in terms of its relationships with other key stakeholders such as suppliers and customers that prefer to interact with counterparties with strong balance sheets.

In terms of competition, a further advantage of a conservative balance sheet is that the company can compete with other companies in the sector in terms of price or by offering longer credit periods to customers or in some other way. The company with the strongest balance sheet is best equipped to lead competitive action in this way.

These considerations suggest that capital structure should consider both the acquisition policy of the company and the relative financial strength of the other companies in the sector.

This approach runs contrary to the ideas contained in the two main theories of capital structure – pecking order and trade-off theories. This strategic approach suggests that companies that are candidates to make acquisitions will have lowly geared balance sheets.

The example of leveraged buy-outs is given to explain the difference between the capital structure of listed companies and those of leveraged buy-outs. The difference can be explained by the difference in incentive arrangements in place that supports the arguments presented here.

The leveraged buy-out structure shows how much tax shelter can be generated when the amount of debt is maximized: but this is not the capital structure adopted by listed companies. This demonstrates that listed companies do not maximize the amount of tax shelter that can be generated in contradiction to the trade-off theory.

The combination of market power and financial power is defined as firepower and a new variable is created which is a derivative of the Hirschman Herfindahl index which is computed on this basis and, for robustness, using sales and company market values. The hypothesis that is tested is that companies that face low levels of concentration tend to have lower gearing. This strategy enables such companies to compete as a potential purchaser when acquisition opportunities arise.

This is tested empirically using gearing and, to counteract sector factors that affect gearing, relative gearing is used. The empirical results confirm that gearing is positively related to the level of concentration among other companies in the sector implying that companies facing lower market power among other companies in the sector tend to have lower levels of relative gearing which helps them pursue acquisition strategies against their competitors; and, that the firepower approach provides a contrast to the trade-off theory of capital structure. The trade-off theory implies that as bigger companies offer less risk that the trade-off (between tax shelter and financial distress costs) should occur at higher levels of gearing – and gearing is positively related to size. However, the firepower approach provides a different perspective implying that companies will make choices about capital structure that take account of both strategic considerations and the personal objectives of managers.

CHAPTER 5 CONCLUSIONS

The conclusions presented here are extracted from the more detailed conclusion sections at the end of each Chapter.

5.1 Summary of findings

The contributions identified in this thesis are listed in Chapter 1 and at the beginning of each Chapter. Here, the main findings are presented more briefly with more emphasis on the empirical tests conducted.

The key contribution of Chapter 2 is to show that the under-investment problem arises when there are transfers in value between debt-holders and shareholders caused by the financing mix of the external financing for the investment rather than the investment itself and that such transfers can be reversed by a post-investment adjustment in capital structure that restores the gearing ratio prior to the investment. This solution is simple with low costs and is preferable to the solutions proposed in Myers (1977) of shortening debt maturity of reducing gearing – both of which have significant associated costs and reduce flexibility.

There is evidence that is taken to support the solution in Myers (1977) – the negative relationship between debt maturity and gearing and the market to book value ratio. Two explanations are put forward – the on-off model and the structural model both of which predict the observed negative relationship. This is tested empirically using gearing ratios based on book values that confirm a positive relationship between gearing and the market to book value thus contradicting the solution in Myers (1977) and confirming the explanations put forward.

The key contribution of Chapter 3 is to show i) that transfers in value from debt-holders is not sustainable as a strategy since debt investors will react to a strategy that seeks to disadvantage them by demanding either higher returns or greater restrictions on the company or both; and ii) that information asymmetry that restricts the issue of new shares (at a price that represents an under-valuation) can be managed by using a number of alternatives to conventional debt such as bridge financing in a way that removes the rationale for the pecking order theory.

Empirical results support the idea that temporary increases in debt occur but that such increases are followed by reductions in gearing in each of the two years following the year in which a financing deficit occurs that is financed by an increase in debt as proposed in the pecking order theory.

The key contribution of Chapter 4 is to highlight the incentives that managers have to engage in empire building and to explain how that such a strategy is connected to capital structure. The pursuit of acquisitions is facilitated by a conservative capital structure that reflects the degree of concentration among the other companies in the sector: faced with a low (high) degree of concentration, companies have lower (higher) gearing.

This is tested by comparing the capital structure (gearing and relative gearing) of an individual company to the degree of concentration in the sector faced by that company (the concentration among the other companies). The Hirschman-Herfindahl index is computed in several different ways including one version labelled firepower which seeks to combine market power and financial power. The results demonstrate a significant relationship between relative gearing and the degree of concentration faced by a company for all three versions of the Hirschman-Herfindahl index.

5.2 Recommendations and implications

There are some clear implications for capital structure policy. To avoid any transfer of value to debt-holders (as in the under-investment problem) companies should maintain a constant gearing ratio and avoid transactions that might be interpreted by investors as a permanent reduction in gearing as this would transfer value to the debt-holders.

A policy of constant capital structure will discourage debt-investors form believing that any improvement or reduction in gearing or credit quality that occurs is a permanent change. This will mean that the value of debt should not be affected by changes in gearing since the expectation (based on a belief in the observed capital structure policy of constant gearing) is that such changes in gearing are temporary and will be corrected by a subsequent adjustment to capital structure. This will ensure that any value transferred will always be recaptured. By signalling the intention to maintain a stable capital structure by means of the company’s track record and by publishing statements on capital structure, debt-holders will regard any transfers of value in their favour as temporary and therefore they will be small in magnitude.

Companies will be unable to seek transfers of value from debt-holders (to shareholders as in the over-investment problem) without risking adverse reactions from lenders that could lead to an increase in the cost of debt, possible reduced access to debt markets and reduced flexibility. These disadvantages will be significant. So, the best policy is to maintain constant capital structure thus reassuring debt investors that they will not suffer an adverse transfer of value.

The exact meaning of “constant capital structure” is also something that could be interpreted in a flexible way. Companies usually indicate their policy on capital structure in ways which avoid language that is very precise as this reduces their flexibility. There is also the need to adjust capital structure from time to time and there is no real timetable for this – it is a question of arranging an adjustment in a way that does not encourage investors to think that any past change in capital structure away from the target is permanent. The opportunities for adjustments are not always frequent so deviations away from the mean are possible without giving the impression that such deviations are permanent. Management will be able to indicate their plans by means of signals in their communications with investors and can make additional comments where the adjustment to capital structure is delayed.

Such a policy is entirely consistent with models of capital structure that suggest that gearing ratios revert to a target as in Jalilvand and Harris (1984). Ju, Parrino, Poteshman and Weisbach (2005) develop a contingent claims model to assess a constant capital structure in a trade-off setting. Their model suggests that the costs of deviations from the target are relatively small and that infrequent adjustments to capital structure targets are likely to be reasonable for most firms.

The above considerations do not suggest a particular level of gearing but rather a constant level of gearing. The alternative solutions to the information asymmetry problems described in Chapter 3 include the use of bridge financing. To be able to use bridge financing, the company should maintain reserve debt capacity so that bridge financing is always available should it be required – this suggests a conservative debt policy and provides a rationale as to why companies do not maximise the tax savings that could occur at higher levels of gearing, an issue that has figured in various parts of the literature.

The pecking order theory and the trade-off theories are not supported by the evidence presented above.

5.3 Limitations

The dataset employed here is comprehensive and for a reasonably long time period. However, it is restricted to North America. A useful extension would be to other major markets. An advantage of Compustat data (for North America) is the availability of debt maturity details. In other jurisdictions, there are data limitations and the only choice for measuring debt maturity is to use debt with a maturity longer than 1 year as a proportion of total debt (see examples in the Appendix to Chapter 2).

One of the ideas discussed in the Introduction was the feature of corporate finance research wherein some phenomena hold weakly in broad panels but strongly in narrow samples. This suggests an approach that seeks to identify narrow samples rather than analyse broad panels. The example of large dividend increases and large gearing increases in Cooper and Lambertides (2016) was given in the introduction. The example of self-sustainers was described in Chapter 3.

This suggests that narrow samples might offer more precise results. This method has been followed in some ways in the analysis of the financing deficit which was restricted to companies with a positive financing deficit and an increase in gearing.

In Chapter 4, the regression equation might be extended to include a dummy variable relating to the acquisition policies of each company as in Uysal (2011) as this might link capital structure policy decisions more closely to acquisition intentions.

5.4 Further research

There is always scope for further work. Some obvious areas are described below.

Those companies with high market to book value ratios tend to have fewer balance sheet assets and more expenses – this relationship could usefully be examined further to support the analysis in the simple on-off model in Chapter 2.

The empirical analysis of bridge financing solutions in relation to the pecking order theory could be extended to examine acquisition transactions and their financing. This might enable the bridge financing process to be identified more precisely rather than by looking in a large dataset that includes other companies not pursuing such strategies in the absence of information asymmetry.

One modification to the firepower approach that would address the narrow/broad sample approach would be to attempt to distinguish predators from prey to see if there were differences in capital structure.

The measurement of gearing could be modified to take account of size. Since larger companies are less risky than smaller companies (other things being equal) a simple gearing ratio will not capture this difference in credit quality. A large company with 25% gearing is much less risky than a small company with the same level of gearing. Perhaps the introduction of a credit rating or shadow rating might lead to increases in the precision of the analyses.

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