The design of corporate debt: Evidence from Eurobond issues made by UK companies

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Declaration of Authors Rights

DEDICATION

This Ph.D. thesis is dedicated
to the loving memory of my mother

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ABSTRACT

This thesis provides a comprehensive analysis of the determinants for the optimal choice of contract terms on a unique type of debt instrument: Eurobonds. A discussion of corporate finance theories that postulate the use of debt contract features for mitigating financing inefficiencies provides the foundation for the development of the empirical investigation. More specifically, theories that associate the choice of debt features namely, maturity, call options, convertible options, and protective covenants with firm's and market's characteristics are discussed in detail. Emphasis is also given to the theoretical predictions about the interdependencies established between the debt features that are viewed as alternative control devises for mitigating debt-contracting costs.

Panel data and simultaneous-equations estimation methods are used to regress the relevant debt features on a set of proxies for firm characteristics, market conditions, and related contract features for a sample of 377 Eurobonds issued by UK companies over the period 1986-1999. The evidence from both panel data and simultaneous-equations analyses provide strong support to the prediction that both callable and short-term debt and convertible and debt with protective covenants are used as alternative control devises to mitigate agency costs. Further evidence suggests, however, that contrary to the fundamentals guiding the choice of maturity and callability structures, the use of convertible options and protective covenants in Eurobond contracts seems to be determined by equity agency costs rather than debt agency costs. Some support is also found for the risk uncertainty theory underlying the use of convertibles and for the liquidity risk arguments regarding the choice of protective covenants. No support is found for signalling and interest tax-shield hypotheses.

Some proposals for further research on debt contract design are identified and discussed.

CHAPTER I: INTRODUCTION, OBJECTIVES, AND OVERVIEW OF THE THESIS

The importance of debt financing, in particular, of publicly traded debt has increased significantly in the recent years. The Financial Times (2002, April 10, p. 25) provides a description of this evolution by remarking that "the destiny of debt-ridden companies has been snatched unceremoniously from owners of equity [to] holders of bonds". Although there has been substantial research on the impact of debt financing on firm's capital structure, only recently has the design of debt contracts begun to be extensively analysed and its implications for optimal financing decision assessed. Theoretical literature has driven the analysis of debt contract design to the choice of contract features that, conditional on firm's and market's characteristics, lead to the reduction of the debt financing inefficiencies. Furthermore, significant emphasis has been given to the interrelationships established between financing decisions such as the choice of leverage and the specification of contract features, which are viewed as alternative control mechanisms for mitigating debt-contracting costs. In spite of the considerable developments in theory, the empirical analysis of the structure of debt contracts has been scarce and has generally ignored the interdependencies between the relevant debt features. To this extent, the evidence provided is, inconclusive, incomplete, and lacks a comprehensive explanatory background. This research aims to provide a contribution to the literature in three main areas. The first is to contribute to a more comprehensive analysis of the determinants of the debt structure

choice by examining the joint selection of contract terms in a non-homogeneous and publicly traded debt instrument: Eurobonds. The second is to provide a more robust analysis of the debt design process by considering not only cross-sectional but also time-series effects influencing firm's management behaviour. Finally, the third is to provide a deeper understanding of the impact of the interrelationships between debt financing decisions on the optimal choice of debt structure by accurately considering the endogenous character of the features that are used as alternative control devices for mitigating contracting costs.

The remaining chapters of this thesis are organised as follows. Chapter II describes the Eurobond securities pointing out the main characteristics and comparative advantage of using this type of debt instrument for the examination of the debt design decisions. Chapter III reviews the theory and discusses the main predictions for the optimal choice of debt contracts' structure and the impact of the interrelationships among concurrent features on this selection process. Chapter IV analyses the empirical studies developed in this area and identifies the main limitations. Chapter V provides a descriptive analysis of the sample set used in this research. Chapter VI empirically tests the validity of the theoretical predictions taking into account the impact of cross-sectional and time-series effects governing the choice of debt features for the longitudinal sample of Eurobond issues. Chapter VII provides a comparative analysis to the results obtained in Chapter VI by considering the impact of the jointly determination of contract features and firm leverage on the optimal choice of debt composition. Finally, Chapter VIII

summarises the main findings of this thesis, identifies certain limitations of the empirical analysis, and proposes some extensions for further research.

CHAPTER II: THE EUROBOND MARKET – DEFINITION, STRUCTURE, AND CHARACTERISTICS

2.1. Introduction

This study examines the optimal choice of debt features for an unique type of corporate debt instrument: Eurobonds. The reasons for choosing this type of instrument for assessing the theoretical predictions about debt contract structure are twofold. Firstly, the Eurobond market has expanded significantly over the last years representing nowadays a major source of corporate financing. Moore (2001) points out that while in 1990 fewer than 1,200 new Eurobond issues raised a total of US$ 175 billion, in 1999, more than 4,600 issues raised 1,2 trillion. Moreover, Levich (2001) notes that since 1985, roughly 80 percent of all international bond issues have been floated in the Euromarket, surpassing the threshold of 85 percent in 1994. Clearly, the increasing importance held by the Eurobond market in corporate debt financing calls for an in depth analysis of the impact of Eurobond design on the reduction of contracting costs. Secondly, the unique characteristics of the Eurobond contract make this instrument a well-suited and particularly interesting tool for examining the mainstream theories about optimal choice of debt design. Generally, five major characteristics of the Eurobond offerings can be pointed out as comparative advantages for using this security to study debt contract structure's determinants. First, Eurobond issues are non-homogeneous instruments providing a useful basis for the study of the choice of contract features available to borrowers.

Second, the Eurobond market functions as a segmented capital market in which investors are willing to pay more for the issues than for identically designed securities launched in other markets. In these circumstances, it is likely to expect that issuers place a greater emphasis on the optimal design of the issue in order to guarantee the success of the offering and to be able to capitalise the underlying comparative advantages of Eurobond financing. Third, new Eurobond issues are well suited for analysing the impact of factors that have a transient character such as firm tax status, firm credit quality, and market conditions. This aspect is even more important when it is confronted with studies based on static balance-sheet data (e.g. Stohs and Mauer (1996) and Barclay and Smith (1995)), which provide inconclusive results for tax-related and asymmetric information theories. Furthermore, the analysis of the characteristics of new debt issues has advantages compared to the study of balance sheet's data as the latter is constrained by the accounting categorisation of the different types of debt contracts. Fourth, the focus on a single type of debt allows the study to overcome the problems from analysing structures of debt conditioned by different market factors and serving different purposes. In this context, the use Eurobond issues is crucial because although a considerable part of debt financing is omitted (e.g. bank loans and domestic public debt), the relevance of this study on the debt contract design is not removed, due to the importance of Eurobond offerings on issuer's total financing. Finally, Eurobond issues are publicly traded and are typically issued by large firms that are closely scrutinised by groups of analysts and investors in general. These factors contribute to the availability of a consistent amount of information that is required for the study of the debt design's determinants. A more elaborated analysis of the characteristics of Eurobonds and the importance of these

characteristics for a robust and accurate evaluation of contract structure's determinants will be provided in section 2.2.

Succinctly, this chapter is organised as follows. Section 2.2 describes the evolution of the Eurobond market and highlights the factors underlying its sustainable growth. Additionally, this section points out the characteristics and innovative aspects of Eurobond market stressing the importance of these factors for a comprehensive and robust study of corporate debt design. Finally, it highlights the influence of institutional features on the development of innovative products in the Eurobond market. Section 2.3 describes the main characteristics of the issuers, investors, and institutional intermediaries in the Eurobond market. Finally, section 2.4 concludes providing a summary of the main issues discussed in this chapter.

2.2. Eurobond market evolution and characteristics

One of the main characteristics of the Eurobonds that distinguishes them from other forms of public debt (i.e. domestic and foreign bonds) is that they are issued in markets other than that of the currency of issue. Due to its independence from country-specific regulatory systems, the Eurobond market has expanded most in times of regulation and financial barriers (Gallant (1988)). Typically, the original impetus for the launching of the Eurobond market has been associated with the imposition of tax barriers by the US government to the acquisition of foreign securities by domestic investors. Thus, encouraged by the implications of the changes in US tax system, non-US borrowers (mostly Europeans) began to issue substantial volumes of US-dollars denominated bonds syndicated outside American

borders and free of any taxes. During the course of the 1960s, the growth of the market for Eurodollar bonds continued to be determined by events beyond the influence of Europe. In 1967, forced by the passage of the Mandatory Restraint Program that prohibit US companies from making investment abroad above set quotas, a number of US multinationals chose to finance their overseas operations via the Eurobond market. During the early years of the Eurobond market existence, the US dollar was the dominant currency of issuance with a reported volume, in 1970, of US$ 1.80 billion or 74% of the total volume of Eurobonds issued. Nevertheless, by the end of the 1960's and beginning of the 1970's, other currencies were playing an increasingly important role in the expansion of the Eurobond market. To this extent, we can point the increasing importance assumed by issues denominated in Deutsch marks, French francs, Sterling pounds, Australian dollars, and Danish krones.

During the 1980's, the Eurobond market continued to grow driven to some extent by the emergence of the interest-rate and currency swaps, which influenced the evolution of the broader and more sophisticated derivatives market of the 1990's. During the 1990's the Eurobond market grew substantially in volume and scale with increasing depth of the investor base and increasing size of individual transactions that could be accommodated in this market. The figures provide a clear view of importance attained by the Eurobond issues in the 1990's. Thus, in 1990, fewer than 1,200 new international bond issues raised a total of US$ 175 billion; in 1999, more than 4,600 issues raised US$ 1.2 trillion (Moore, 2001, p.16). Important changes in the market share of currencies of denomination for Eurobond issues occur after 1995. Levich (2001) notes that after this year US$ share of the Eurobond market expanded, exceeding 50 percent in 1998. Nevertheless, with the start of the EMU (European

Monetary Union) in 1999 the market share of Euro currency grew in importance representing 39% of the total issues of Eurobond in this year. The elimination of country-specific currencies among EMU members leaded also to a concentration of Eurobond currencies of denomination, which is attested by the fact that almost 95% of all Eurobond issued in 1999 were denominated in either US$, Euro or UK£ (Levich, 2001, pg. 339). It is important to note here, that the fact of Eurobond issues being denominated in a number of different currencies raises problems for the assessment of the impact of specific market conditions (e.g. interest rates term structure) on the choice of debt terms. Indeed, the modelling complexity and econometric constraints that results from the inclusion of a large number of proxies for the market characteristics associated to each currency of denomination imposes serious limitations for the empirical testing. In order to overcome these limitations, this study uses a sample set aggregating Eurobond issues made by UK companies which traditionally denominate their bond issues in a single currency: pounds sterling. A more elaborated analysis of the currency structure's characteristics underlying the data set used for empirical testing is provided in chapter V.

The analysis the Eurobond market's history reveals that although the initial impetus for its existence is closely associated with the regulatory constraints imposed on US dollar domestic issues, its continuous growth is fuelled by the flexibility of the inherent institutional features and innovative product offerings. One important institutional feature of this market is the bearer form of the majority of its issues. Claes et al. (2000) report that 84.5% of the total Eurobond issues between 1980 and 2000 are bearer bonds. This characteristic of the Eurobond issues makes them

attractive to certain types of investors who desire anonymity. To this extent, Levich (2001) points out that contrary to other types of bond issues that require registration and withholding of taxes, Eurobonds are favoured by retail investors who are not audited and therefore can evade tax payments. Institutional investors are although the larger and more reliable target for Eurobond placements. These investors are attracted by the worldwide pool of issuers that reduce their exposure to credit risk, the increase on returns from Eurobonds' currency appreciation and diversification, and the absence of withholding taxes (which favours particularly those who are tax-exempt entities) (Levich, 2001, pg. 344). Nevertheless, not only the demand side for corporate financing is attracted by the Eurobond market. Well-known and/or high credit quality companies have also comparative advantages in recourse to this market for funding. First, minimal disclosure requirements for Eurobond offerings reduce the issuance costs and increase the speed of the placement's process. According to Fisher (1988), on average, only 19 days elapse from the date when the initial organisation meeting takes place until the offering day of Eurobonds and another 19 days until the closing and delivery of funds to the issuer. The speed of the issuance process is particularly valuable because it allows issuers to capture windows of opportunity and to launch securities at favourable terms and conditions. Second, interest expenses are typically lower for Eurobonds compared to other sources of funds with equal terms and conditions. Investors seem to be willing to give up a fraction of the returns that they could obtain in equally designed bonds to place their funds in Eurobonds. Levich (2001) notes that this segmentation of capital markets determined by Eurobond market participants results from the comparative advantages offered by Eurobond issues to worldwide investors. To this extent,

Levich (2001) points out while retail investors look for Eurobonds for investment secrecy purposes, institutional investors attribute more value to Eurobonds due to the greater variety of high-quality issuers available, the easy of clearing and settlement, and the larger issues with good liquidity obtained. The segmentation of capital markets is likely to affect the relevancy of theoretical predictions about optimal choice of contracts' structure when these predictions are based on equilibrium conditions for the global markets. Taking this into account, the influence of Eurobond market specific characteristics on the existing theories about debt contract design will be addressed in detail in Chapter III. Finally, Eurobond market attracts corporate issuers because they can choose the currency of denomination for their offerings from a large range of currencies available and place these offerings to a large pool of international investors.

It is important to note here, that the segmentation effect observed in the Eurobond market although influencing the relevancy of certain debt design predictions, contributes decisively for enhancing the comparative advantage of using Eurobond instruments to assess the determinants for the optimal debt terms' choice. Indeed, it is plausible to argue that if Eurobond issues are comparatively more valuable for investors than otherwise identically structured securities, issuers have more bargaining power to include the optimal terms in their offerings considering the firm characteristics and market conditions prevailing at the date of the issue. While private placements and even publicly traded bond issues are subject to a degree of standardisation imposed by financial intermediaries in order to reduce structuring and organisation costs, Eurobond issues are more likely to be composed by a

particularly adequate and diversified number of contract features. Clearly, this fact contributes for the increase of the robustness of an empirical study that aims to assess the relevancy of existing predictions about the impact of the debt design process on reduction of contracting costs.

Along the decades, Eurobonds have also been known for accommodating innovative and complex features in order to fulfil the financial needs of international borrowers and lenders. There are three main types of Eurobonds: fixed-rate instruments, floating rate notes (FRN), and convertible bonds. Fixed rate bonds are by far the largest type of fund raising in Eurobond market. In the period of 1980-2000, 73.8% of coupon-bearing bonds have fixed rate coupons (Claes et al. (2000)). Floating rate notes and convertibles represent, respectively, 21.8% and 4.4% of the total of coupon bearing bonds issued in this period (Claes et al., *ibid.*). In spite of their relative importance, the FRNs are considered by some commentators as not suitable to be classified as tradable Eurobonds. Strictly speaking, FRNs are used for short-term financing and can be seen as "disguised bank credits. They tend to find their way straight into bank portfolios and are not effectively traded as securities" (Financial Times, January 1981). On the other hand, the proportion of convertibles in Eurobond markets increases significantly when only private and corporate issuers are considered. In the period of 1980-1987, 16.3% of the total issues by corporate borrowers include convertible options (Gallant, 1988, p. 51).

Types of embedded options other than convertible options are also used in Eurobond contracts. Claes et al. (2000) point out that 14.4% of the Eurobonds issued over the

period 1980-2000 have a call or a put option attached. Although callable bonds are more common, the use of put options has expanded substantially in the end of 1980's and during the 1990's especially among UK-based issuers. As Moore (2001) points out the put options that are triggered by credit rating downgradings are more extensively used by UK issuers compared to other European issuers for a number of reasons, including the general impression that UK companies not only lead in terms of ratings but they have also a traditionally more demanding base of institutional investors which constitute an important external disciplinary mechanism conditioning the structure of Eurobond issues. Furthermore, the uncertainty raised by the stream of privatisation and mergers processes in the UK market during this period contributed to the increased use of put options attached to UK Eurobond issues.

Dual-currency issues represents another innovation introduced in Eurobond market to fulfil issuers need for increasing currency diversification and reducing exchange rate risk. Thus, this feature of Eurobond issues allows the firms to pay the interest coupons in a currency other than the one used for the principal payment, assuring therefore some protection against unfavourable exchange rate movements[1].

2.3. Issuers, investors, and intermediaries

The issuers in the Eurobond market are traditionally split between the public sector (sovereigns, municipals, and supranationals) and private sector (banks, other

[1] Although commonly used among Eurobond issuers, the dual-currency feature raise problems for empirical testing due to the need of considering the influence of multiple market factors for different currencies of denomination. Nevertheless, for this study this problem was resolved a priori as none of the Eurobond issues analysed incorporate this feature.

financial institutions, and corporate). Traditionally, the private sector (in particular the corporate sector) has been the primary issuer in the Eurobond market although during the 1980's and early 1990's a substantial increase of government issues was observed in most major currencies. This increase was, however, reversed in the mid to late 1990's due to the Maastricht-induced restrictions in governments borrowing and the depth of the investor base for corporate financing following the introduction of a single currency for the European Monetary Union (EMU) countries - the euro.

In spite of belonging to different economic sectors, the Eurobond issuers have similarities in being easily recognised among investors and/or being graded with high credit ratings. Gallant (1988) points out that issuers with a rating lower than single A rarely can use the Eurobond market. To this extent, Claes et al. (2000) shows that approximately 40% and 30% of the rated issues made between 1980 and 2000 are classified as AAA and AA (respectively) by the rating agencies and only 5% of the issues are in the lowest investment grade category (BBB). In fact, only issuers with reasonable credit quality status can attract the pool of domestic and foreign investors to accommodate the high volume of borrowings characteristic in the Eurobond markets. Eurobond issuers are also known for exploiting the scarcity value of their offerings. As Levich (2001, pg. 364) points out issuers are likely to "...use the Eurobond market to capture special windows of opportunity when their scarcity value in the market is high." In fact, the scarcity or infrequent offerings of Eurobonds contributes for enhancing the segmentation effect of Eurobond market strengthening the fact of this market representing a particularly attractive source of low-cost financing for issuers with strong credit rating and/or high name recognition. This again highlights the crucial importance assumed by the contract's optimal design for

issuers in order to assure the success of the offering, enabling the firm to capitalise the comparative advantages offered by the Eurobond market financing.

The nature of the investor base supporting the Eurobond market has changed over the years. Moore (2001) notes that in the early years, the main investors were retail buyers attracted by the anonymity they were guaranteed by buying bearer securities. However, by the 1980's, a broad range of institutional investors - spanning from central banks to insurance companies, pension, and mutual funds – have become much more active players in the market. The surge of institutional investors has not meant, however, that the demand from retail investors has diminished completely. Particularly, in the middle of the 1990's, the retail market expanded with the emergence of extremely high levels of demand from Japanese investors. They were encouraged to invest in the Eurobond market by the combination of extremely low domestic interest rates and the poor performance of Japanese equities. Nevertheless, the retail investor base continued to be regarded by the majority of the market participants as being unpredictable and unsophisticated and a comprehensive marketing strategy to institutions is generally used by the issuers to place their borrowings.

The creation of a new Eurobond requires that the issuer appoint a lead manager that places the issue on its own or forms a syndicate with other institutions. Claes et al. (2000) reports that 17.4% of the issues were placed by a single lead manager, during 1980 to 2000. The syndicate can include managers, sub-underwriters, and a selling group. The managers of the group have the primarily responsibility of underwriting

the issue i.e. of guaranteeing the sale of the issue, holding the bonds in their own account if they are unable to place them to investors. Sub-underwriters can be appointed to share the risk of taking the Eurobonds that they are not able to resale to investors. Finally, a selling group of institutions can be selected to help in the distribution of the issue.

Gallant (1988) notes that, although in the early days of the Eurobond market, the issuance of bonds usually involved a large number of institutions (sometimes as many as 250 managers, underwriters, and selling agents), the competition among investment banks leads to the reduction of syndicates to a small but powerful group of agents. The US investment banks have dominated the issuance of securities in the Eurobond market, since it first was created in 1963. Nevertheless, the presence of the European leading banks has been growing significantly, in particular, after the introduction of the euro currency. The depth of investor base for euro-denominated bonds together with the unique placing power of the European banks across an evolving but fragmented base of European institutional investors contribute to the increasing reputation of European banks as serious competitors to US investment firms (Moore, 2001, p. 124).

Levich (2001) provides evidence of the competition and mobility observed among leading underwriting banks of Eurobond offerings for the period 1978-1999. Thus, this author reports that for six selected years during this period, only two firms - Deutsche Bank and Credit Suisse First Boston – appear consistently in the top 10 ranking of lead managers. The other sixteen Eurobond lead managers have rotated positions in the top 10 raking during these years. Thus, while in 1978 German banks occupied top positions in the league table due to the appreciation of Deutsch mark

and the requirement, at the time, of Deutsch mark Eurobond issues to be lead-managed by German banks, in 1982 US banks regain their importance in this table. Although Japanese investment banks held several top positions in the late 1980s, helped by the relaxation of capital controls in this country and the buoyant stock market, they have not been able to maintain their importance as Eurobond lead-managers, as in 1999 none of the top 10 positions was occupied by Japanese banks.

Another interesting evidence of an ongoing competition among investment banks for lead-managing Eurobond offerings is the fact that, 75% of a total sample of 219 firms with three or more issues outstanding on 29/04/1994, used more than one lead manager to handle their bond offerings (see Levich, 2001, pg. 353). Obviously, the competition among lead-managers in Eurobond market benefits issuers that are able to attract the large international demand for well-structured and high credit rating securities facing relatively low underwriting costs.

2.4. Summary and conclusions

This chapter highlights the comparative advantages of the use of Eurobonds for this study's purpose and discusses the main characteristics of the Eurobond market. Emphasis is given to the magnitude of the capital raised in Eurobond markets, the high credit ratings issuers, and the degree of complexity that can be observed in Eurobond contracts. Furthermore, the importance of the segmentation of the capital markets induced by Eurobond investors is discussed and the influence of this segmentation on the design Eurobond contracts is evaluated and analysed. Finally, the main characteristics of Eurobond participants (issuers, investors, and institutional intermediaries) are identified and described.

CHAPTER III: THEORETICAL PREDICTIONS ABOUT DEBT CONTRACT DESIGN

3.1. Introduction

In recent years, corporate finance literature has focused on assessing how the design of debt contracts can be used to reduce financing inefficiencies not completely resolved by decisions related to capital structure and creditor identity choices. Given well-defined market conditions, unrestricted access to capital markets, and absence of strong regulatory mechanisms controlling firm's financial decisions, several authors hypothesise that the choice of the appropriate debt features is determined by firm-specific characteristics. The hypotheses predicting the optimal design for debt contracts are typically aggregated into three major categories: agency costs, asymmetric information, and tax/bankruptcy. In this chapter these hypotheses will be explored and discussed for a particular type of debt contracts i.e. Eurobond securities, which differ in terms of maturity, callability, convertibility, and inclusion of restrictive covenants. It is clear from the analysis of the theoretical models that some of these features cannot be discussed on their own without considering the effect of other contract terms that are chosen at the same time. Indeed, corporate theory predicts the existence of some alternative mechanisms among certain type of debt features that are taken into account by managers when deciding about the structure of debt offerings. Furthermore, some authors postulate about the impact that the simultaneous decision about the firm's leverage level and the debt contract

design has on firm's financial policies. In spite of degree of complexity that this simultaneous-decision framework brings to the model analysis, it is undeniable that managers consider these mechanisms when controlling for potential contracting costs.

Although this chapter is divided into four sections each one related to the contract terms mentioned above, references to the relationships among contract terms and between these and the leverage level are made through out the chapter. Furthermore, special emphasis is given to the potential impact that unique characteristics of Eurobond contracts might have on the relevance of some theoretical conjectures about debt design. Briefly, this chapter is organised as follows. Section 3.2 provides a foundation by describing and analysing the theories related to maturity choice. Section 3.3 focuses on the theoretical hypothesis for the inclusion of call provisions in debt indentures. Section 3.4 discusses the theories underlying the use of convertible debt. Section 3.5 centres on the theories that highlight the determinants for the inclusion of protective covenants in debt contracts. Finally, section 3.6 concludes this chapter by summarising the theoretical predictions about debt contract design.

3.2. Maturity

Several authors have pointed out that firms can benefit from optimally scheduling debt payments by mitigating financing inefficiencies that are not completely resolved by the optimal choice of firm's debt capacity. Some emphasis is drawn on the impact that interest tax advantages along with bankruptcy considerations exert on the choice

of the maturity structure that maximises firm's total value. In section 3.2.1 the works of Brick and Ravid (1985), Mauer and Lewellen (1987), Kane et al. (1985), and Lewis (1990) are discussed and the main insights concerning maturity choice versus tax and bankruptcy considerations are set out. Other studies have highlighted the importance of debt maturity choice in reducing contracting costs of debt financing. In section 3.2.2 the studies by Myers (1977) on underinvestment costs and Barnea et al. (1980) on risk shifting costs are analysed and their main implications for debt maturity selection are discussed. Finally, the studies that analyse the effects of information asymmetry on the choice of the adequate timing for the stream of interest payments are discussed in section 3.2.3. More specifically, this section focuses on the studies by Flannery (1986), Kale and Noe (1990), and Diamond (1991, 1993) that contrast the models that lead to a pooling equilibrium of all the firm quality types with those that allow for a separating equilibrium where securities mispricing is eliminated.

3.2.1. Tax/bankruptcy cost hypothesis

Brick and Ravid (1985) and Mauer and Lewellen (1987) argue that whenever interest income and capital gains are subject to different tax treatment i.e. capital gains are non-taxable, then the choice of maturity structure is relevant for the maximisation of the value of debt. More specifically, Brick and Ravid (1985) predict that for increasing term structure of interest rates, adjusted for default risk premium, firms favour the issuance of long-term debt as this leads to debt tax gains from accelerating debt payments. In other words, by increasing the first period interest payments through the use of a relatively higher long-term rate, firms are able to capture the

gains accrued from asymmetric taxation between debt and equity financing. Brick and Ravid (1985) base their prediction on the assumption that the firm's leverage choice is independent of the maturity structure decision. To this extent, the discounted pre-tax debt payments are kept constant in order to guarantee that the value of debt and equity claims are unaffected by the maturity structure choice. Under these conditions, the strategy of issuing long-term debt when long-term interest rates are relatively high yields tax benefits for the firm that are not cancelled out by the increase in the present-value of pre-tax interest payments. Mauer and Lewellen (1987) argue that firms have a comparative advantage from issuing long-term debt even when coupon interest payments tax treatment is irrelevant for the firm's value maximisation. According to these authors, whenever long-term debt is traded above its face value shareholders are able to capture tax gains by repurchasing the outstanding debt as long as these gains exceed the after-tax transaction cost. Mauer and Lewellen (1987) stress that the degree of repurchase-premium tax savings granted to shareholders depends on the interest rate volatility[2], the level of transaction costs, and the corporate tax rates. Of course, the fact of Eurobond issues being denominated in different currencies and launched by firms under different corporate tax jurisdictions raises problems for the empirical validation of these theories due to the lack of comparability of the proxies for the relevant interest rate structures and corporate tax burdens. Considering the constraints of using Eurobonds for empirical testing, this study focuses on a sample of Eurobonds issued by UK companies, which traditionally denominate its offerings in pound sterling.

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[2] In particular, increases in interest rate volatility affect positively debt-repurchase tax savings because the probability of the market price of long-term debt to exceed its par value increases accordingly.

Under the assumption of asymmetric taxation for equity and debt income, Kane et al. (1985) show that firms benefit from issuing short-term debt whenever the corporate tax rate is relatively high and the cash-flows from firm's assets are more volatile. This result relies on the premise that interest tax gains are maximised when the advantages of rebalancing more frequently the firm's capital structure are enhanced. More specifically, Kane at al. (1985) argue that firms with more volatile asset returns benefit most from reducing the probability of bankruptcy by decreasing the time to maturity of debt issues. The reduction of bankruptcy probability leads to a decrease on the credit risk premium demanded by debt-holders and, for a given level of firm assets, to an increase on the firm's debt-asset ratio. On the other hand, the higher the corporate tax rate, the greater the tax advantage of issuing more frequently relatively less costly debt compared to equity capital. In other words, Kane et al. (1985) contend that the reduction of debt maturity for high corporate tax rates and high firm's risk frameworks maximises the benefits associated with the trade-off between the tax advantages and potential bankruptcy costs attributable to debt finance.

It is important to note that the asymmetric taxation models of Brick and Ravid (1985), Mauer and Lewellen (1987), and Kane et al. (1985) only hold if Miller's (1977) tax irrelevance equilibrium does not prevail. Indeed, if capital markets are perfect and integrated, investors will not be able to capture any tax advantage from holding debt rather than equity claims and the marginal investor tax rate will be simply equal to the corporate tax rate. In other words, the tax advantage of debt financing for corporate firms will be simply off set by the tax disadvantage of debt income for investors. Nevertheless, considering that the Eurobond market functions

as a segmented capital market where investors value more Eurobond issues than otherwise equally tailored debt securities, Miller's tax irrelevance argument cannot hold anymore. In these circumstances, tax considerations might be indeed determinant for the choice of Eurobond issues' maturity.

There is, however, a stronger argument against the role played by corporate taxes on the choice of debt maturity. Indeed, Lewis (1990) dismisses Brick and Ravid's (1985) and Mauer and Lewellen's (1987) studies arguing that the predictions of tax shield relevance result from the misspecification of their models. In a perfect market context except for tax considerations, Lewis (1990) demonstrates that when debt maturity structure and optimal leverage are chosen simultaneously, the effect of maturity structure on a firm's tax liability is irrelevant. More specifically, if the level of leverage is selected in order to maximise the stream of payments that generate tax gains, changes in the proportion of outstanding debt's maturity will carry no additional tax shield for the firm. It is important to stress that this result is independent from the condition of integrated capital markets as it is plausible to assume that, managers consider securities belonging to the same market category when deciding about the change of the proportion of outstanding debt's maturity. Lewis (1990) also argues that there is more than one set of strategies for the debt maturity structure and firm leverage that lead to the maximisation of the interest tax shield and ultimately to the maximisation of the firm's value. This result is strong not only because it denies the impact of taxation on the optimal choice of debt maturity but also because it departs from single period analysis that predict a unique equity-debt ratio for the maximisation of a firm's value.

In addition, Lewis (1990) also identifies limitations of studies such as that from Kane et al. (1985) stressing that the optimal maturity structure prediction results from the assumption of market imperfections other than taxation alone. If debt-holders have to bear costs following firm's bankruptcy (e.g. court fees, loss of clients, diversion of managerial effort) the amount that they will be willing to pay for default claims decreases. In these circumstances, Lewis (1990) sustains that the choice of debt maturity structure will no longer be irrelevant for the maximisation of firm's value. He adds, however, that this result holds because the firm is concerned not only with the net tax subsidy from debt financing but also the impact of the debt issuance strategy on bankruptcy costs.

3.2.2. Agency cost hypothesis

According to Myers (1977), the use of debt capital to finance new projects may lead to the transference of some accrued cash flows from shareholders to fixed security claimants. This is because, even in the worst states of nature, debt-holders benefit from the priority of payment over shareholders that might no longer be able to capture the full benefits of a new investment. In these cases, shareholders are discouraged from undertaking profitable investments, which reduces the firm total value.

Myers (1977) argues that this underinvestment problem, which is induced by debt financing, can be curbed by reducing the level of leverage, by including restrictive covenants in debt contracts or by shortening the effective maturity of the firm's debt.

In particular, as Myers (1977) pointed out, if debt matures just before shareholders can decide whether or not to exercise real investment options, the conflict of interests over the partition of future cash flows is foregone and therefore, the disincentive to invest is eliminated. The more growth options the firm has in its opportunity investment set, the more often shareholders disregard profitable projects as they may not generate enough returns to justify the allocation of shareholders resources. Hence, it is generally accepted that firms with projects that have more growth options employ shorter-maturity debt in their capital structure. On the other hand, if restrictions are imposed to firm's debt financing capacity, shareholders' motivation to jeopardise bondholders' interests and to pursue inefficient investment policies will be less compelling. Additionally, Smith and Warner (1979) suggest that risky firms are particularly better off with the inclusion of restrictive covenants in debt contracts because this leads to a comparatively more effective monitoring over the residual claimants' activities, contributing for the implementation of optimal investment policies. One implication from Myers' (1977) study is that the analysis of the optimal choice of debt contract terms should not ignore the substituting role played by financing policies such as the issuance of short-term debt, the restriction of leverage capacity, and the inclusion of protective covenants in debt indentures.

Following a different approach from Myers (1977), Barnea et al. (1980) stress that debt-contracting costs arise because shareholders have an incentive to invest in riskier projects in order to maximise the expected value of their claims. Nevertheless, this risk incentive problem can be eliminated by the issuance of either short-term debt or callable debt. More specifically, they argue that the issue of callable debt

decreases shareholders incentive to jeopardise debt-holders' interests because the long position that shareholders have in the call option would be lost if they followed a policy contrary to creditors' interests. On the other hand, Barnea et al. (1980) argue the issuance of short-term debt protects the creditors position on firm's value because it assures a close monitoring of firms activities. Overall, Barnea et al. (1980) predict that short-term debt and callable debt act as substitute mechanisms in alleviating the agency costs of debt financing.

3.2.3. Asymmetric information hypothesis

In a world of asymmetric information, where firm's insiders are assumed to be systematically better informed than outsider investors, the design of debt's contracts might accomplish an important role by conveying relevant information to the market place. This argument is supported by Flannery (1986) and Kale and Noe (1990). Flannery (1986) points out that if creditors are uniformed and cannot separate high quality firms from low quality firms they will demand an average return that will benefit low quality firms opposed to high quality firms. To this extent, high quality firms will always prefer to issue short-term debt because if debt is underpriced this effect is smaller than it would be for long-term loans. It seems plausible to argue that, in opposition, the low quality firms should issue the more overpriced long-term debt, because debt's mispricing factors will be magnified by long-term maturity contracts. However, if this happened creditors would be able to recognise bad quality firms by the type of contract chosen and demand a relatively higher yield to compensate the financing risk incurred. Therefore, low quality firms will be better off if they imitate the high quality firm's behaviour and also issue short-term debt. In other words, if

no mechanism exists to prevent bad quality firm from mimicking high quality firms only a pooling equilibrium can be attained and long-term contracts are excluded from the market place.

Flannery (1986) suggested that transaction costs incurred with the issuance of debt might be used to discourage bad quality firms from mimicking the high quality firms. Hence, if transaction costs are high enough to make the continuous issuance of short-term debt unattractive for low quality firms, these firms will optimally issue long-term debt even when good firms borrow short-term debt.

Kale and Noe (1990) extend the work of Flannery (1986) arguing that even in the absence of transaction costs a separating equilibrium is possible where firms which are perceived to be of good quality by the market issue short-term debt and the other firms issue long-term debt. The major distinction from Flannery's (1986) framework relies on the assumption that the values of the projects for good quality firms are correlated over time. Additionally, this analysis assumes that: (1) the probability of a quality downgrade at the second period given a quality downgrade at the first period is higher for firms with higher expected value projects and (2) the accumulated probability of default over the two periods is higher for lower expected value projects. In these circumstances, Kale and Noe (1990) demonstrate that low quality firms issue only long-term debt in order to avoid the expected mispricing loss driven by unfavourable refinancing at the beginning of the second period when their projects are pooled with those of high quality. On the other hand, high quality firms benefit from issuing short-term debt and therefore separating themselves from bad quality firms because the relatively high default premium required by the market for

long-term debt - due to the presence of low quality firms - leads to expected mispricing losses for high quality firm.

Both Flannery (1986) and Kale and Noe (1990) have been criticised due to the restrictive assumptions that underlie their signalling arguments. Indeed, it is apparent from their models that unless these strong assumptions are made no separating equilibrium can be obtained and long-term debt will be excluded from the market place. Countering the predictions derived from these models, Diamond (1993) argues that whenever managers hold private information, both high quality and bad quality firms will optimally choose to issue a mix of short- and long-term debt. In particular, Diamond (1993) contends that the optimal maturity structure for high quality firms involves the issuance of long-term debt that should be subordinated to short-term debt. In this context, borrowers are able to increase the sensitivity of financing costs to the arrival of new information and simultaneously protect themselves against inefficient liquidation decisions[3]. On the other hand, low quality firms are induced to imitate good firms financing behaviour in order to be able to capture funds to support their investments. According to Diamond (1993), these firms will not survive long in the market because whenever their credit worthiness is revealed they will be unable to refinance their capital.

Taking into account the optimal trade off between the liquidity risk and the financial-costs information sensitivity and the mimicking behaviour of bad quality firms,

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[3] Diamond (1993) argues that firm's liquidation will always be inefficient whenever it leads to the loss of control rents that can only be assigned to borrowers but not to creditors. These control rents represent part of the proceeds from future investments that accrue to the borrower due to the bargaining power held by him over firm's returns. This bargaining power over firm's returns exists either because the borrower is critical to running the firm or because he can take unobservable actions and must be provided with proper incentives in order to pursue value maximising policies.

Diamond (1993) predicts that very high and low rated firms will issue mainly short-term debt while middle rated firms will rely mostly on long-term debt financing. This non-monotonic relation between debt maturity choice and firms' credit quality corroborates the previous results from Diamond (1991). Nevertheless, Diamond (1991) also points out that in some circumstances middle rated firms may be screened out from long-term market because of moral hazard conditionings. Indeed, when firm leverage exceeds its debt capacity borrowers have the incentive to invest in low-value, high risky projects leading to a wealth transfer from lenders to borrowers. To avoid this wealth transfer lenders are only willing to offer shorter-term debt in order to control borrowers' investment decision by imposing costly monitoring or forcing inefficient liquidation[4]. In practice, this screening mechanism might force middle rated firms to issue in the middle of debt maturity's spectrum leaving the issuance of longer and shorter-end maturity debt for high and low rated firms.

Finally, Diamond (1993) points out that apart from a mix between junior long-term and senior short-term the issuance of callable long-term debt represents also a first best solution, because it leads to optimal decisions concerning liquidation or restructuring of firms.

It is important however to bear in mind that, the relevancy of Flannery (1986), Kale and Noe (1990), and Diamond (1993) arguments relies strongly on the assumption that there is a high degree of asymmetry of information about firm's future prospects among market participants. In the case of the Eurobond market, this assumption is

[4] See Stiglitz and Weiss (1981) and Diamond (1989) for moral hazard models.

not likely to hold as issuers typically are well recognised by investors, have high credit quality, and are continuously scrutinised by financial analysts that provide updated information about firm's credit ratings and future prospects. Thus, contrary to what can be expected for other forms of debt financing, asymmetric information's considerations are not likely to be relevant for the optimal choice Eurobonds maturity.

3.3. Callability

Call provisions are defined as "the firm's right to redeem the debentures before maturity at a price that is typically included in the indenture agreement" (Smith and Warner (1979, p. 142)). Traditionally, the corporate literature has focused on providing explanations for two questions: (1) why companies choose to include call covenants on their debt issues and, once this choice is made, (2) what are the factors that determine the optimal time for the call exercise. Both of these questions have been approached by the literature that aims to assess the degree of association of firm-specific characteristics and financial market conditions with firm's decisions that affect the design and value of financing securities.

The determinants of firm's financing decisions regarding the inclusion and exercise of call provisions have been aggregated into four hypotheses. One of these hypotheses lead to a pure wealth transfers from bondholders to shareholders and have been defined as zero-sum game theory. In contrast, the remaining three hypotheses rely upon non-constant-sum mechanisms that lead to an increase on firm's value. In sections 3.3.1 and 3.3.2, these two categories of hypotheses are analysed in detail and the inherent predictions are spelled out and explained. In

particular, section 3.3.2 is divided in three sub-sections: 3.3.2.1 focuses on the studies by Bodie and Taggart (1978) and Barnea et al. (1980) for the agency costs hypothesis; 3.3.2.2 analyses the works of Boyce and Kalotay (1979), Marshall and Yatwitz (1980), Brick and Wallingford (1985), and Mauer et al. (1991) for the interest tax advantage hypothesis; finally, 3.3.2.3 centres on the research by Robbins and Schatzberg (1986) for the signalling hypothesis.

3.3.1. Zero-sum game theory

The zero-sum game theory is related to managers' incentive to reduce interest rate uncertainty taking advantage of the asymmetric information about the market future interest rate. Pye (1966) was the first to support the argument that the prevalence of callable bonds relied on their special attributes that allow hedging against interest rate risk[5]. He argued that if the assumption of certainty regarding the future interest rate level is abandoned, borrowers and lenders might no longer be indifferent as to the choice between callable or non-callable bonds. In particular, he argues that if the expectations about future interest rates differ between lenders and borrowers or if the agents are risk-averse, private corporations opposed to public institutions will always prefer to issue callable bonds[6]. In relation to the demand side for callable bonds, Pye (1966) argues that lenders that plan to sell the bonds well before maturity will constitute a clientele for callable bonds whereas those who wish to hold the bonds until maturity will form a clientele for non-callable bonds. In this context, Pye (1966)

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[5] Pye (1966) points out two other less important reasons for the issuance of callable bonds. These reasons are connected with borrowers' incentive to remove restrictive covenants and to reduce the amount of borrowings before the bond matures.

[6] Public institutions have no incentive to issue debt with call options as the exercise these options in periods of low interest rates would lead to an undesirable result of reducing private spending precisely in times when the economy is in recession.

points out that, in equilibrium, only the marginal borrower would be indifferent between issuing callable or non-callable bonds.

According to Kraus (1973), in an efficient market characterised by fully available information about the future interest rates to all investors, the increased flexibility provided by call provisions enabling managers to refinance high-cost debt with low cost debt, results in a zero-sum game. In other words, countering Pye's (1966) predictions, Kraus (1973) argues that private corporations do not benefit from issuing callable bonds because the potential gains obtained from optimally exercising the call option are simply off set by the higher yield demanded by bondholders. This argument is further supported by Myers (1971) and Bodie and Taggart (1978). Indeed, in spite of assuming as Pye (1966) that interest rates are stochastic and there is no insider information about the behaviour of future interest rates, both Myers (1971) and Bodie and Taggart (1978) point out that no incentives for issuing callable bonds can be drawn from motivations that lead to a zero-sum game. In particular, Myers (1971) stressed that unless managers possess special expertise in forecasting interest rates, there must be other unspecified motivations, apart from hedging against interest risk, to justify the generalised inclusion of call provisions into corporate debt indentures. This statement provides an impetus to new areas of research.

3.3.2. Non-zero sum game theories

3.3.2.1. Agency costs hypothesis

Bodie and Taggart (1978) argue that callable bonds are always preferable to non-callable bonds because the inclusion of a call option into a straight debt contract contributes to the reduction of shareholders incentive to reject profitable investment opportunities. Assuming efficient market conditions and risky debt financing, they demonstrate that shareholders are unable to capture the full benefit of additional investment unless appropriate mechanisms are available providing them the required rate of return. The inclusion of call options in bond contracts allows the shareholders to negotiate an interest rate on any new debt that fully reflects the value of the additional investment. Indeed, if shareholders are able to call back the outstanding debt before exercising the profitable investment option, they can adjust the interest rate of the new debt financing in order to reflect the inherent decrease on the default risk faced by bondholders. To this extent, no wealth transfer from shareholders to bondholders occurs and consequently the incentive to disregard future growth opportunities is mitigated.[7]

Barnea et al. (1980) have extended the Bodie and Taggart's (1978) work by considering shareholder risk incentives along with asymmetric information as additional agency costs that can be solved by inclusion of call provisions. In the context of asymmetric information, Barnea et al. (1980) argue that managers with

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[7] An implication that can be drawn from Bodie and Taggart's (1978) analysis is that the increasing flexibility benefits provided by call provisions are enhanced whenever the firm's bankruptcy risk is higher. Indeed, it is undeniable that bondholders will demand a higher interest return if the risk that they incur of not receiving the contracted income increases. Consequently, the call provisions will grant shareholders the ability of financing a greater amount of new investments (that otherwise would be rejected) using an adequate cost of capital.

favourable information about firm prospects will be unwilling to issue bonds before the true quality of the project is revealed to the market due to mispricing problems. However, these problems can be overcome if managers issue callable bonds with an exercise date equal to the project quality revelation date. In this case, the effect of the straight debt's mispricing will be offset by the inclusion of the call option because creditors tend to undervalue the call option due to their wrong perception about the shareholders' opportunity of refunding the outstanding bond with profit[8]. In the case of Eurobonds, the advantage of including call options in the contracts' indenture is necessarily reduced due to the fact that investors tend to be well informed about the quality of firm's projects. Indeed, as only medium/good credit quality firms can assess to Eurobond market for funding, it is reasonable to expect that investors are able to separate these firms from others of lower quality and attribute a fair price for Eurobonds offerings, which necessarily removes relevancy to the role played by embedded call options.

Nevertheless, Barnea et al. (1980) also sustain that callable debt can be used to mitigate managers' incentive to undertake lower-value, riskier projects after receiving debt financing. In this case, the inclusion of call provisions in Eurobond indentures can be indeed valuable as increases investors' guarantee that their interests will not be jeopardise by manager's adverse investment policies. More specifically, whenever the firm has callable Eurobonds outstanding, the shifting of

[8] Barnea et al. (1980) assume that the call price is set in the way that always exceeds the market value of the outstanding debt of firms with low quality projects. Therefore, low quality firms will never be able to profitably exercise the call option and the value of the call privilege will be zero for this firms. To this extent, investors will undervalue the call privilege for high quality firms because, in an asymmetric information environment, these firms cannot be distinguished from those of lower quality.

project's risk leads to a reduction on the value of firm's long-term position in inherent call options since the probability of these options to be exercised decreases to zero. According to Barnea et al. (1980), the role of call provisions in reducing managers' risk shifting incentive is magnified for firms that possess larger sets of investment opportunities.

3.3.2.2. Interest tax shield hypothesis

Boyce and Kalotay (1979) and Marshall and Yatwitz (1980) argue that, as long as the profitable corporate borrower paid, on average, a higher tax rate than the typical lender, callable bonds would always prevail over non-callable bonds. Like Brick and Ravid (1985), Boyce and Kalotay (1979) postulate that whenever the interest payments follow a non-flat pattern, lower-taxed lenders are better off by receiving decreasing interest coupons and paying increasing interest coupons while higher-taxed borrowers optimally prefer policies that result in strictly opposed interest flows. Taking into account that, interest payments on a callable bond and on its refunding issue can decline but never increase, Boyce and Kalotay (1979) point out that profitable corporate borrowers and typical lenders will mutually benefit from, respectively, selling and buying callable bonds. Typically, in this case, the exercise of the call option results in a reduction of the tax liability of the issuer, which is not offset by the additional taxes paid by the lender.

Adopting a different approach, Marshall and Yatwitz (1980) argue that the tax advantage obtained by issuing callable bonds results from the differential taxation of the call premium to lenders and borrowers. Obviously, Marshall and Yatwitz (1980)

underpin their prediction on the premise that borrowers' income tax rate exceeds lenders' capital gain tax rate, which leads to a mutual tax benefit that can be captured by these agents in determent to the government. Arguably, the impact that the call premium's differential taxation exerts on both borrowers and lenders' aggregated wealth is irrelevant when Miller's (1977) conditions for market equilibrium prevail. Nevertheless, in the case of Eurobond market because the equilibrium condition of integration of capital markets is not fulfilled, the validity of Marshall and Yatwitz's (1980) predictions about the impact of call premium tax's differential on Eurobond design cannot be removed.

Marshall and Yatwitz's (1980) predictions are however contested even when Miller's equilibrium conditions are not fulfilled. Thus, Brick and Wallingford (1985) argue that, even in a context where tax arbitrage opportunities exist, no incentive for the inclusion of call provisions can be driven from the particular tax treatment applicable to the call premium. More specifically, Brick and Wallingford (1985) develop a model showing that, for reasonable levels of capital gains tax rate, non-callable bond issues that are repurchased at a market price always dominate the conventional callable issues redeemed at fixed call price. Therefore, they argue that unless the marginal tax applicable to capital gains is substantially high, the prevalence of bonds with fixed call premiums can only be explained by other factors namely, the relatively lower agency costs carried by the standard callable issues.

The hypothesis of the relevance of call provisions due to asymmetric taxation of firm revenues is further contradicted by the study of Mauer et al. (1991). These authors

extend the assumptions underlying Miller's (1977) equilibrium hypothesis, considering that future marginal personal tax-rates and interest rates are uncertain and positively affected by the level of general business conditions[9]. Under these conditions, Mauer et al. (1991) argue that whenever a decrease of interest rates makes the exercise of call options profitable, the value of this option as it is perceived by the investor is higher than the one set by the firm. This difference of valuation results from the fact that the exercise of the call option eliminates the investor-specific's advantage of receiving relatively high interest income in periods of low personal taxes. In these circumstances, the investors will demand a so-called tax premium for the inclusion of call features on a bond, which results in a negative-sum game from the issuer's perspective. To this extent and in contrast to previous research, this model implies that a tax disadvantage is associated with the issuance of callable bonds. This result also applies for the case of Eurobonds because, under the assumptions of Mauer et al.'s (1991) model, investors will be penalised by the exercise of Eurobond's call options that tend to occur at the times when Eurobond are more valuable to investors due their personal income tax's characteristics.

3.3.2.3. Signalling hypothesis

Robbins and Schatzberg (1986) argue that callable bonds dominate non-callable bonds because they allow managers to convey to the market the firm's true credit quality. Moreover, Robbins and Schatzberg (1986) postulate that the signalling role provided by call issues entail greater advantages than short-term debt offerings

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[9] Previous studies provide evidence that attest for a positive association between both interest rates and personal tax rates and general economic conditions. To this extent, one should note the work by Van Horne (1990) for interest rates and the works by Dammon (1987), Ross (1985), and Lewis (1990) for progressive personal tax rates.

because the former mechanism allows for risk sharing among agents. Assuming that managers' compensation scheme depends on firm's residual value, Robbins and Schatzberg (1986) demonstrate that managers of firms with good quality projects will always prefer to issue either callable debt or short-term debt due to the favourable information that these securities' offerings convey to the market. This signalling effect of short-term or callable bonds prevails only because poor quality firms are better off when financing their investments using equity rather than short-term or callable bonds[10]. Nevertheless, the variability of firm's liquidation value and consequently the variability of manager compensations across all states of the world, are significantly reduced when investments are financed though callable bonds rather than short-term bonds. Assuming the managers are risk-averse, Robbins and Schatzberg (1986) conclude that the inclusion of call options on bond issues dominates the issuance of short-term, non-callable bonds.[11] Nevertheless, Robbins and Schatzberg (1986) arguments should not apply for the case of Eurobonds as investors recognise the superior credit quality of Eurobond issuers and are able to fairly price even the non-callable offerings.

[10] Under the conditions of Robbins and Schatzberg's (1986) model, bad quality firms always prefer to issue equity due to the financial recontracting costs incurred once the quality of their investment prospects is revealed to the market. More specifically, the model assumes that the default probability after the revelation of projects' quality to the market increases to such an extent that makes the renegotiation of short-term or callable contracts disadvantageous for bad quality firms when compared to the issuance of equity that occurs prior to the revelation-date.

[11] Robbins and Schatzberg's (1986) model is later criticised by Wall (1986) due to lack of generality. In fact, in their counter-argument Robbins and Schatzberg (1988) unveil some restrictive assumptions underlying their predictions. To this extent, callable bonds only act as best suited instrument for signalling firm's quality under non-stochastic dominance for firm default probability function, unrestricted overcapitalisation, and absence of trading constraints in capital markets.

3.4. Convertibility

Several authors have hypothesised about the distinctive role played by convertibles as an alternative source of capital raising compared to other more basic forms of external funding: equity and straight debt. Indeed, convertible debt constitutes a hybrid instrument for fund raising that aggregates characteristics of both debt and equity capital. To this extent, the way that convertible offerings affect the value of the issuer firm and its financing claims depend strongly on the combination of equity and debt-like components embedded in this type of offering. In a context of value maximising agents, corporate literature has been concerned with the impact that the issuance of straight debt or common stock exert on the total value of the firm and on the value of the individual contracts that support the firm's business activity. On the other hand, due to the linkage of convertible debt to both straight debt and equity claims, most of the studies concerning convertible debt rationale have focused on the use of equity-like and debt-like features to produce desired effects on the value of individual and aggregate claims over firm's assets. In section 3.4.1 the studies of Jensen and Meckling (1976), Smith and Warner (1979), and Green (1984) that attribute to convertible issues the ability to reduce costs are discussed. Section 3.4.2 analyses the studies by Constantinides and Grundy (1989), Stein (1992), Nyborg (1995), and Mayers (1998) that predict the use of convertibles for signalling the favourable information about firm's projects. Finally, in section 3.4.3 Brennan and Kraus (1987) and Brennan and Schwartz (1988) studies that highlight the importance of convertibles for reducing risk measurement's uncertainty are discussed.

3.4.1. Agency costs hypothesis

Jensen and Meckling (1976) stress that the use of convertibles or detachable warrants is attractive because it reduces agency costs associated with debt financing by allocating part of the proceeds from pursuing low-value, riskier investment policies to convertible- and warrant-holders. Of course, the magnitude of this reduction in debt agency costs, and ultimately in the total costs of agency, is more significant the higher the managers' incentive to increase equity-holders' wealth at the expense of debt-holders. In this context, Jensen and Meckling (1976) point out that the inclusion of convertible privilege or detachable warrants in debt contracts should be more frequent for those cases where less constrains exist for managers to transfer wealth between firm's financing claimants by pursuing non-value maximising projects. In particular, these authors mention the case of conglomerated companies where it is particularly easy to change from previously defined acquisition and divestiture policies and where the distorting incentives for wealth transfers are significant.

Conversely, Smith and Warner (1979) argue that the inclusion of convertible provisions in debt contracts leads to two opposing effects on the value of the firm. Hence, these authors point out that although convertible debt issues may reduce manager's incentive to increase firm's risk, they may also exacerbate the manager's willingness to forsake profitable future investments. According to Smith and Warner (1979) the underinvestment costs will be enhanced by the existence of outstanding convertible debt in firm's capital structure because wealth transfers from shareholders to convertible-holders will occur if certain profitable projects are undertaken. Indeed, whenever the investment on profitable projects allows the firm

avoid bankruptcy in those states where otherwise bankruptcy would occur, convertible-holders benefit from the increase on the value their defaultable convertible bond at the expense of the value of current shareholders' claims. Intuitively, firms with high growth opportunities face opposing value effects from issuing convertible debt: on the one hand risk incentive costs are reduced but on the other hand the underinvestment costs are enhanced. According to Smith and Warner (1979) the dominance of one of these effects will determine the optimal choice of debt contract.

Green (1984) provides the analytical foundation for the use of convertibles and warrants as risk-incentive neutralising mechanisms. Assuming the absence of equity agency costs, the partial exercise of conversion privilege and the existence of risky debt[12], Green (1984) demonstrates that for certain non-bankruptcy states convertible-holders would prefer not to convert and to receive a fixed payment as ordinary straight debt-holders. In this case, existing shareholders will not benefit from pursuing higher risk policies because whenever the convertible option is not exercised convertible-holders fully capture project's rents without bearing any additional risk. Therefore, the issuance of convertibles prevents shareholders from choosing non-value maximising projects because only in upper states existing equity-holders are able to share with the new equity claimants the benefits from redistributing bondholders' wealth. In intermediate states existing shareholders will

[12] The assumption of risky debt is particularly relevant to support Green's (1984) predictions because it is only the existence of bankruptcy states that provides shareholders the incentive to increase the volatility of firm's cash-flows by pursuing 'anti-diversification' policies that lead to investments in activities highly correlated with firm's existing assets.

be stripped out from these benefits, as the rents generated by the riskier project will be fully captured by convertible debt-holders.

3.4.2. Asymmetric information and signalling hypotheses

Assuming information asymmetry between insiders and outsider investors, Constantinides and Grundy (1989) argue that in the absence of other signalling mechanisms[13] convertible issues represent the best instrument for conveying credible signals to the market and for avoiding sub-optimal investment policies. In Constantinides and Grundy's (1989) model the partial use of new funds to finance the stock repurchase from outside investors plays a crucial role in assuring that the choice of the appropriate signalling mechanism eliminates all potential deviations from optimal investment policies. Indeed, managers are prevented from conveying wrong signals to the market because the benefits that they can get from issuing overvalued claims are cancelled off by the losses resulting from an inherently more costly stock repurchase process. To this extent, Constantinides and Grundy (1989) argue that convertibles as hybrid securities are more suited for signalling a firm's true quality than straight debt because their market value will always equal or exceed the value of funds allocated to the stock repurchase. While for low values of the firm the debt-like component dominates and the value of the convertible increases with the firm value at decreasing rates, for high values of the firm the equity-like component dominates and the value of the convertible increases at increasing rates.

In contrast, the value of straight debt contracts increases continuously at decreasing

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[13] Constantinides and Grundy (1989) show that whenever the level of investment undertaken signals favourable information about the quality of firm's projects, straight debt issues will dominate convertible offerings as the most suited tool to convey firm's true quality to the market.

rates which implies that for higher firm's values the cost of stock repurchase will always outweigh the amount of funds that investors are willing to lend to the firm. The signalling model by Constantinides and Grundy (1989) has been criticised by subsequent works mostly because of its lack of relevance to empirical evidence[14]. In particular, the studies by Stein (1992), Nyborg (1995), and Mayers (1998) constitute important contributions for providing empirical support to the signalling rationale that attributes to convertibles comparative advantage in alleviating adverse-selection costs.

Both Stein (1992) and Nyborg (1995) allow for the existence of a separating equilibrium where good quality firms issue long-term debt, bad quality firms issue equity and medium quality firms issue convertible debt. However, while Stein (1992) argues that signalling rationale underlying the use of convertibles is related to financial risk-hedging motivations, Nyborg (1995) contends that these motivations are related to the elimination of potential costs of adverse-selection. The distinctive feature between Stein's (1992) and Nyborg's (1995) models derives from the different role attributed to the inclusion of call provisions in convertible indentures as a mean of guaranteeing an efficient conversion of these securities into equity capital. According to Stein (1992), call provisions play a crucial role in forcing the exercise of the conversion privilege because, unless the investors are induced to exercise the convertible option, the firm will be left with the burden of repaying unconvertible

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[14] In particular, the restrictive assumptions of absence of risky debt, perfect coincidence between investment and financing timing, and prohibition of stocks repurchase from managers have been pointed out as significant pitfalls to validity of Constantinides and Grundy's (1989) model. Furthermore, no evidence has been found for the predicted association between the issuance of convertible or straight debt and the repurchase of common stocks.

debt. Moreover, investors will only be willing to convert their claims when managers call back the convertibles if the conversion value excess the call price. Consequently, Stein (1992) argues that only insiders that possess good prospects about the evolution of firm stock prices are able to optimally issue convertible securities. Whenever, financial distress costs are high enough to restrain bad quality firms from issuing less mispriced securities (e.g. straight debt or convertibles), an separating equilibrium is obtained in which good firms issue long-term debt, bad firms issue equity, and medium firms issue convertible debt. In this context, the benefit for medium quality firms of issuing convertible securities is twofold. First, issuance's mispricing costs are reduced because these firms are able to signal their higher quality to the market and separate themselves out from bad quality firms. Second, the insurance against the financial distress costs driven by the negative impact on interest payments of adverse stock price movements is obtained by successfully forcing conversion through the exercise of the embedded call option.

Countering this view, Nyborg (1995) points out that the benefits of using convertible debt as an instrument to hedge against financial distress are only realised when voluntary rather than forced conversion is achieved. According to this author, the information effects on stock price are more negative if equity capital is obtained via first issuing callable convertible debt and later forcing conversion rather than issuing equity outright[15]. Nyborg (1995) points out that bad quality firms are deterred from issuing convertible debt not because of the prohibiting costs induced by the

[15] The intuition behind the argument that the forced conversion of bonds leads to more unfavourable effects on stock prices than an initial issuance of equity financing results from the appealing assumption that the market recognises more precision on information conveyed by financing policies that take place closer to firm quality's revelation date.

repayment of unconvertible debt but rather because of the negative informational effects resulting from call exercise. In these circumstances, bad quality firms are forced to issue the most mispriced security i.e. equity capital, due to excessive costs associated with the use of the insurance against financial distress provided by the call provision. On the other hand, managers of medium quality firms benefit from issuing callable convertible debt because they can profit from issuing a less undervalued security without incurring in an excessive risk of having to use the call provision to protect against adverse stock price movements. Good quality firms are able to convey their true quality and separate themselves out from lower quality firms by issuing straight debt and therefore giving up insurance against stock prices' variance. Unlike previous analyses, Nyborg (1995) has the merit of providing an informational asymmetry rationale for the use of callable convertible debt consistent with the observed delay on call exercise (e.g. Ingersoll (1977) and Brennan and Schwartz (1988)) and with the significant negative market reaction to convertibles call announcement (Mikkelson (1981)).

Although adopting a different approach both Stein's (1992) and Nyborg's (1995) predictions are consistent with the contradictory evidence found by Mikkelson and Partch (1986) that high rating convertibles issues have a negative effect on stock prices whereas low rating convertibles issued have essentially no impact on stock prices. Indeed, the lower the issue rating the more credible the signal conveyed by convertibles about the quality of firm's future prospects.

Interestingly, Mayers (1998) argues that the prevalence of convertible issues is justified by sequential financing requirements. Although this model also relies on call provisions to ensure that forced conversion is achievable, Mayers (1998) distances himself from Stein (1992) by arguing that forced conversion is required to alleviate uncertainties regarding the value of future investment options rather than reducing information asymmetries about the assets-in-place. More specifically, Mayers (1998) contends that firms benefit from issuing convertible bonds because these type of securities provide not only economies of scale in issuance costs but also reduce the overinvestment incentive postulated by Jensen (1986)[16]. Essentially, convertible bonds provide equity funds for the firm through conversion when the future investment option is valuable and control the overinvestment incentives by returning the funds to creditors when the investment option is not exercised. Moreover, Mayers (1998) claims that whenever this investment option expires before the conversion exercise date, convertible bonds that include a call option have an advantage relative to other sources of financing. This advantage results from the accrued flexibility to force conversion whenever the investment option is valuable and the bond is in the money (i.e. the conversion value exceeds the call price).

Generically, Mayers (1998) postulates that firms with focused, less diversified activities benefit the most from issuing convertible bonds. He justifies this by pointing out that the firms that have a strong positive correlation between the values of the current project and the investment option benefit from larger reductions on

[16] Indeed, Jensen (1986) points out that whenever funds are raised before the future investment option matures, managers have the incentive to overinvest benefiting from the free-cash-flows in determent of creditors' interest. Moreover, Smith (1977) and Bhagat and Frost (1986) provide evidence of economies of scale in issuance costs captured by avoiding smaller multiple issues.

issuance and overinvestment costs than more diversified firms. For the more diversified firms the issuance of convertibles might result on unwanted conversion when the convertible bond is in the money but the investment option is not worthy and excessive issuance cost when the convertible bond is out of the money but the investment option is valuable.

Although Stein (1992), Nyborg (1995), and Mayers (1998) conjectures about the relevancy of convertible offerings might be valid in markets where asymmetric information about firm's existing and/or future projects prevails, it is reasonable to expect that the same does not apply in the Eurobond market. Indeed, considering that Eurobond issuers are known as being of medium/high credit quality, the signalling effect of convertibles that assures an adequate pricing for other types of debt securities is likely to be irrelevant for Eurobond offerings.

3.4.3. Risk uncertainty rationale

Brennan and Schwartz (1988) in a pioneering framework argue that the use of convertibles is intrinsically connected with the insensitivity of convertibles' value to issuer's risk. Moreover, they point out this feature of convertible bonds also protects creditors against managers' incentive to pursue risk-shifting policies (see Jensen and Meckling (1976) and Green (1984)). Companies for which there is a greater divergence in risk assessment between outsider investors and managers benefit most from issuing convertible debt. This argument is consistent with the empirical evidence that shows a strong positive relationship between the issuance of

convertibles and the firm leverage, the set of growth opportunities, and the volatility of cash flows.

Brennan and Kraus (1987) argue that in the context of information asymmetry about the density function of firm's existing and new project returns, the choice of the appropriate financing strategies is crucial to guarantee the firm's quality type is fully revealing equilibrium[17]. In their model, Brennan and Kraus (1987) analyse the case where investors are uncertain about the "riskiness" of the distribution of firm's returns. For a specific set of probability density functions of firm's returns, Brennan and Kraus (1987) argue that the issuance of convertible bonds, junior bonds or packages of bonds and warrants can be used as mechanisms for signalling firms' true inherent risk. In particular, they point out that highly leverage firms with favourable information about future stock returns benefit from issuing subordinated convertible bonds as these firms are able to separate from other high levered firms whose future payouts are thought to be insufficient to assure full conversion of the bonds issued.

3.5. Protective covenants

There are several restrictive covenants that can be used in debt indentures for mitigating agency costs and reducing moral hazard and/or adverse selection problems. Smith and Warner (1979) aggregate debt covenants into five major categories: firm's investment/production policy controls, dividend payout controls, financing policy controls, debt payoffs controls and bonding controls. Although this

[17] According to Brennan and Kraus (1987) a fully revealing equilibrium exists when all the issued claims are priced at their true, full-information, value. To this extend, Brennan and Kraus's (1987) signalling equilibrium model rules out all the potential conflicts of interest between actual and future firm's financial claimants.

classification is fairly extensive it is not mutually exclusive. More specifically, bonding controls provide a foundation for the definition of income and balance-sheet thresholds and credit risk ratings that allow for close monitoring of firm's financing, investment, and dividend policies. In practice, bonding controls determine the amount and quality of the accounting information provided by the firm to outside agents and assure the compatibility of this information across firms and time. To this extent, these covenants provide reliability for the definition of accounting-based thresholds that allow creditors to control firm's activities by triggering default whenever one of these thresholds is violated. On the other hand, bonding controls also provide a framework to external rating agencies that regularly assess the evolution of firm's credit quality. Put options that are triggered by credit downgrades formulated by these rating agencies represent another feature available to creditors to closely monitor firm's policies. Specifically, these put options confer to creditors the right to demand the immediate payment of all debt obligations whenever an event that is likely to change substantially the firm's business risk e.g. financial restructuring, take-over or mergers, and changes in operating licenses prompts a downgrading assessment by a rating firm. Both accounting-based and credit-downgrading covenants will be analysed and the main hypotheses about their use for reducing financing inefficiencies will be discussed in the following sections. Specifically, section 3.5.1 discusses the studies by Myers (1977) and Smith and Warner (1979) that postulate the use of protective covenants for agency costs motivations. Section 3.5.2 analysis the works by Chan and Kanatas (1985) and Chan and Thakor (1987) focused on the use of embedded covenants to reduce asymmetric information costs.

3.5.1. Agency costs hypothesis

Typically, the use of protective covenants has been associated with the desire to reduce or eliminate debt agency costs. Indeed, Myers (1977) and Smith and Warner (1979) argue that protective covenants can be used to alleviate inefficiencies derived from the distorting investment incentives induced by growth option assets and bankruptcy risk. Myers (1977) points out that, even in absence of capital market imperfections, the use of debt financing induces firms to pursue underinvestment policies in those states where bankruptcy is unavoidable unless the investment option is otherwise exercised. He stresses the fact that if the debt maturity date occurs after the information about future states of the world is revealed but before the expiration of the investment option, the exercise of this option will result in a transfer of wealth from shareholders to bondholders. In a rational expectations' world, creditors will be expected to demand a higher interest yield to compensate the monitoring costs incurred in controlling shareholders incentives to disregard profitable investments. For this reason, shareholders will be prepared to accept debt terms that restrict their investment decision power but that allow for a greater alignment between creditors and shareholders' interests to avoid excessive agency costs. Smith and Warner (1979) extend the use of protective covenants for purposes of controlling shareholders incentive to follow risk-shifting investment policies and to dilute the value of outstanding debt by issuing equal- or higher-ranking claims. In particular, Smith and Warner (1979) predict that the higher firm's leverage the greater creditors' incentive to force the inclusion of terms that restrict firm's debt capacity. Indeed, an excessive increase of bankruptcy risk that follow the acceptance of additional debt

leads inevitably to the dilution of outstanding claims jeopardising therefore creditors interests.

3.5.2. Asymmetric information hypothesis

Assuming asymmetry of information between lenders and borrowers about firm's credit worthiness, Chan and Kanatas (1985) postulate that higher quality firms attach covenants that restrict the use of specific assets to their debt contracts in order to signal their superior quality to the market. These authors sustain that whenever the transaction costs associated with the inclusion of these covenants (e.g. legal documentation, monitoring and/or insurance for the asset to maintain the value at the agreed level, and the costs of the restrained use of the assets) are high enough to prevent low quality firms from mimicking high quality firms' behaviour a separating equilibrium is attainable. In this context, high quality firms are able to issue debt at favourable interest rates avoiding inherent adverse-selection costs by including restrictive covenants in the indentures of new debt contracts. Chan and Thakor (1987) extend the work of Chan and Kanatas (1985) considering the impact of asymmetric information about not only firm quality type but also borrower unobserved actions on the design of debt contracts. In other words, Chan and Thakor (1987) model the use of restrictive covenants considering both adverse-selection costs and moral hazard problems. Similar to Chan and Kanatas (1985), Chan and Thakor (1987) contend that whenever the supply of funds is limited, the debt contracts issued by high quality firms are more likely to include greater restrictions over the disposition of tangible assets. The intuition behind this argument is that by attaching more restrictive covenants to their contracts, high quality firms signal not

only the higher probability of success of their projects but also their willingness to apply more managerial effort in order to avoid the inherent higher costs of defaulting debt covenants.

Both Chan and Kanatas (1985) and Chan and Thakor (1987) models cannot, however, adequately explain the decision to include protective covenants in Eurobond indentures as investors are able to recognise the superior credit quality of Eurobond issuers and therefore are confident about borrowers' ability to service the contract obligations.

3.6. Summary and conclusions

Several studies have discussed the crucial role played by the optimal design of debt contracts in assuring the maximisation of firm's total value. In particular, these studies discuss how debt-financing inefficiencies magnified by the market conditions and firm specific characteristics can be resolved by an adequate choice of contract terms. Myers (1997) and Barnea et al. (1980) predict that risky firms with high growth opportunities benefit from issuing short-term or callable debt due to the ability of these contracts to eliminate shareholder's distorting investment incentives. Moreover, Myers (1977) points out that the reduction of firm's leverage capacity can fulfil the same aim by reducing distorted wealth transfers between shareholders and debt-holders. Bodie and Taggart (1978) also support the prediction that the issuance of callable bonds mitigates contracting costs of high growing firms. On the other hand, Flannery (1986), Kale and Noe (1990), and Diamond (1991, 1993) argue that, in contexts of high asymmetric information, the use of optimal maturity structure is crucial for signalling purposes or for reducing adverse-selection costs. More

specifically, while Flannery (1986) and Kale and Noe (1990) stress that firms use short-term debt to signal their credit worthiness, Diamond (1991, 1993) predicts a non-monotonic relationship where intermediate firms issue in the middle of the maturity spectrum and low and high rated firms issue at the maturity ending points. Both Diamond (1993) and Robbins and Schatzberg (1986) attribute to the maturity choice and the issuance of callable debt a substituting role in order to minimise asymmetric information costs. However, Robbins and Schatzberg (1986) argue that call provisions have comparative advantages to short-term debt because they not only act as a signalling mechanism, but also it provides a better risk sharing of firm uncertain cash-flows. Obviously, the explanatory power of these studies, that are based on the assumption of asymmetric information markets, is likely to be limited for the case of Eurobond contract's design as the level of information about issuers' credit quality conveyed to Eurobond market participants is typically high. In a context of asymmetry of taxation over personal and corporate income and assuming non-flat term structure of interest rates, Brick and Ravid (1985) and Mauer and Lewellen (1987) predict that the optimal choice of debt maturity will confer tax advantages both to creditors and borrowers. Later on, Lewis (1990) dismisses this view arguing that whenever firm's leverage and contract structure are simultaneously chosen, debt maturity relevance can no longer be explained by tax arguments alone. The discussion about the impact of taxation on the use of call provisions leads also to contradicting arguments. Hence, both Boyce and Kalotay (1979) and Marshall and Yatwitz (1980) argue that for asymmetric taxation and uneven interest term scenarios, the issuance of callable debt provides tax gains to investors at the expense of the government. Conversely, Brick and Wallingford (1985) and Mauer et al.

(1991) predict a comparative advantage of non-callable bonds due to increased tax gains from repurchase and elimination of accrued discount of bond price, respectively. On the other hand, the superior abilities of callable bonds to hedge against interest rate risk underscore Pye's (1966) argument that firms are more willing to include call provisions in their contracts whenever interest rate are high and/or more volatile.

Jensen and Meckling (1976), Smith and Warner (1979), and Green (1984) hypothesise the use of convertible debt by high levered, high growing firm as a mean to reduce potential agency costs. Nevertheless, Smith and Warner (1979) emphasise that the beneficial effects of convertible issues can be removed by the increase of underinvestment incentives associated with these types of issues. The relevance of convertible provision for alleviating financing inefficiencies is also stressed by Constantinides and Grundy (1989), Stein (1982), Nyborg (1995), and Mayers (1998) but for signalling reasons. These signalling reasons are, however, deemed to become irrelevant for explaining the design of offerings in markets where the symmetry of information prevails, as in the case of the Eurobond market. Brennan and Schwartz (1986) and Brennan and Kraus (1985) predict a widespread use of convertible contracts whenever the firm's cash-flows risk is perceived to be high or very difficult to assess. Finally, Myers (1977) and Smith and Warner (1980) predict that high risk, growing firms reduce agency costs by attaching protective covenants to debt contracts while Chan and Kanatas (1985) and Chan and Thakor (1987) postulate the use of these covenants for adverse-selection and/or moral hazard motivations. Once again, the latter motivations that are related to asymmetric information premises are

likely to become irrelevant for explaining the inclusion of covenants in the case of Eurobond offerings.

Generically, the predictions from the aforementioned studies about the determinants of debt contract design underpin the empirical analysis of this research whose main hypotheses will be discussed and tested in chapters VI and VII.

CHAPTER IV: EMPIRICAL STUDIES ON DEBT CONTRACT DESIGN

4.1. Introduction

The purpose of this chapter is to discuss the existing empirical studies testing the theoretical predictions on the choice of debt contract design. The main focus of discussion will be on methodological or sample selection issues, which are relevant for particular emphasis of this thesis. Almost all of the previous empirical analyses focus on the choice of one particular type of debt contract feature. The only exception to this is the study by Dennis et al. (2000). This study examines the determinants of the simultaneous choice of maturity structure and security covenants[18] for a particular set of debt contracts. Furthermore, the regression analysis employed in this study allows for the simultaneous determination of the contract terms and the level of firm leverage. Due to the particular interest of the empirical analysis by Dennis et al. (2000) for this research's purposes a relatively greater attention will be allocated to the discussion of their work.

This chapter is organised as follows. Section 4.2 focuses on the studies by Barclay and Smith (1995), Guedes and Opler (1996), Mitchell (1993) and Dennis et al. (2000) that test predictions of debt maturity choice. In section 4.3 the studies by Mitchell (1991) and Kish and Livingston (1992) that focus on the determinants for

[18] Security provisions are described as mechanisms that confer to creditors the title to pledged assets in the case of bankruptcy or liquidation of the firm.

the inclusion of call provisions in debt contracts are discussed. Section 4.4 analyses the studies by Abhyankar and Dunning (1999) and Billingsley et al. (1988) that provide evidence on the rationale for inclusion of a convertible option. Section 4.5 focuses on the studies by Citron (1995) and Dennis et al. (2000) that assess theoretical predictions regarding the use of certain protective covenants in debt indentures. Finally, section 4.6 summarises the limitations and main findings of the empirical studies.

4.2. Maturity

Barclay and Smith (1995) test the theoretical predictions about debt maturity choice using a methodology that separates time-series effects from cross-sectional effects, which permits to overcome some of the econometric limitations pointed out to studies that use pooled regression methods. Although no change is observed in the sign of the coefficients of the cross-section and time-series effects regressions compared to the pooled regression, the significance of the coefficients changes dramatically in some of the cases. In particular, these authors show that the impact of factors such as firms' credit worthiness and tax liability status on debt maturity structure are primarily induced by changes across time rather than changes across firms. Overall, Barclay and Smith (1985) provide strong support to Myers' (1977) underinvestment hypothesis and mixed support for the asymmetric information hypothesis[19]. No evidence is found to support Brick and Ravid's (1985) argument of tax advantage effect on debt maturity choice. Unlike the approach used in this thesis,

[19] Flannery (1986) prediction about the propensity of firms to issue shorter-term debt in highly asymmetric information environment is statistically although not economically validated by the data. On the other hand, Diamond (1991) hypothesis of a non-monotonic relation between firm size and maturity choice is generally supported by the regression analysis.

Barclay and Smith (1995) focus on the analysis of the maturity of all the liabilities included in the firm's balance sheet. Therefore, the impact exerted by the unique characteristics of certain types of liabilities (e.g. Eurobonds) on the maturity structure of debt contracts cannot be assessed in this study. Moreover, there are comparative advantages of using an incremental analysis that focuses on new debt issues over the balance sheet approach adopted by Barclay and Smith (1995). These comparative advantages will be discussed in Chapter V where the characteristics of the sample set used in this research are examined in detail.

Guedes and Opler's (1996) results are based on an univariate study and a multivariate pooled regression analysis that relies on a similar set of proxies for firm's characteristics to Barclay and Smith (1995). Nevertheless, Guedes and Opler (1996) add some other interesting measures to assess the importance of signalling and agency costs theories. Hence, to test Myers (1977) and Barnea et al. (1980) arguments that whenever new investment timing coincides with the repayment of debt contracts the distorting investment incentives that lead to sub-optimal decisions are eliminated, debt offering maturity is regressed on a proxy for issuer's asset maturity[20]. To assess the validity of predictions from asymmetric information and signalling theories variables such as the log of sales revenue (as a proxy for firm size), and the stock return of one year before and two years after the issue are used.

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[20] Asset maturity is defined as the time pattern of cash flows generated from a firm's assets and is measured by Guedes and Opler (1996) as (gross PP&E/Assets) multiplied by (gross PP&E/Depreciation) where PP&E stands for property, plant, and equipment.

Overall, the results from Guedes and Opler (1996) are generally in line with agency costs hypothesis but only partially support asymmetric and signalling views. In particular, the coefficient of the stock returns for one-year prior and two years after announcement-date are statistically non-significant which contradicts the arguments that firms take advantage from securities' mispricing or use debt maturity to signal their superior quality. Finally, none of results from Guedes and Opler's (1986) analysis provide support to theoretical predictions that relate tax considerations with debt maturity decision. In spite of focusing on new issues, Guedes and Opler (1986) use different types of debt offerings for hypotheses testing, which does not allow the examination of the influence exerted by certain characteristics of debt markets, e.g. the segmentation of the Eurobond market, on the relevancy of debt design's determinants.

It is relevant at this stage to comment briefly on the study by Mitchell (1993) due to its particular focus on debt maturity decisions that are driven by monitoring constraints. The idea that due to low quality firms with particularly uncertain short-term prospects are more likely to issue short-term debt are strongly support by Mitchell's (1993) regression analysis on a pooled sample of debt issue announcements. On the other hand, in line with Barclay and Smith (1995) and Guedes and Opler's (1996) analyses, all other inferences driven from Mitchell's (1993) study provide partial validity to signalling factors and remove the relevance of tax considerations for determining firm's debt financing choices.

Finally, Dennis et al. (2000) departs from the previous analyses and provides a considerable contribution in the study of the fundamentals underlying the simultaneous choice of debt contract features. Indeed, Dennis et al. (2000) find evidence that suggests the validation of theoretical predictions related to the choice of debt features is more robust when the assessment of single features is abandoned and the simultaneous choice of other contract terms and leverage level is taken into account. In particular, these authors observe that the inferences about cost-contracting hypotheses became more consistent with the underlying theory when other contract features and firm leverage are allowed to change simultaneously with the relevant dependent variable. The relevant variables concerning debt design that are considered in Dennis et al.'s (2000) study correspond to debt maturity and the inclusion of collateral provisions.

Another comparative advantage of Dennis et al. (2000) arises from the focus on only one type of debt issue – bank revolving credit agreements – avoiding therefore the limitations from analysing an extensive and differentiated set of debt financing instruments. The revolving credit agreement is a bank facility that enables firms to borrow, repay, and re-borrow certain amounts providing that they do not exceed the maximum limit established at the beginning of the deal. Like the Eurobond issues that are the focus of this thesis, revolving credit agreements are typically issued by median/large firms and involve amounts that account for a significant portion of issuer's total liabilities. Therefore, the results from Dennis et al. (2000) will be used consistently as a benchmark for the discussion of empirical evidence presented in subsequent chapters.

Generally, Dennis et al. (2000) provide unequivocal support to the agency cost argument that predicts that shortening debt maturity and pledging collateral fulfil the same role in resolving the asset substitution and underinvestment problems. Furthermore, consistent with Myers' (1977) predictions that the reduction of leverage level acts as a substitute mechanism to the shortening of maturity and to the inclusion of collateral provisions, the coefficient of leverage is significantly negative in the maturity regression and significantly positive in the collateral debt equation. On the other hand, similar to previous studies the non-monotonic relationship between credit quality (proxied by the firm's Z-score value) and debt maturity is strongly validated by the simultaneous regression results.[21] Interestingly, countering previous empirical evidence, the tax shield effect on maturity choice postulate by Brick and Ravid (1985), Mauer and Lewellen (1987), and Kane et al. (1987) are partially supported by Dennis et al.'s (2000) results. Finally, no support is presented for the signalling theories and only the asymmetric information prediction of increased propensity to issue short-term debt for firms holding private information is supported by the expected sign on the firm size's coefficient.

4.3. Callability

Mitchell (1991) considers three types of debt features: time to maturity, call options, and sinking fund provisions as factors that can used by managers to affect the maturity length of a bond issue.[22] She runs a conditional Logit regression over a

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[21] Dennis et al. (2000) validate the U-shape relationship between credit quality and maturity predicted by Diamond (1991, 1993) by introducing a non-linear variable in the regression measured by the square value of the proxy for credit risk.

[22] Clearly, it is easy to understand how the choice of maturity or the inclusion of call features can affect the period of time over which bond's contracted obligations have to be satisfied. On the other

sample of bond issues excluding floating-rate bonds, convertible bonds, and issues made by public utility firms. The conditional Logit regression tests the probability of an issue to include one type of provision given the previous choice on the other types of debt terms. The results provide mixed support to both signalling (see Flannery (1986) and Robbins and Schatzberg (1986)) and asymmetric information arguments (see Barnea et al. (1980)) although the choice of contract terms most frequently observed is slightly more consistent with the asymmetric information theory. More specifically, high quality firms tend to issue median term callable bonds with or without sinking fund features, which is consistent with asymmetric information arguments. The observed complementary role played by sinking fund and call features is consistent with asymmetric information view that firms should devise a contract that provides the best match between the refunding time and the release of new information in an attempt to avoid excessive adverse-selection costs. Conversely, this finding contradicts the signalling view that suggests that high quality firms are restrained from including sinking fund provisions in their contracts because this would reduce contracting costs and potentially lead bad quality firms to pool their projects with those of high quality firms. Nevertheless, the evidence which suggests that high quality firms choose a relatively shorter maturity contract together with call option features seems to be out of line with the substitution arguments stressed by Barnea et al. (1980, 1981).

It is important to note, that the fact that several types of bond offerings are used in Mitchell's (1991) study, is bound to introduce some bias in the analysis and might

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hand, sinking fund provisions impose to the firm the obligation to retire part of the bond issue each year by calling the required number of bonds at a specified price (usually the par value) or by repurchasing them in the market, whichever is cheaper.

explain some of the inconclusive results obtained particularly for asymmetric information predictions. Hence, the use of a single type of offerings i.e. Eurobond issues for hypotheses testing should provide more consistent results about the validity of theoretical predictions regarding the use of call provisions in debt indentures.

Kish and Livingston (1992) run a univariate and a Logit analysis to assess the predictive power of a set of explanatory variables in identifying a firm's propensity to issue callable versus non-callable bonds[23]. The explanatory variables were selected to proxy for firm specific-characteristics considered relevant to test a number of theoretical predictions regarding the use of callable bonds. Hence, Kish and Livingston (1992) test the (1) interest risk uncertainty hypothesis, (2) interest level hypothesis, (3) agency costs hypothesis[24], (4) tax advantage hypothesis, and (5) maturity hypothesis, assessing their accuracy individually and as a group. Although the later hypothesis is supported by the call option valuation theory that postulates a positive association between bond maturity and the value of the call written on the bond, the estimation results might be biased as the impact of joint effects is not taken into account. Thus, according to a significant number of theoretical studies (see Barnea et al. (1980), Diamond (1993), and Robbins and Schatzberg (1986), amongst others) the decisions about the maturity structure and the inclusion of call options in bond issues are taken simultaneously and serve a similar role in mitigating agency

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[23] Convertible, zero-coupon, and floating rate bond issues are excluded from the sample set.

[24] Kish and Livingston (1992) assess individually the predictions from agency cost theory that are related to underinvestment and information asymmetry arguments on one hand and bankruptcy risk hypothesis on the other. For testing underinvestment and asymmetric predictions a proxy for firm's growth opportunities was used. For assessing bankruptcy risk significance two different measures of firm leverage were used namely, debt and asset ratio and new debt to total outstanding debt ratio.

and asymmetric information costs[25]. Moreover, the inclusion of leverage as a proxy for bankruptcy risk introduces inconsistencies in the analysis due to the same kind of reasons. Generally, Kish and Livingston's (1992) analysis provides significant support to agency costs hypothesis, interest level hypothesis, and maturity hypothesis. On the other hand, the results are inconsistent with the interest rate uncertainty and tax advantage hypothesis.

4.4. Convertibility

Abhyankar and Dunning (1999) examine the accuracy of theoretical predictions about the use of convertibles by regressing the announcement-date abnormal returns on firm-specific characteristics. The data set that supports Abhyankar and Dunning's (1999) empirical analysis aggregates 237 convertible bonds issued by UK companies from 1982 to 1996. These authors use a set of proxy-variables to test the predictions related to the firm's risk uncertainty by Brennan and Schwartz (1988) and Brennan and Kraus (1987), the risk-shifting incentive by Green (1984), and the signalling rationale by Stein (1992). Abhyankar and Dunning (1999) find that, the only variable that is statistically significant is the proxy for the call protection period. Nevertheless, the results show a positive relation between the stocks abnormal return and the call protection period, which is inconsistent with Stein's (1992) signalling arguments.

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[25] This issue is particularly highlighted by the empirical study of Thatcher (1985). Indeed, this author does not include the maturity issue as an explanatory variable to avoid inconsistencies arising from not allowing for the simultaneous choice of maturity and inclusion of call provision in the contract.

The approach followed in this research departs from Abhyankar and Dunning's (1999) regression analysis essentially for four reasons. Firstly, in order to avoid the spurious effects from outside variables affecting the movement of stock market price (e.g. parallel announcements of changes in firm's investment, financing or payout policies) the propensity of issuance of convertibles instead of the abnormal announcement date return is used as the dependent variable. Secondly, the potential serial correlation problems introduced by running a pooled regression over a longitudinal data set are overcome by using a panel data approach. Thirdly, a single type of debt offerings is used not only to avoid the influence of spurious factors unrelated to the main hypotheses about debt design but also to consider the impact of the unique characteristics of the Eurobond market on the issuance of convertibles. Finally, a simultaneous-equations approach is used in order to test the joint effects of the choice of other features and firm leverage on the decision to issue convertible securities.

Billingsley et al. (1988) assess the propensity of firms to issue convertibles compared to the probability of issuing either equity or debt capital. Although this study does not shed light about the determinants for the issuance of convertibles, it highlights the importance of considering the equity market performance, firm's risk, and debt-equity target ratio as control variables influencing managers' behaviour regarding the choice of financial contracts. Billingsley et al.'s (1988) results show that the equity market performance and firm's risk are significantly positively related to firm's propensity to issue equity-like securities whereas the deviation from debt-equity

target ratio is significantly positively related to the firm's propensity to issue debt-like securities.

4.5. Protective covenants

For a sample of UK public debt issues, Citron (1995) demonstrates that accounting-based covenants act as a substitute control mechanism to the issuance of secured debt (that confers to its holders priority over the selling proceeds of certain firm's assets, in the case of bankruptcy or liquidation). Clearly, this finding is in line with the prediction of Smith and Warner (1979) that high growth companies can mitigate the agency costs of debt by including different types of restrictive covenants. Furthermore, Citron's (1995) results show a positive relationship between the issuance of subordinated debt[26] and the inclusion of convertible provisions. This evidence reinforces Jensen and Meckling (1976) argument that the issuance of debt contracts that produce a greater alignment of interests between shareholders and creditors interests leads to a reduction in contracting costs. Citron (1995) also notes that the absence of accounting-based covenants observed in convertible subordinated debt issues suggests a substitute role between these features in mitigating inefficiencies in financing. Finally, in contrast to Myers (1977) and Smith and Warner (1979) no significant relationship is found between the inclusion of accounting-based covenants and both firm growth opportunities and the leverage level. Nevertheless, the substitution effect of debt maturity and accounting-based covenants (see Myers (1977)) is validated by Citron's (1995) regression results.

[26] Subordinated debt ranks below other type of debt regarding the access to firm's assets proceeds that can be used to satisfy debt contracted obligations in case of bankruptcy.

Dennis et al. (2000) assess the validity of theoretical predictions about security debt covenants using a simultaneous-equation framework. These authors find evidence that supports the arguments that the issuance of secured debt reduces the shareholder's underinvestment and risk shifting incentives (Myers (1977) and Smith and Warner (1979)). On the other hand, strong support is also provided for the claim dilution hypothesis postulated by Smith and Warner (1979). Finally, the evidence corroborates Myers (1977) Smith and Warner (1979) hypothesis that protective covenants and debt maturity can be alternatively used to mitigate agency costs.

4.6. Summary and conclusions

The evidence in support of agency cost predictions for debt features gathers some consensus but it is particularly divergent for asymmetric information/signalling and tax-based arguments. First, with respect to maturity predictions, the agency cost hypothesis is strongly supported by the data while the tax/bankruptcy hypothesis is generally inconsistent with the empirical results. To this extent, from all the studies analysed only Dennis et al. (2000) offer some support to the tax/bankruptcy hypothesis. On the other hand, the argument that firms are more willing to issue shorter-term debt when facing higher agency costs is supported by Barclay and Smith (1985), Opler and Guedes (1996), and Dennis et al. (2000). Furthermore, asymmetric information and signalling hypotheses are only weakly supported by the evidence from these studies.

Kish and Livingston (1992) provide strong support the argument that call provisions are used to mitigate agency costs. Furthermore, this study finds evidence consistent

with the prediction about manager's superior ability to predict future interest rate levels but fails to validate the interest risk uncertainty and the tax hypothesis. Abhyankar and Dunning (1999) find no support for any of the theoretical arguments underlying the choice of convertibles. Finally, Citron (1995) and Dennis et al. (2000) provide evidence that confirm the existence of a substitution effect between debt maturity choice and the inclusion of accounting-based covenants and security provisions, respectively. Nevertheless, while Dennis et al.'s (2000) study provides strong support for the underinvestment and risk-shifting hypotheses, Citron (1995) fails to obtain significant results for the validation of any of these hypotheses.

There are important limitations on the studies referred to above. Firstly, almost all the studies examine the determinants of the choice of a single debt feature without assessing the impact that the decision about other contract features has on this choice. Secondly, these studies focus on a very widespread data sample bringing confounding effects to the analysis as there is no clear distinction between the determinants of the debt composition for a type of contract and a significant number of other factors affecting the preference for different types of structured debt. For instance, the study of the design of bank loan contracts along side with publicly traded debt is likely to introduce spurious elements to the analysis. According to Rajan (1992), publicly traded debt is typically of longer maturity than bank loans because the costs of close monitoring and control over firm's activities are likely to be lower for banks than for arm's length investors. Other example of the existence of conflicting factors impairing the study of the debt design for a widespread category of contracts is the fact that debt covenants such as convertible and call options can be included as control mechanisms in tradable securities indentures but not in private

placement agreements. This limitation is overcome in this research because, the unique characteristics of Eurobond contracts are individually considered in assessing the validity of the existing conjectures about contract's optimal terms composition. Thirdly, apart from a few studies such as that by Barclay and Smith (1995)[27] most of the studies ignore the presence of a time-series effect on a longitudinal data sample. By ignoring these effects the inferences will be not only affected by serial correlation errors but also unable to accurately measure the impact of cross-sectional variables that are transient by nature (e.g. asymmetric information context and tax liability status). Finally, a simultaneous framework for the choice of contract terms and leverage level is only provided by Dennis et al. (2000), although the simultaneous character of financial decisions has been pointed out in significant number of theoretical works (e.g. Myers (1977), Barnea et al. (1980), Diamond (1993), and Robbins and Schatzberg (1986)).

[27] Stohs and Mauer (1996) develop a similar study to Barclay and Smith (1995) using a panel data approach to test the validity of the debt maturity structure hypotheses on a sample of 328 firms over the period from 1980 to 1989. The results from Stohs and Mauer (1996) provide only a moderate support to the agency costs predictions but a strong support to the signalling/adverse-selection theories. Similar to Barclay and Smith (1995) no consistent support is found for the tax-related hypothesis.

CHAPTER V: DESCRIPTIVE ANALYSIS OF THE EUROBOND ISSUES SAMPLE

5.1. Introduction

This chapter provides a descriptive analysis of the Eurobonds issued by non-financial UK-based companies for the period between January 1986 and December 1999, which is the data set used in this research to test the theoretical hypotheses regarding the choice of debt features.

The characteristics of the Eurobond sample are obtained from the Bondware Database files. The accounting and financial information used in the construction of the variables that proxy for the firm and market characteristics is from Datastream. In some cases missing information was provided by an analysis of the annual financial statements for the Eurobond issuers.

Between 1986 and 1999, the Bondware Database files report a total of 439 Eurobond issues offered by 146 UK companies excluding financial institutions, insurance and real estate companies. The exclusion of the Eurobonds issued by these companies is due not only to the lack of comparability between the accounting information provided by financial and non-financial firms but also to the focus of debt design theory on the financing decision process which governs non-financial firms' behaviour. This data set also excludes all Floating Rate Notes (FRN) instruments issued by UK companies that are typically used for short-term cash funding and

therefore are likely to distort the analysis of contract features choice for more general forms of debt financing.

From the initial data set, 49 Eurobonds are excluded due to the lack of a Datastream code for respective issuing companies listed in the Bondware Database files. More specifically, the Datastream code was not available for 35 issuers because 29 companies are not listed in the stock exchange, 4 companies are privately owned and 2 companies are not identifiable. Finally, 13 issues are further excluded from the final data set due to the lack of accounting information for the financial year-end prior to the Eurobond issue. Overall, the data set contains 377 Eurobond issues made by 109 non-financial companies distributed across 25 different industries. Table 5.1 shows the decomposition of the initial data set, identifying those firms that are excluded from the final sample due to the lack of Datastream code. Additionally, Table 5.2 and Table 5.3 report the number and frequency of Eurobond issues across the sample firms and industries, respectively. Some sectors such as telecommunications and food retailers account for a significant proportion of the total Eurobond issues made in this period (14.6% and 8.8%, respectively). Other sectors with a relatively high proportion of Eurobond issues are electricity (8.8%), general retailers (8.8%), transport (7.2%), and water (6.9%). A detailed industry analysis for the sample of Eurobond issues is provided in section 5.3. Section 5.2 describes the evolution in the number, amount, currency of denomination, and other contract characteristics (namely, average maturity and embedded options) of the Eurobonds issued during the period in analysis. Finally, section 5.4 concludes this chapter.

5.2. Time-series analysis

Figure 1: Evolution of the number and the nominal amount of Eurobonds issued by UK companies (1986-1999)

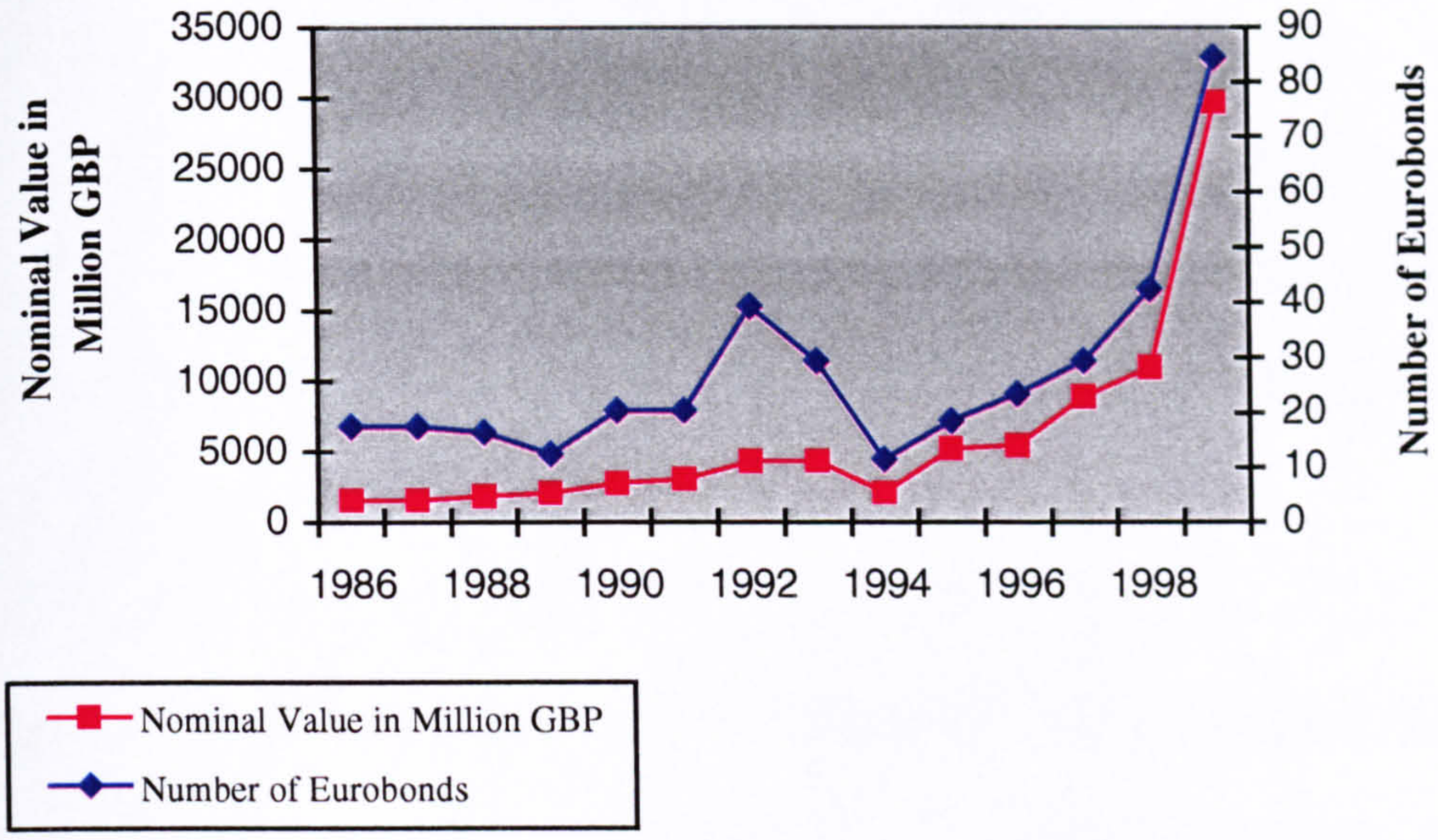

Figure 1 shows that apart from the significant increase in the number of Eurobond issues observed in the 1992 (as a result of numerous small tranches of Eurobonds issued by British Telecommunication plc), both the number and amount issued follow a steady trend until 1996. After this year an exponential increase is observed and, in 1999, maximum values of 84 and 29.608 million pounds sterling are reached, respectively, for the number and amount of Eurobonds issued (see Table 5.4). One of the reasons for the substantial growth of Eurobond issues by UK companies observed in 1999 is likely to be associated, as Claes et al. (2000) point out, with the introduction of the euro currency. The need of UK firms to hedge against the exchange rate risk associate with the European Monetary System (EMS) currencies together with the non-existence a country of denomination for the euro, makes the Eurobond market an attractive source for UK companies' debt financing. An analysis

of Table 5.5 reveals indeed that, in 1999, the number of Eurobonds denominated in euros represents approximately 24% of the total issues by UK companies, overtaking the number of issues denominated in US dollars that typically occupied the second position as the most used currency of denomination. Another reason that can be pointed out for the expansion of the Eurobond market, in this period, is linked with the incapacity of bank borrowings to satisfy the increasing amounts of funding required to finance mergers and acquisitions and the aim of issuers to create a sufficiently liquid secondary market to facilitate the placement of subsequent issues (Economic Bulletin, March 2000, p. 54).

A more detailed analysis of Table 5.5 reveals that most of the issues made by UK companies during 1986-1999 are denominated in sterling. Thus, during this period, 71.4% of the Eurobonds are issued in sterling while only 14.3%, 5.8%, 3.4%, and 1.6% are issued respectively in US dollars, euros, Japanese yens, and Deutsch marks. The importance of sterling as currency of denomination is particularly significant in 1988, 1992, and 1993 where the issues denominated in this currency account for 93.8%, 94.9%, and 96.6% (respectively) of the total number of Eurobond issues made in these years.

Figure 2: Evolution of the embedded options and the average maturity for the Eurobonds issued by UK companies (1986-1999)

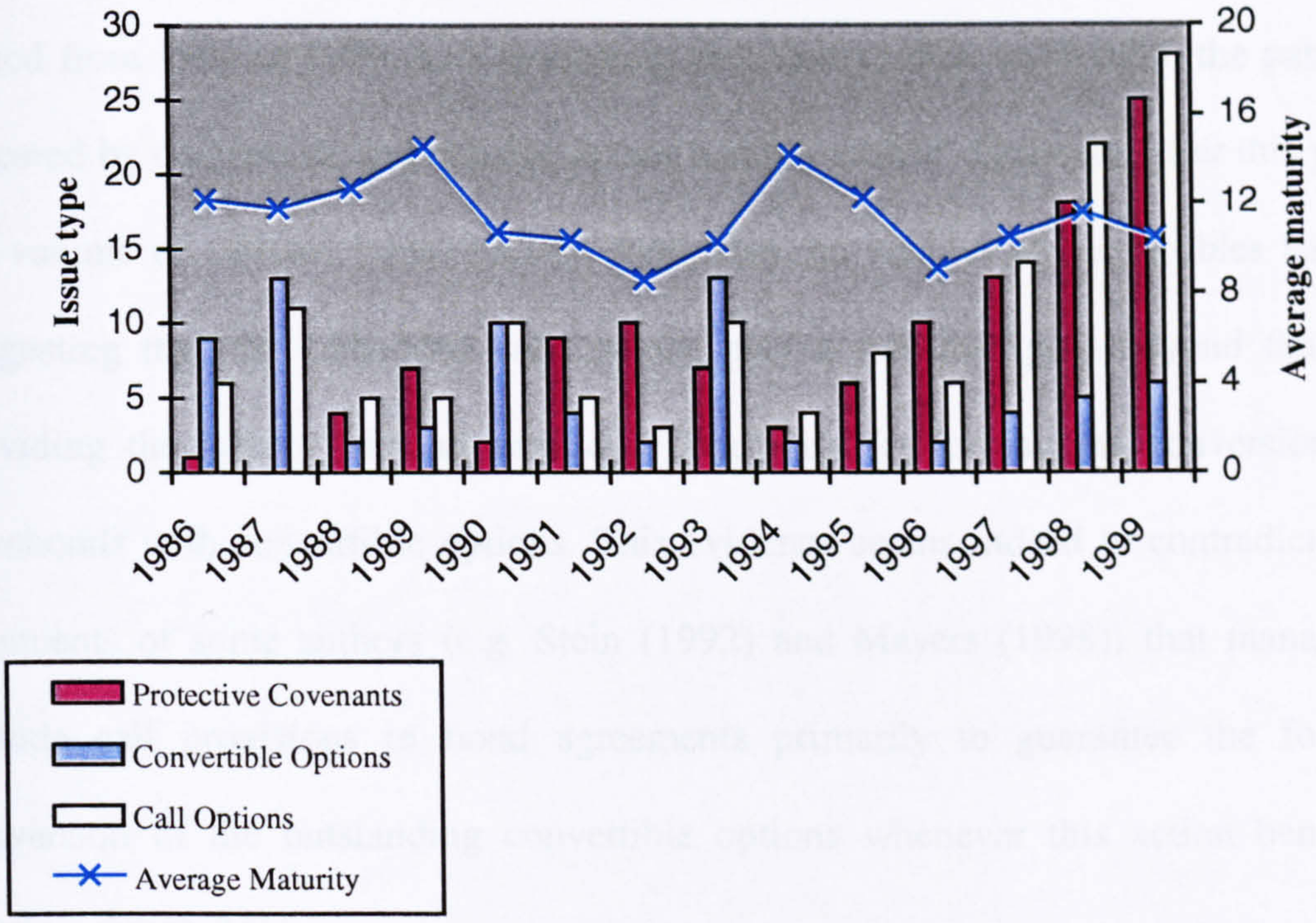

Figure 2 shows that, during the period of 1986-1999, the average maturity of Eurobond issues varies within a range from eight to twelve years, with the only exceptions being the years of 1989 and 1994 where this variable raises to 14.4 and 14.1 years, respectively (see Table 5.6). These average values do not provide, however, a clear insight on the spectrum of maturities observed for the Eurobond issues under analysis. Indeed, in the aforementioned period, the maturity spectrum spans from one year to fifty years with the lower-end and the high-end values corresponding to, respectively, an issue made by Marks and Spencer plc in 1998 and an issue made by British Gas plc in 1994.

With respect to the type of embedded options, Figure 2 shows that the largest number of Eurobond issues with convertible options attached occurs before 1994 while the issuance of Eurobonds with call options and protective covenants dominates in the period from 1997 to 1999. It is interesting also to note that, until 1994, the pattern followed by convertible and callable issues is fairly similar. However, after this year the volume of callable issues clearly dominates the volume of convertibles issues suggesting that the embedded call options play a role that goes beyond that of providing the issuers with an additional flexibility for forcing the conversion of Eurobonds with convertible options. This evidence seems indeed to contradict the arguments of some authors (e.g. Stein (1992) and Mayers (1998)) that managers include call provisions in bond agreements primarily to guarantee the forced conversion of the outstanding convertible options whenever this action benefits existing shareholders.

The substantial growth observed in the number of issues with protective covenants and call options between 1997 and 1999 is fuelled by the general increase in the volume of Eurobonds issued during this period. Moreover, the stream of mergers and take-overs during the 1990's, particularly in the utility and transport industries, contribute to reinforce the increase in the volume of Eurobond issues with protective covenants (see Moore, 2001, p. 110). In fact, the protective covenants include not only accounting-based options but also put options that are triggered by credit downgradings following a restructuring event (namely, changes in the certification license, take-overs, and/or changes in core business). Considering that important changes in corporate governance follow mergers and take-overs can substantially

increase the risk of issuers' credit downgrade, it is not surprising that the degree of protection demanded by investors is higher at the times when business restructuring is significant.

5.3. Industry analysis

Figure 3: Distribution of Eurobonds across industries

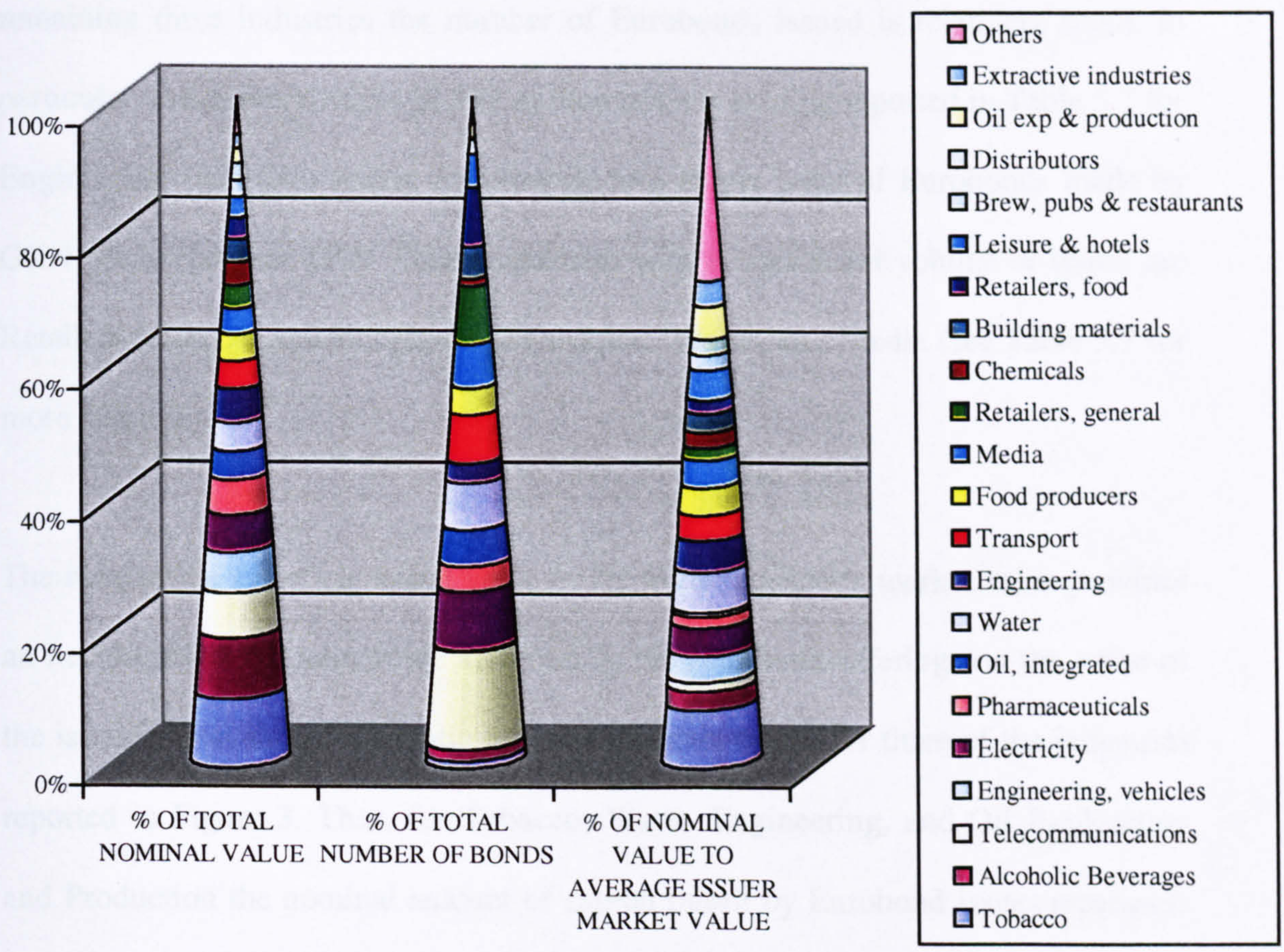

Figure 3 highlights the importance by the Eurobond issues of UK companies from ten different industries during the period 1986-1999. Apart from the proportion on the total volume and nominal amount of Eurobonds, the graph also provides information about the ratio of issue's nominal value to average issuer's market

value[28] for these industries. The five largest industries in terms of the value of Eurobonds issued are: Tobacco, Alcoholic Beverages, Telecommunications, Engineering (vehicles), and Electricity. The issues made by companies from these industries account for approximately 38% of the total nominal value equivalent to 4.965 million pounds sterling. Although for Telecommunications and Electricity a large nominal value of issues corresponds also to a large number of Eurobonds offerings (14.6% and 8.75% of the total volume of Eurobonds, respectively), for the remaining three industries the number of Eurobonds issued is relatively small. In particular, the nominal value of 300 million pounds sterling reported in Table 5.7 for Engineering (vehicles) sector corresponds to a single issue of Eurobonds made by GKN plc in October 1999. Other industries with a significant volume of issues are Retailers (food), Retailers (general), Transport, Water, and Media (see Table 5.7 for more details).

The ratio of the issue's nominal value to the average issuer's market value provides an insight about the magnitude assumed by the Eurobond offerings on the value of the issuer's total assets. The ratio exceeds the level of 5% for three of the industries reported in Figure 3. Thus, for Tobacco, Water, Engineering, and Oil Exploration and Production the nominal amount of capital raised by Eurobond issues represents 9.11%, 6.34%, 5.01%, and 5.21%) of the market value of the issuer's total assets. Other industries with a ratio greater than 5% but not individually considered in Figure 3 are: Support Services (11.80%), Health Care (7.56%), and Construction (6.69%) – see Table 5.7.

[28] The average issuer's market value is calculated as the industry average of the issuers' value of total assets plus the market capitalisation less the book value of equity.

Figure 4: Distribution of Eurobonds with embedded options across industries

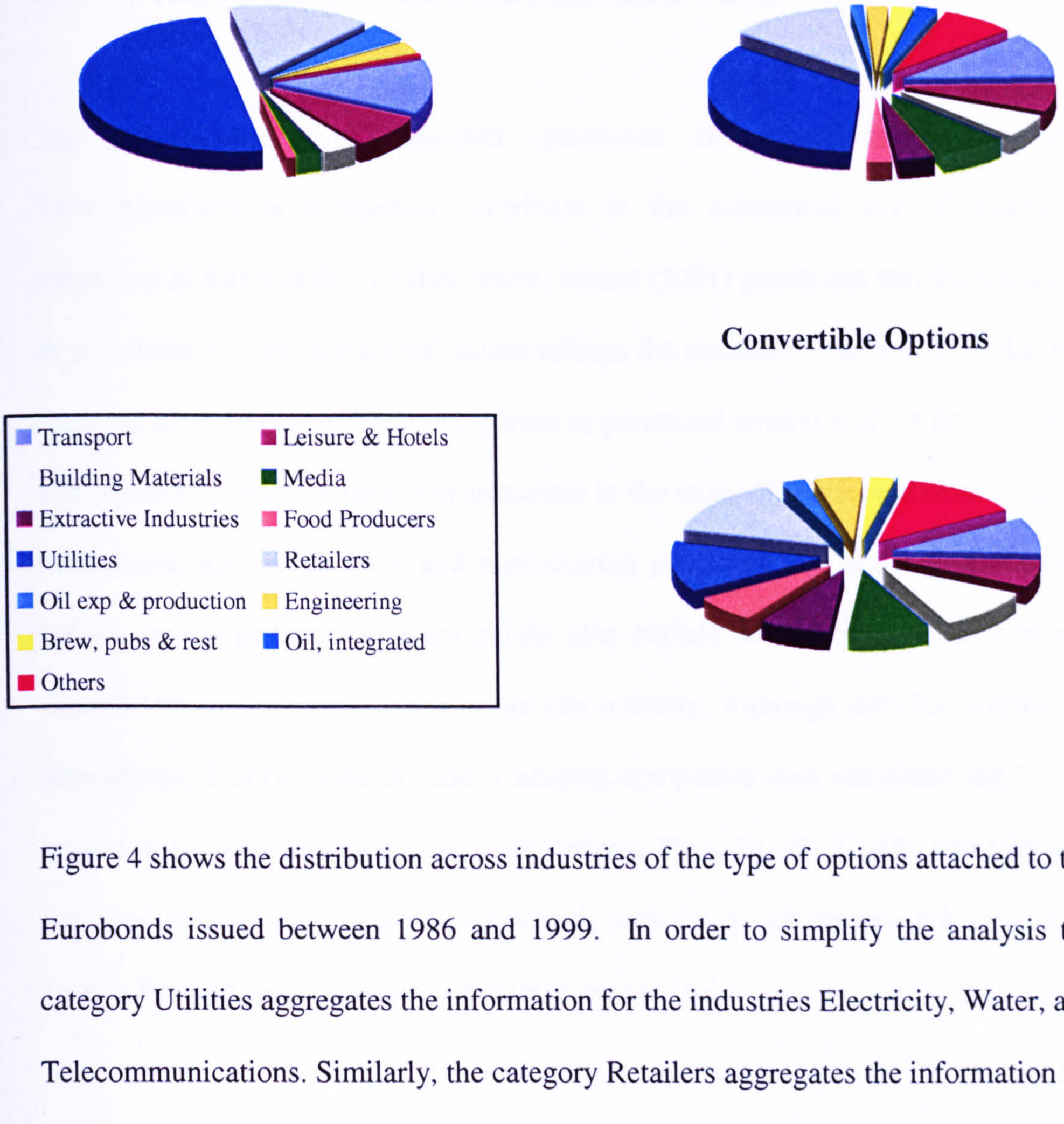

Figure 4 shows the distribution across industries of the type of options attached to the Eurobonds issued between 1986 and 1999. In order to simplify the analysis the category Utilities aggregates the information for the industries Electricity, Water, and Telecommunications. Similarly, the category Retailers aggregates the information for the industries Retailers (food) and Retailers (general). Table 5.8 reports the individual data for these industries and also for those industries included in the category Others.

An analysis of Figure 4 reveals a clear dominance of the utility companies as the main issuers of Eurobonds with protective covenants. Indeed, Electricity, Water, and Telecommunications are responsible for approximately 50% of the total issues with protective options. The other main issuers of protected Eurobonds are Retailers (14.7%), Transport (13.0%), and Leisure and Hotels (7.8%).

The privatisation and take-over processes in Electricity, Water, and Telecommunication companies contribute to the substantial use of protective covenants in Eurobonds. To this extent, Moore (2001) points out that the inclusion of covenants in these industries' issues reflects the uncertainty arising from the new status of Electricity and Water companies as privatised entities and the downgrading risk associated with the take-over processes in the expanding telecom sector. On the other hand, the privatisation and restructuring processes that occurred during the 1990's in the transport industry might also explain to the observed importance assumed by the protected issues in the this industry. Although with less expressive proportions, Utility, Retailer, and Transport companies also constitute the largest issuers of Eurobonds with attached call options. Thus, 34.3%, 13.9%, and 10.9% of the total number of Eurobond issues with embedded call options are offered by Utility, Retailer, and Transport companies, respectively.

Unlike callable and protected Eurobond issues, the distribution of convertible issues is more homogeneous across industries. Table 5.8 reveals that eight of the main industries portrayed in Figure 4 have proportions of convertible issues that are not

lower than 6.5% or greater than 10.5%. These industries are: Building Materials (10.4%), Media (9.1%), Transport (9.1%), Extractive Industries (7.8%), Retailers, food (7.8%), Retailers, general (6.5%), Food Producers (6.5%), and Media (6.5%). The relative dominance assumed by Building Materials, Media, and Transport issues on the total number of convertible Eurobonds is likely to reflect the preference for a financing instrument that is relatively insensitive to the business risk by those firms that belong to industries with higher exposure to economical cycles.

Table 5.9 provides a comparison between the average market values of the Eurobond issuers and the respective industry group for 19 of the 25 sectors analysed[29]. Typically, only large and median/high credit quality firms are able to raise funds in the Eurobond market. As Gallant (1988) points out although not all the Eurobonds issues are graded by external rating agencies, only large firms with a well-recognised name are able to attract the multinational pool of investors in the Eurobond market. The lack of credit rating grade for a significant part of the Eurobond issues from UK companies prevent us, however, to use this variable as a proxy for issuers' credit quality. Therefore, the variable market value is used here as a proxy of average firm size and credit quality.

Consistent with the view that Eurobond issuers are larger and higher quality companies, Table 5.9 shows that not only the total average market value for the sample Eurobond issuers exceeds the total industry mean value but also the

[29] For four of the sectors no data was available to calculate the market value for industry mean and for two sectors the number of observations was not enough to perform the comparative analysis as only one Eurobond was issued in each of these sectors.

difference between these values is positive and significant for 11 of the 19 industries analysed. In particular, for the Leisure and Hotels, Retailers (food), Retailers (general), Telecommunications, and Transport sectors the null hypothesis of equality of the mean values for the Eurobond issuers' sample and overall industry sample is rejected at 1% level of significance.

One limitation can be, however, pointed out to this comparative analysis. Indeed, the industry mean values obtained from Datastream take into account only the companies that are live and listed in the London Stock Exchange at the time when this data is retrieved (in this case at 31 December 2001). This limitation is likely to explain the negative and significant differences between the mean market values found for two of the industries analysed i.e. Tobacco and Water. Thus, the recent listing of British American Tobacco plc in the London Stock Exchange and the merger processes that occur in the Water sector during the 1990's suggest that the industry mean values from Datastream can be overstating those expected for the period in analysis. Taking this into account, the characteristics of the UK-based Eurobond issuers for the period of 1986-1999 seem to be, indeed, consistent with the general assessment that the issuers are of higher quality and of a larger size.

5.4. Summary and conclusions

This chapter provides a descriptive analysis of the sample of new issues by UK companies that supports this study. In particular, the volume and number of issues, type of embedded options, and average maturity of Eurobonds is analysed across the time and sample industries. A comparative analysis between the average sample issuer and the industry mean is also provided. This comparative analysis provides

evidence that supports the general assessment of higher credit quality and large size attributed to Eurobond issuers.

Table 5.1: Disaggregation per companies and issues of initial Eurobonds sample

	Total	
	Issues	Companies
Eurobond issues from UK non-financial companies over 1986-1999 (excluding FRN issues)	439	146
Less:		
(A) Non listed companies		
CATALYST HEALTHCARE (WORCESTER) PLC	1	
COMPUTACENTER PLC[a]	1	
CORAL GROUP PLC	1	
COUNTY HOTELS GROUP PLC	1	
DUNLOP STANDARD AEROSPACE HOLDINGS PLC	1	
ECO-BAT TECHNOLOGIES PLC	1	
FIRST HYDRO PLC	1	
GUINNESS PLC	4	
HEALTH MANAGEMENT (CARLISLE) PLC	1	
HMV MEDIA GROUP PLC[a]	2	
HURST GROUP PLC	1	
IPC MAGAZINES GROUP PLC	2	
JOHN LEWIS PLC	1	
LUXFER HOLDINGS PLC	1	
MIDDLEWEB PLC	1	
PREMIER INTERNATIONAL FOODS PLC	1	
RANK ORGANISATION PLC[a]	1	
NORTHERN IRELAND ELECTRICITY PLC	1	
SCOTTISH HYDRO-ELECTRIC PLC	1	
SOUTH WALES ELECTRICITY PLC	1	
SOUTH WEST WATER PLC	1	
TEXON INTERNATIONAL PLC	1	
TM GROUP HOLDINGS PLC	2	
TRAFALGAR HOUSE PLC	1	
UNIQUE PUB COMPANY PLC	2	
V2 MUSIC HOLDINGS PLC	2	
WELLINGTON PUB COMPANY PLC	3	
WELSH WATER UTILITIES PLC	2	
ZSC SPECIALTY CHEMICALS PLC	1	
TOTAL (A)	40	29
(B) Privately owned companies		
ESPRIT TELECOM UK LTD	2	
REGIONAL INDEPENDENT MEDIA LTD	2	
SOUTH SOMERSET HOMES LTD	1	
WILLIAM HILL ORGANISATION LTD	1	
TOTAL (B)	6	4
(C) Non identified companies		
NAVIGATOR GAS TRANSPORT PLC	2	
YORKSHIRE POWER LTD	1	
TOTAL (C)	3	2
(D) Issues from companies for which there is no accounting information for the financial year-end prior to the Eurobond announcement	13	2[b]
TOTAL (D)	13	2[b]
Sample used for Empirical Testing: Initial Sample – (A) –(B) –(C) –(D)	377	109

(a) Companies listed in the stock exchange after Eurobond issue. Specifically, Computacenter plc was first listed in 29/05/98, HMV Media Group plc in 15/05/02, and Rank Organisation plc in 07/10/96.

(b) Additional companies not accounted for in previous sub-groups.

Table 5.2: Distribution of Issues across Companies

Companies	Issues	(%)	Companies	Issues	(%)
AIRTOURS PLC	2	0.53	HYDER PLC	9	2.39
ALLIED DOMECQ PLC	1	0.27	ICI, IMPERIAL CHEMICAL INDUSTRIES PLC	1	0.27
ANGLIAN WATER PLC	6	1.59	IMPERIAL TOBACCO GROUP PLC	2	0.53
ASDA GROUP PLC	4	1.06	INCHCAPE PLC	1	0.27
ASSOCIATED BRITISH PORTS PLC	3	0.80	KINGFISHER PLC	5	1.33
BAA PLC	7	1.86	LASMO PLC	4	1.06
BASS PLC	2	0.53	LONDON INTERNATIONAL GROUP PLC	1	0.27
BET PLC	1	0.27	LONRHO PLC	7	1.86
BG PLC	15	3.98	MARKS & SPENCER PLC	11	2.92
BLUE CIRCLE INDUSTRIES PLC	3	0.80	MORGAN CRUCIBLE COMPANY PLC	2	0.53
BOC GROUP PLC	3	0.80	NATIONAL GRID COMPANY PLC	4	1.06
BOOTS COMPANY PLC	4	1.06	NATIONAL POWER PLC	6	1.59
BPB INDUSTRIES PLC	1	0.27	NEWS INTERNATIONAL PLC	4	1.06
BRITISH AEROSPACE PLC	3	0.80	NEXT PLC	2	0.53
BRITISH AIRWAYS	4	1.06	NFC PLC	1	0.27
BRITISH ENERGY PLC	3	0.80	NORTHERN FOODS PLC	1	0.27
BRITISH PETROLEUM COMPANY PLC	5	1.33	NORWEB PLC	1	0.27
BRITISH SKY BROACASTING GROUP PLC	1	0.27	ORANGE PLC	6	1.59
BRITISH STEEL PLC	2	0.53	P&O, PENINSULAR AND ORIENTAL STEAM PLC	6	1.59
BRITISH TELECOMMUNICATIONS PLC	35	9.28	PEARSON PLC	7	1.86
BURMAH CASTROL PLC	1	0.27	PILKINGTON PLC	2	0.53
CABLE & WIRELESS	2	0.53	POWERGEN PLC	4	1.06
CADBURY SCHWEPPES PLC	3	0.80	RAILTRACK GROUP PLC	4	1.06
CARLTON COMMUNICATIONS PLC	3	0.80	RANK GROUP PLC,	1	0.27
CENTRAL INDEPENDENT TV PLC	1	0.27	REDLAND PLC	7	1.86
CHELSEA VILLAGE PLC	1	0.27	REUTERS GROUP PLC	2	0.53
CLUBHAUS PLC	2	0.53	ROLLS ROYCE PLC	3	0.80
CLYDE PETROLEUM PLC	1	0.27	SAFEWAY INC	5	1.33
COATS VIYELLA PLC	1	0.27	SAINSBURY, J PLC	12	3.18
COLT TELECOM GROUP PLC	5	1.33	SCOTIA HOLDINGS PLC	1	0.27
COMPASS GROUP PLC	2	0.53	SCOTTISH & NEWCASTLE PLC	2	0.53
COOKSON GROUP PLC	1	0.27	SCOTTISH & SOUTHERN ENERGY PLC	1	0.27
CORPORATE SERVICES PLC	1	0.27	SCOTTISH POWER PLC	7	1.86
COSTAIN GROUP PLC	1	0.27	SEARS PLC	2	0.53
DAILY MAIL & GENERAL TRUST PLC	5	1.33	SEEBOARD PLC	1	0.27
DIAGEO PLC	2	0.53	SEVERN TRENT PLC	4	1.06
DIXONS GROUP PLC	5	1.33	SMITH & NEPHEW PLC	1	0.27
EAST MIDLANDS ELECTRICITY PLC	1	0.27	SMITHKLINE BEECHAM PLC	9	2.39
EASTERN GROUP PLC	2	0.53	SOUTHERN ELECTRICITY PLC	1	0.27
EIDOS PLC	1	0.27	STAGECOACH GROUP PLC	2	0.53
ENERGIS PLC	2	0.53	STOREHOUSE PLC	1	0.27
ENGLISH CHINA CLAYS PLC	1	0.27	TATE & LYLE PLC	7	1.86
ENTERPRISE OIL PLC	3	0.80	TAYLOR WOODROW PLC	1	0.27
FISONS PLC	1	0.27	TELEWEST COMMUNICATIONS PLC	2	0.53
FORTE PLC	5	1.33	TESCO PLC	12	3.18
GALLAHER GROUP PLC	2	0.53	THAMES WATER PLC	4	1.06
GKN PLC	1	0.27	THORN PLC	1	0.27
GLAXO WELLCOME PLC	3	0.80	UNILEVER PLC	2	0.53
GRANADA GROUP PLC	1	0.27	UNITED BISCUITS PLC	2	0.53
GRAND METROPOLITAN PLC	3	0.80	UNITED NEWS & MEDIA PLC	1	0.27
GREAT UNIVERSAL STORES PLC	2	0.53	VODAFONE GROUP PLC	3	0.80
GREENALLS GROUP PLC	1	0.27	WHITBREAD PLC	1	0.27
HANSON PLC	4	1.06	YORKSHIRE ELECTRICITY PLC	2	0.53
HEPWORTH PLC	1	0.27	YORKSHIRE WATER PLC	3	0.80
HILTON GROUP PLC	7	1.86			

Table 5.3: Distribution of Issues across Industries

Code [a]	Industry	Issues	(%)
12	EXTRACTIVE INDUSTRIES	8	2.12
15	OIL, INTEGRATED	21	5.57
16	OIL EXPLORATION	8	2.12
21	CONSTRUCTION	3	0.80
22	BUILDING MATERIALS	18	4.77
23	CHEMICALS	4	1.06
26	ENGINEERING	11	2.92
27	ENGENEERING, VEHICLES	1	0.27
32	ALCOHOLIC BEVERAGES	6	1.59
33	FOOD PRODUCERS	15	3.98
34	HOUSEHOLD GOODS	1	0.27
36	HEALTH CARE	2	0.53
37	PHARMACEUTICALS	14	3.71
38	TOBACCO	4	1.06
41	DISTRIBUTORS	1	0.27
42	LEISURE & HOTELS	19	5.04
43	MEDIA	25	6.63
44	RETAILERS, FOOD	33	8.75
45	RETAILERS, GENERAL	33	8.75
46	TELECOMMUNICATIONS	55	14.59
47	BREWERIES, PUBS & RESTAURANTS	8	2.12
48	SUPPORT SERVICES	1	0.27
49	TRANSPORT	27	7.16
62	ELECTRICITY	33	8.75
68	WATER	26	6.90
	TOTAL	377	100

(a) Industry classification according to Financial Times-Stock Exchange Actuaries System as at 30/11/1999.

Table 5.4: Number and Nominal Value of Issues per Year

Year	Nominal value (in millions of GBP)	(%)	Number of issues	(%)
1986	1 526	1.8	17	4.5
1987	1 530	1.8	17	4.5
1988	1 780	2.1	16	4.2
1989	2 021	2.4	12	3.2
1990	2 724	3.3	20	5.3
1991	3 012	3.6	20	5.3
1992	4 291	5.2	39	10.3
1993	4 308	5.2	29	7.7
1994	2 059	2.5	11	2.9
1995	5 176	6.2	18	4.8
1996	5 412	6.5	23	6.1
1997	8 875	10.7	29	7.7
1998	10 939	13.1	42	11.1
1999	29 608	35.6	84	22.3
Total	83 261	100.0	377	100.0

Table 5.5: Currency of Issues

Year	Total	Sterling		US dollar		Euro		Japanese yen		Deutsch Mark		Others[a]	
		Obs.	(%)	Obs.	(%)	Obs.	(%)	Obs.	(%)	Obs.	(%)	Obs.	(%)
1986	17	10	58.8	5	29.4		–		–		–	2	11.8
1987	17	13	76.5	3	17.6		–		–	1	5.9		–
1988	16	15	93.8	1	6.3		–		–		–		–
1989	12	6	50.0	4	33.3		–		–		–	2	16.7
1990	20	17	85.0	2	10.0		–		–		–	1	5.0
1991	20	15	75.0	2	10.0		–		–		–	3	15.0
1992	39	37	94.9	2	5.1		–		–		–		–
1993	29	28	96.6	1	3.4		–		–		–		–
1994	11	9	81.8	2	18.2		–		–		–		–
1995	18	14	77.8	4	22.2		–		–		–		–
1996	23	13	56.5	7	30.4		–	3	13.0		–		–
1997	29	20	69.0	7	24.1		–	1	3.4		–	1	3.4
1998	42	27	64.3	5	11.9	2	4.8	1	2.4	5	11.9	2	4.8
1999	84	45	53.6	9	10.7	20	23.8	8	9.5		–	2	2.4
Total	377	269	71.4	54	14.3	22	5.8	13	3.4	6	1.6	13	3.4

(a) This column includes issues denominated in Swiss francs, Australian dollars, Luxembourg francs, French francs, Italian liras, and Turkish liras.

Table 5.6: Embedded Options and Average Maturity of Issues per Year

Year	Protective covenants		Convertible Options		Call Options		Average maturity
	Obs.	(%)	Obs.	(%)	Obs.	(%)	
1986	1	0.9	9	11.7	6	4.4	12.1
1987	0	0.0	13	16.9	11	8.0	11.7
1988	4	3.5	2	2.6	5	3.6	12.6
1989	7	6.1	3	3.9	5	3.6	14.4
1990	2	1.7	10	13.0	10	7.3	10.6
1991	9	7.8	4	5.2	5	3.6	10.3
1992	10	8.7	2	2.6	3	2.2	8.5
1993	7	6.1	13	16.9	10	7.3	10.2
1994	3	2.6	2	2.6	4	2.9	14.1
1995	6	5.2	2	2.6	8	5.8	12.1
1996	10	8.7	2	2.6	6	4.4	9.0
1997	13	11.3	4	5.2	14	10.2	10.4
1998	18	15.7	5	6.5	22	16.1	11.5
1999	25	21.7	6	7.8	28	20.4	10.4
Total	115	100.0	77	100.0	137	100.0	

Table 5.7: Nominal value, Number, and Proportion of Nominal Value to Average Issuer's Market Value of Eurobonds across Industries

Code[(a)]	Industry	Nominal value (in millions of GBP)	% of total nominal value	Number of issues	% of total number of issues	Average issuer market value (in millions of GBP)	(%) of nominal value to average issuer market value
38	TOBACCO	502	10.11%	4	1.06%	5 510	9.11%
32	ALCOHOLIC BEVERAGES	455	9.16%	6	1.59%	15 010	3.03%
46	TELECOMMUNICATIONS	335	6.74%	55	14.59%	23 759	1.41%
27	ENGINEERING, VEHICLES	300	6.04%	1	0.27%	7 228	4.15%
62	ELECTRICITY	280	5.65%	33	8.75%	6 203	4.52%
37	PHARMACEUTICALS	254	5.11%	14	3.71%	14 327	1.77%
15	OIL, INTEGRATED	214	4.31%	21	5.57%	32 180	0.67%
68	WATER	209	4.20%	26	6.90%	3 291	6.34%
26	ENGINEERING	250	5.03%	11	2.92%	4 982	5.01%
49	TRANSPORT	208	4.18%	27	7.16%	5 215	3.98%
33	FOOD PRODUCERS	199	4.02%	15	3.98%	4 614	4.32%
43	MEDIA	191	3.84%	25	6.63%	4 441	4.30%
22	BUILDING MATERIALS & MERCHANTS	171	3.44%	18	4.77%	5 712	2.99%
45	RETAILERS, GENERAL	173	3.49%	33	8.75%	8 502	2.04%
23	CHEMICALS	171	3.45%	4	1.06%	7 107	2.41%
12	EXTRACTIVE INDUSTRIES	103	2.07%	8	2.12%	2 545	4.04%
47	BREWERIES, PUBS & RESTAURANTS	126	2.55%	8	2.12%	5 242	2.41%
44	RETAILERS, FOOD	159	3.20%	33	8.75%	7 593	2.09%
42	LEISURE & HOTELS	151	3.04%	19	5.04%	3 127	4.83%
41	DISTRIBUTORS	125	2.52%	1	0.27%	5 066	2.47%
16	OIL EXPLORATION & PRODUCTION	110	2.22%	8	2.12%	2 113	5.21%
34	HOUSEHOLD GOODS &TEXTILES	76	1.52%	1	0.27%	2 521	3.00%
21	CONSTRUCTION	74	1.49%	3	0.80%	1 107	6.69%
36	HEALTH CARE	70	1.41%	2	0.53%	926	7.56%
48	SUPPORT SERVICES	60	1.21%	1	0.27%	508	11.80%
	TOTAL	4 965	100.00%	377	100.00%	178 831	

(a) Industry classification according to Financial Times-Stock Exchange Actuaries System as at 30/11/1999. Industry ranking as function of the nominal value of Eurobond issues per industry.

Table 5.8: Eurobonds' Embedded Options across Industries

Code[a]	Industry	Protective Covenants		Call Options		Convertible Options	
		Issues	(%)	Issues	(%)	Issues	(%)
12	EXTRACTIVE INDUSTRIES		–	5	3.6%	6	7.8%
15	OIL, INTEGRATED		–	3	2.2%		–
16	OIL EXPLORATION & PRODUCTION	5	4.3%	2	1.5%	2	2.6%
21	CONSTRUCTION		–	1	0.7%	2	2.6%
22	BUILDING MATERIALS & MERCHANTS	4	3.5%	8	5.8%	8	10.4%
23	CHEMICALS		–		–		–
26	ENGINEERING	3	2.6%	3	2.2%	4	5.2%
27	ENGINEERING, VEHICLES		–	1	0.7%		–
32	ALCOHOLIC BEVERAGES		–	2	1.5%	2	2.6%
33	FOOD PRODUCERS	1	0.9%	4	2.9%	5	6.5%
34	HOUSEHOLD GOODS &TEXTILES		–	1	0.7%	1	1.3%
36	HEALTH CARE		–	2	1.5%	2	2.6%
37	PHARMACEUTICALS	1	0.9%	1	0.7%	1	1.3%
38	TOBACCO		–	1	0.7%		–
41	DISTRIBUTORS		–	1	0.7%	1	1.3%
42	LEISURE & HOTELS	9	7.8%	9	6.6%	5	6.5%
43	MEDIA	3	2.6%	10	7.3%	7	9.1%
44	RETAILERS, FOOD	12	10.4%	9	6.6%	6	7.8%
45	RETAILERS, GENERAL	5	4.3%	8	5.8%	5	6.5%
46	TELECOMMUNICATIONS	14	12.2%	16	11.7%	4	5.2%
47	BREWERIES, PUBS & RESTAURANTS		–	3	2.2%	2	2.6%
48	SUPPORT SERVICES		–	1	0.7%	1	1.3%
49	TRANSPORT	15	13.0%	15	10.9%	7	9.1%
62	ELECTRICITY	26	22.6%	15	10.9%	3	3.9%
68	WATER	17	14.8%	16	11.7%	3	3.9%
	TOTAL	115	100.0%	137	100.0%	77	100.0%

(a) Industry classification according to Financial Times-Stock Exchange Actuaries System as at 30/11/1999.

Table 5.9: Comparison Between the Mean Market Values of Eurobond Issuers and Correspondent Industry Group

Code[a]	Industry	Mean Market Value			p-value[b]
		Eurobond Issuers	Industry Group	Difference	
12	EXTRACTIVE INDUSTRIES	2 545	1 686	859	0.032
15	OIL, INTEGRATED	30 783	39 599	-8 816	0.153
22	BUILDING MATERIALS & MERCHANTS	5 963	2 797	3 166	0.124
23	CHEMICALS	7 107	6 250	858	0.450
26	ENGINEERING	4 982	1 974	3 008	0.046
32	ALCOHOLIC BEVERAGES	15 010	10 002	5 009	0.323
33	FOOD PRODUCERS	4 614	5 713	-1 099	0.514
36	HEALTH CARE	926	255	671	0.298
37	PHARMACEUTICALS	14 327	6 670	7 657	0.013
38	TOBACCO	5 510	9 172	-3 662	0.094
42	LEISURE & HOTELS	3 127	1 415	1 712	0.000
43	MEDIA	4 441	2 741	1 700	0.084
44	RETAILERS, FOOD	7 593	3 300	4 293	0.000
45	RETAILERS, GENERAL	8 502	2 865	5 636	0.000
46	TELECOMMUNICATIONS	23 758	9 178	14 580	0.000
47	BREWERIES, PUBS & RESTAURANTS	5 242	2 060	3 182	0.029
49	TRANSPORT	5 215	1 973	3 241	0.000
62	ELECTRICITY	6 203	4 906	1 298	0.098
68	WATER	3 291	4 194	-903	0.023
	TOTAL SECTOR MEAN	8 396	5 691	2 706	0.287

(a) Industry classification according to Financial Times-Stock Exchange Actuaries System as at 30/11/1999.

(b) Significance level for the null hypothesis that tests the equality between the mean market value of the Eurobond issuers and the correspondent value of the industry group.

CHAPTER VI: PANEL DATA ANALYSIS OF THE CHOICE OF CONTRACT TERMS IN EUROBOND ISSUES

6.1. Introduction

A panel (or longitudinal) data estimation model is the appropriate econometric tool to analyse data sets that aggregate both time-series and cross-section effects. In this type of data analysis, both intertemporal dynamics and cross-sectional factors play a pivotal role in explaining the relationships under analysis. According to Hsiao (1986), the panel data approach has three major advantages compared to classical estimation methods. These advantages are the following:

(1) it improves the efficiency of econometric estimates by considering a larger number of data points, which increase the degrees of freedom of the estimation and reduces the collinearity among explanatory variables. In particular, the panel data approach allows for the inclusion of observations that in conventional cross-section or time series analysis have to be disregarded due to the lack of degrees of freedom;

(2) it provides answers to questions that conventional cross-section or time series analyses are, per se, unable or unsuited to resolve. More specifically, although some explanatory factors can be used to justify the differences observed for decision processes across units, the analysis of sequential observations for each

unit is essential for assuring the reliability of the results. In other words, the dynamics of change inherent to cross-sectional evidence need to be taken into account to accurately assess the relevance of the individual effects to the decision process in analysis;

(3) it reduces the misspecifications that are due to omitted variables by using information available on both the intertemporal dynamics and the individual characteristics of the entities being investigated.

Taking into account the comparative advantages of the panel data models and their particular adequacy to large cross-sectional and narrow time-series data sets, this type of model will be used to analyse the impact of firm characteristics on the choice of optimal terms for the Eurobond issues across time. As it was mentioned in Chapter V, the data set used in this research aggregates the Eurobond issues made by 109 UK-based companies during the period from January 1986 to December 1999. By investigating the behaviour of a large set of firms consistently through a fourteenth-year period, we aim to determine and explain the transient effects as well as the cross-sectional impact associated with the explanatory factors for the Eurobond-terms selection process.

Considering that this selection process aggregates not only a quantitative and continuous dependent variable – Eurobond maturity structure – but also qualitative dependent variables – presence or absence of call provisions, convertible privileges, and protective covenants in Eurobond agreements – different panel data models will

be adopted. A description and discussion of these different models will be provided in the next section. This chapter is organised as follows. Section 6.2 describes the basic framework for the estimation of panel data models considering two different types of dependent variables – i.e. continuous and qualitative variables. Section 6.3 lists and discusses the main hypotheses to be tested in this study. Section 6.4 identifies the potential multicollinearity problems and discusses them in the context of an accurate model design. Section 6.5 provides an insight to the specification of the models for the four dependent variables in analysis. Finally, a discussion of the empirical findings and the main conclusions are presented in sections 6.7 and 6.8, respectively.

6.2. Panel data models

6.2.1. Continuous dependent variables

Greene (2000, p. 560) presents the basic framework for a panel data model as the following:

$$\gamma_{it} = \alpha_i + \beta' x_{it} + \varepsilon_{it} \qquad (6.1)$$

Where y_{it} and x_{it} are, respectively, the dependent and K explanatory variables at time t and for unit i, and ε_{it} are the regression disturbance terms. The parameter α_i measures the individual effect that is specific to the unit i and is time invariant. The parameter β measures the impact of changes in the explanatory variables and is

taken as constant across time and is the same magnitude for all units. There are two basic approaches for the generalisation of this model, which are designed as the *fixed-effects approach* and the *random-effects approach*. In the fixed-effects approach the term α_i is defined as a unit-specific constant term in the regression model. On the other hand, in the random-effects approach the term α_i is considered as a unit-specific disturbance term, which contrarily to ε_{it} enters as a single draw in the regression identically in each period. Specifically, the random-effects approach considers α_i as a random variable with $E[\alpha_i]=0$, $E[\alpha_i^2]=\sigma_\alpha^2$, and $E[\alpha_i\alpha_j]=0$ for $i \neq j$.

The choice of fixed-effects or random-effects approach depends on the aims pursued by the study and the characteristics of the data sample under analysis. The random-effects approach is more appropriate when the objective of the study is to make inferences about the population characteristics and when the sample observations are random selections from the relevant population. On the other hand, the fixed-effects approach is more suited when the study is strictly concerning a particular sample set, which is considered exhaustive or can be easily delimited. Taking into account the important constraints that the fixed-effects approach imposes on a study that aims to provide broad inferences about the optimal choice of contract terms for a set of potential issuers in Eurobond market, the empirical framework adopted in this research follows the random-effects setting.

The prevailing specification tests used for assessing the statistical properties of estimators obtained by the random-effects approach are the Lagrange multiplier test

devised by Breusch and Pagan (1980) and the χ^2 test proposed by Hausman (1978). The Lagrange multiplier tests whether there are individual-specific effects across units (α_i) in which case the classical OLS estimation models yield inefficient estimators. The Hausman test assesses whether the required orthogonality between the individual effects (α_i) and the regressors (x_{it}) is satisfied so that the generalised least-square estimators from the random-effects model embody the desired properties of asymptotic consistency and efficiency. As it will become apparent from the regression estimation analysis in section 6.7, both Hausman and Likelihood test ratio results strongly support the use of random-effects model as the best-devised framework to analyse the determinants of the maturity choice in Eurobonds issues.

A reformulation of the equation (6.1) for the estimation of the parameters in a random-effects model is provided by Greene (2000) and can be described as follows:

$$\gamma_{it} = \alpha + \beta' x_{it} + u_i + \varepsilon_{it}, \qquad i = 1,...,n; \quad t = 1,...,T_i \tag{6.2}$$

where there are K regressors in addition to the constant term and T_i is the sample size of unit i. In a balanced data set $T_i = T_j = T$ for $i \neq j$. The variable u_i is in this expression the random disturbance characterising the ith observation with the distribution properties described before. It is further assumed that:

$$E[\varepsilon_{it}] = 0,$$

$$E[\varepsilon_{it}^2] = \sigma_\varepsilon^2,$$

$$E[\varepsilon_{it} u_j] = 0 \text{ for all } i, t, \text{ and } j,$$

$$E[\varepsilon_{it} \varepsilon_{js}] = 0 \text{ if } i \neq j \text{ or } t \neq s$$

Moreover, considering that

$$w_{it} = \varepsilon_{it} + u_i \tag{6.3}$$

then, for this model

$$E[w_{it}^2] = \sigma_w^2 = \sigma_\varepsilon^2 + \sigma_u^2,$$

$$E[w_{it} w_{is}] = \sigma_u^2 , \qquad t \neq s$$

$$Corr[w_{it}, w_{is}] = \rho = \frac{\sigma_u^2}{\sigma_w^2} \qquad t \neq s$$

It follows, therefore, from the assumptions underlying the random-effects model that the aggregate disturbance terms (w_{it}) are correlated across time t and for each unit i. To this extent, one of the basic assumptions of the OLS model no longer holds and the OLS estimators will be inefficient relative to the generalised least square (GLS) estimators. A detail explanation regarding the use of the generalised estimation method to the random-effects model in (6.2) is provided in Appendix 6.1.

The understanding of the information conveyed by the generalised estimator of the slope parameter β in (6.2) is of particular interest considering that this estimator

reflects the aggregate impact of a combination of time-series and cross-section driven factors. More specifically, the generalised least square estimator for β can be described as a weight average between the cross-section effects estimator – so called the between-units estimator – and the time-series effects estimator – so called the within-units estimator is devised. Analytically, the generalised random-effects estimator can be represented as:

$$\hat{\beta} = \hat{F}^{w}\,\hat{\beta}^{w} + (I - \hat{F})\,\hat{\beta}^{b} \tag{6.4}$$

where,

(1) I is the identity matrix;

(2) $\hat{\beta}^{w}$ is the within-units estimator matrix, given by $[S_{xx}^{w}]^{-1} S_{xy}^{w}$;

(3) $\hat{\beta}^{b}$ is the between-units estimator matrix, given by $[S_{xx}^{b}]^{-1} S_{xy}^{b}$;

(4) $\hat{F}^{w}$ is the weight matrix, given by $[S_{xx}^{w} + \lambda S_{xx}^{b}]^{-1} S_{xx}^{w}$.

In this context, λ is the weight parameter that depends on the variance of the residual disturbance ε_{it}, the variance of the unit-specific disturbance term u_i and on the length of the time-series T_i. More specifically, λ is equal to $\frac{\sigma_{\varepsilon}^{2}}{\sigma_{\varepsilon}^{2} + T_i \sigma_{u}^{2}}$. On the other hand, S_{xx}^{w} and S_{xy}^{w} stand for the moment matrices associated with the within-

units estimator while S_{xx}^{b} and S_{xy}^{b} stand for the moment matrices associated with the between-units estimator. In analytical terms, these moment matrices are expressed as follows:

$$S_{xx}^{w} = \sum_{i=1}^{n}\sum_{t=1}^{T_i}(x_{it} - \bar{x}_{i.})(x_{it} - \bar{x}_{i.})' \qquad (6.5)$$

$$S_{xy}^{w} = \sum_{i=1}^{n}\sum_{t=1}^{T_i}(x_{it} - \bar{x}_{i.})(y_{it} - \bar{y}_{i.}) \qquad (6.6)$$

$$S_{xx}^{b} = \sum_{i=1}^{n} T_i(\bar{x}_{i.} - \bar{\bar{x}})(\bar{x}_{i.} - \bar{\bar{x}})' \qquad (6.7)$$

$$S_{xy}^{b} = \sum_{i=1}^{n} T_i(\bar{x}_{i.} - \bar{\bar{x}})(\bar{y}_{i.} - \bar{\bar{y}}) \qquad (6.8)$$

given that,

x_{it} and y_{it} are as before. $\bar{x}_{i.}$ is the Kx1 vector of means of x_{it} over the T_i observations. $\bar{y}_{i.}$ is the mean of the dependent variable for the unit i over the T_i observations. $\bar{\bar{x}}$ and $\bar{\bar{y}}$ are the overall means over the n units and the T_i observations.

6.2.2. Qualitative dependent variables

As stated in Judge et al. (1985) when researchers are faced with behaviour processes in which the alternatives are limited in number, i.e. the alternatives are discrete or quantal, standard estimation procedures such as OLS are no longer appropriate. When the endogenous random variable assumes only discrete values, the individual

behaviour choice must be described in probabilistic terms and a *qualitative dependent variable* (QDV) model should be adopted. The simplest QDV case is the *binary choice* model in which the individual behaviour choice involves only two alternatives and one must be chosen. The decisions whether or not to include call, convertible, or protective covenants in Eurobond issues are such examples. In this context the dependent variable takes the value of one or zero that are associated, respectively, with the presence or absence of the aforementioned covenants in the Eurobond agreements.

There are three different approaches for modelling the binary choice probability distribution. They are the *linear probability* model, the *Probit* model and the *Logit* model. The choice of different models rests upon the assumption being made about the cumulative density function (CDF) of the binary choice variable. More specifically, the linear probability model assumes that the CDF for the binary choice variable is linear. On the other hand, the Probit model and the Logit model assume a standard normal distribution function and a logistic distribution function respectively for the binary choice variable. As Greene (2000) points out, although the choice between the Probit and Logit models is difficult to justify on theoretical grounds, a number of shortcomings hinder the use of the linear probability model. These shortcomings are related to the violation of the standard estimation assumptions of normality and homoscedastic variances for the disturbance terms and the impossibility to constraint the values of the underlying cumulative density function to the interval [0,1]. Omitting the linear probability model, a choice has to be made between the Probit model and the Logit model. As the Probit model allows for a

more detailed information about the marginal contribution of the explanatory variables to the binary choice process,[30] the estimators for the callable, convertible, and protective covenants models discussed in the next sections were obtained using the Probit model.

The structural Probit model for a possible unbalanced panel of data i.e. a data set that might include different number of observations for individual units, is presented by Greene (1998) as follows:

$$y_{it}^{*} = \beta' x_{it} + u_i + v_{it}, \qquad i = 1,\ldots,n; \quad t = 1,\ldots,T_i \tag{6.9}$$

$$y_{it} = \begin{cases} 1 & if\ y_{it}^{*} > 0 \\ 0 & otherwise \end{cases}$$

Where y_{it} and x_{it} are, respectively, the unit i dichotomous dependent variable and K regressors at time t. y_{it}^{*} is the *unobservable* or *latent* variable that underlies the Probit probability function for the unit i and time t. β is the vector of coefficients for the K+1 regressors in x_{it} including the constant term. Finally, u_i stands for the unit-specific disturbance terms that enters as a single draw identically in each period and v_{it} stands for all remaining disturbance factors that affect y_{it}^{*} across time t and

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[30] As Greene (2000) states "whatever distribution [standard normal or logistic] is used [...] the parameters of the model, like those of any non-linear regression model, are not necessarily the marginal effects we are accustomed to analysing." Therefore, to compute the marginal effects of the explanatory variables on the conditional probability for the dependent variable further calculations have to be carried out. Greene (1998) notes that the use of Logit models in panel data settings is not suited for the calculation of these marginal effects as the required individual conditional means for the dependent variable are not needed in the model estimation and therefore are not computed by the statistical programmes.

cross-sectional unit i. The random variables u_i and v_{it} are assumed to be normally distributed with zero means and independent of each other, so that

$$Var[u_i + v_{it}] = Var[\varepsilon_{it}] = \sigma_u^2 + \sigma_v^2 \qquad (6.10)$$

and

$$Corr[\varepsilon_{it}, \varepsilon_{st}] = \rho = \frac{\sigma_u^2}{\sigma_u^2 + \sigma_v^2} \qquad t \neq s \qquad (6.11)$$

Similar to the panel data model for continuous dependent variable, several tests are available to assess the appropriateness of using the random effect Probit model on a specific data set. To this extent, the null hypothesis of no unit-specific random effects can be tested with a Wald test or with a Likelihood ratio test. The Wald test is a *t* test that assesses the statistical significance of the correlation coefficient (ρ) of the regression disturbance terms across time for each individual unit. The expression (6.11) shows that if the time-series correlation of the disturbance terms for each individual unit is not statistical different from zero then the variance for the unit-specific disturbance terms (δ_u^2) is insignificant and the pooled Probit model with no unit-specific effects should be applied.[31] The Likelihood ratio test assesses the statistical significance of the increase in the goodness of fit of the random effects model compared to the restricted model - pooled Probit model - where no unit-specific effect is considered. As it will be shown in section 6.7, both the Wald and the Likelihood ratio tests suggest the presence of unit-specific effects for the

[31] For a detailed specification of the pooled Probit model see Greene (2000, p. 814).

convertible provisions and protective covenants models but not for the call option model. For this reason, we use the random-effects Probit model to estimate the parameters of the convertible and protective covenants models and the pooled Probit method to obtain the regression estimators of the call option model.

6.3. Testable hypotheses

The previous literature has various conjectures about the influence of firm's characteristics and/or specific market conditions on the design of debt contracts. Almost all previous empirical studies have focused only on a single feature of the debt contract, omitting the substitution effect between some of the contract features. Additionally, previous studies tend to use data sets containing different debt instruments, which might confound the analysis. The contribution of this study is to examine all choices of contract terms in a comprehensive manner taking into account the substitution effect. To avoid the confounding effect due to mixing different debt instruments, we chose to focus our analysis on a single debt instrument, namely the Eurobond.

Hypothesis one: Debt features act as substitute mechanisms in reducing the contracting costs associated with the issuance of Eurobond contracts.

Myers (1977) was the first to stress that the debt maturity and the protective covenants embedded in the debt contract indenture could act as substitute mechanisms to reduce financing agency costs. This argument was latter extended by Barnea et al. (1980) regarding the alternative choice between maturity and the

inclusion of call options and by Jensen and Meckling (1976), Mikkelson (1980), and Smith and Warner (1979) concerning the substituting role played by convertible privileges, maturity, and protective covenants. Myers (1977) argues that both short-term debt and debt with protective covenants can be used to reduce shareholders' underinvestment incentive which contributes to a decrease in contracting costs. Barnea et al. (1980) argue that shortening maturity or attaching call options to debt issues mitigates shareholder's distorting incentives because these debt features allow for a better matching between the exercise date for firm's growth options and the debt payments service. Finally, Jensen and Meckling (1976), Mikkelson (1980), and Smith and Warner (1979) stress the importance of the inclusion convertible privileges and/or protective covenants in aligning the interests of shareholders with those of creditors. To this extent, these types of covenants embedded in debt contracts represent also alternative instruments to the reduction of debt maturity.

The single argument in the literature against the substitute mechanism prediction comes from Smith and Warner (1979) who point out that in some circumstances the underinvestment costs exacerbated by inclusion of convertible options might supersede the reduction in contracting costs induced by the issuance of convertible debt. Therefore, whenever the incentive to forsake profitable investments is reasonably strong, callable and short-term debt might play a complementary rather than a substitute role to convertible debt in order to guarantee the reduction of debt contracting costs.

Hypothesis two: The optimal choice of Eurobond terms depends on the level of agency costs faced by the issuing firm.

A number of researchers have postulated about the impact of agency costs on the selection of the appropriated terms embedded in debt contracts. Typically, they predict that the higher the set of growing opportunities and/or financial risk the higher the agency costs of financing and therefore more pertinent will be for a firm to choose the appropriate set of debt terms in order to mitigate these costs. To this extent, shorter-term maturity debt (see Myers (1977)), callable debt (see Bodie and Taggart (1978)), and debt with embedded protective covenants (see Myers (1977) and Smith and Warner (1979)) are postulated to be the optimal instruments for reducing the costs associated shareholders' possible underinvestment. On the other hand, the risk of shareholders following low-value, riskier investment can be mitigated with the issuance of short-term or callable debt (see Barnea et al. (1980)), convertible debt (see Jensen and Meckling (1976), Green (1984), and Smith and Warner (1979)), and debt with protective covenants (see Smith and Warner (1979)). Although contending that the inclusion of convertible privileges contributes to a reduction in risk-shifting costs, Smith and Warner (1979) argue, however, that this beneficial effect can be off set by the inherent exacerbation of underinvestment incentives. In this case, firms will be better off issuing non-convertible debt to avoid facing excessive debt agency costs.

Hypothesis three: The degree of information disclosure in Eurobond markets affects the relevance of adverse-selection and signalling arguments on the optimal choice of Eurobond terms.

In the context of high information asymmetry about the firms' future prospects, several authors argue that the choice of debt contract terms can be used to reduce adverse-selection costs or to signal firms superior quality. Flannery (1986) and Kale and Noe (1990) argue that, in high asymmetric information environments, firms signal their superior quality by issuing short-term debt while Diamond (1991, 1993) contends that short-term debt is favoured by all firms due to the non-existence of mechanisms that prevent bad firms from mimicking the behaviour of good firms. According to Diamond (1993), only the presence of liquidity costs that might eliminate important shareholders' control rents can lead to a separating equilibrium where both low and high quality firms issue mostly short-term debt but middle quality firms issue long-term debt. Nevertheless, Diamond (1991) refers to screening mechanisms that can force middle rate firms to issue in the middle of debt maturity spectrum leaving the issuance of longer and shorter-end maturity for high and low rated firm.

Robbins and Schatzberg (1986) stress that when managers hold private and favourable information about firm's future prospects they tend to issue callable debt to separate themselves from lower quality firms. More specifically, Robbins and Schatzberg (1986) argue that low quality firms prefer to issue equity to short-term or callable bonds due to the recontracting costs incurred when the quality of their projects is revealed to the market. For this reason, Robbins and Schatzberg (1986) contend that the issuance of callable bonds can be used to convey a positive signal to the market about firm's unobservable but favourable prospects. On the other hand, convertible options are predicted to convey the same favourable information about

the quality of firms' future investment projects (see Constantinides and Grundy (1989), Stein (1992), and Nyborg (1995)). Finally, Chan and Kanatas (1986) and Chan and Thakor (1987) argue that high quality firms favour the issuance of debt with embedded protective covenants as it allow for a reduction in the inherent adverse-selection costs.

Taking into account that degree of information disclosure concerning Eurobond issuers tends to be particularly high at the time of the issue announcement, these signalling and adverse-selection arguments might lose their relevance as the determinants of Eurobond contract terms. Therefore, the contradiction of the aforementioned predictions provides the foundation for hypothesis three listed above.

Hypothesis four: The degree of liquidity risk faced by the issuing firm affects the choice of maturity and callable structure of the Eurobond issue.

Diamond (1991) refers to the liquidity risk as the borrower's incapacity to refinance short-term debt at favourable conditions, which might result in important losses regarding borrower's control rents. These control rents that cannot be assigned to creditors represent part of the future return of a project that can accrue to the borrower due to the bargaining power held by him over the project's proceeds. This bargaining power exists because either the borrower is critical to running the firm or because he might take an unobserved action and must be provided with proper incentives (Diamond (1993)). According to Diamond (1991) and Sharpe (1991), even in contexts of symmetry of information about firm's future prospects, liquidity

risk plays a key role on the design of debt contracts. In fact, whenever debt is of shorter maturity than assets and the firm is unable to service its obligations, creditors can force liquidation which unless there are no control rents pledged to the owner-manager leads to a loss in firm's value. Sharpe (1991) points out that even if the extreme outcome of liquidation does not occur and the short-term debt can be rolled over, creditors will demand a high default premium leading to a twofold negative effect in firm's value. First, a direct effect resulting from the increase in cash out-flows to creditors. Second, an indirect effect as the borrower's incentive to apply effort in pursuing firm's investment projects is weakened. Hence, liquidity risk theory predicts that low credit quality firms will always prefer long-term debt to short-term debt in order to avoid the inherent costs of financial distress. Moreover, considering that the inclusion of embedded call options in bond contracts provide additional managerial flexibility to decrease the amount of borrowings before the maturity date or to remove restrictive covenants (see Pye (1966)), callable bonds can also be used to reduce firm's liquidity risk.

> *Hypothesis five: The tax advantages associated with the interest payments play an important role in the choice of the optimal terms for Eurobond issues.*

Typically, tax treatments for firm's interest payments and equity payouts are different. Contrary to the equity income payouts, the interest payments are typically considered as tax deductible for the computation of corporate taxable income. Due to this difference on tax treatment, a number of authors have postulated that the optimal choice of the maturity or call structure for debt issues is affected by tax

considerations. To this extent, it is argued that for increasing slopes of default risk and interest rate term structures, firms are more likely to issue long-term debt due to the time-value of interest tax shield (see Brick and Ravid (1985)) or the repurchase-premium tax savings (see Mauer and Lewellen (1987)). More specifically, Brick and Ravid (1985) postulate that for upward interest rate term structures, the issuance long-term risky debt embeds comparative advantages because it allows the firm to maximise debt tax gains by accelerating interest payments. On the other hand, Mauer and Lewellen (1987) point out whenever the interest term structure is upward sloping and the long-term debt is traded above its face value, shareholders are able to capture tax gains by repurchasing the outstanding debt as long as these gains exceed the after-tax transaction costs. The higher the interest rate volatility, the lower the transaction costs, and the higher the corporate tax rates the higher will be the interest tax benefits granted to the long-term debt issuers. Moreover, Kane et al. (1985) predict that firms with high marginal corporate tax rate and more volatile cash-flows maximise their tax gains by rebalancing more frequently their capital structure and therefore should optimally issue short-term debt. Contesting these arguments, Lewis (1990) contends that when debt-maturity structure and optimal leverage are chosen simultaneously, the impact of the firm's tax liability on its maturity structure irrelevant. In particular, Lewis (1990) emphasises that unless other market imperfections like bankruptcy costs are taken into account, changes in the outstanding debt maturity structure will carry no additional tax shield for the firm. Therefore, the rejection of hypothesis five of this research will be in line with Lewis's (1990) debt maturity tax irrelevance theory.

Boyce and Kalotay (1979) and Marshall and Yatwitz (1980) demonstrate that as long as the corporate tax rate exceeds that personal tax rate borne by the marginal investor, callable bonds will always prevail over non-callable bonds. To this extent, these authors argue that both borrowers and creditors should favour the callable bonds due to the interest tax savings resulting from exercising call option (Boyce and Kalotay (1979)) or to the call premium tax benefit (Marshall and Yatwitz (1980)).

Subsequently, Brick and Wallingford (1985) and Mauer et al. (1991) contest the dominance of call instruments by tax reasons and argue that, even if Miller's (1977) tax irrelevance equilibrium does not hold, other forms of debt financing confer comparatively more tax advantages than callable debt.

Hypothesis six: The inclusion of convertible options in Eurobond issues is determined by the degree of uncertainty surrounding firm's intrinsic risk.

The argument concerning the advantage of convertibles in reducing the risk uncertainty inherent to firm's activity is put forward by Brennan and Schwartz (1988) and Brennan and Kraus (1987). Brennan and Schwartz (1988) argue that, convertible securities, unlike equity and straight debt, protect investors against firm's intrinsic risk because of their hybrid nature. This protection also safeguards investors against discretionary risk-shifting policies pursued by shareholders. Therefore, like Jensen and Meckling (1976) and Green (1984), Brennan and Schwartz (1988) contend that the inclusion of convertible options in debt contracts contribute to a reduction in the creditors/shareholders conflict of interests. On the other hand, Brennan and Kraus (1987) stress that convertible issues can act as a signalling

mechanism for the firm's intrinsic risk, reducing the contracting costs of financing and consequently contributing to the maximisation of firm's value. In Brennan and Schwartz's (1988) or in Brennan and Kraus's (1987) models, the beneficial impact of convertibles is greater the higher the firm's inherent risk, which has been empirically proxied by the firm's leverage, set of growth opportunities, and volatility of cash-flows.

Hypothesis seven: The inclusion of call options in Eurobond indentures is affected by the uncertainty about future interest rate movements.

According to Pye (1966), the prevalence of callable bonds in capital markets is explained by their ability to act as hedging tools against interest rate risk. More specifically, Pye (1966) points out that assuming that managers and investors have different information about future interest rate shifts, the inclusion of call provisions in the bond contracts will always maximise firm's value. In fact, as long as the reduction of financial risk is not fully reflected in the lower callable bond price, corporate firms will always favour the issuance of bonds with call options as the potential financial loss inherent to a decreasing in interest rates is eliminated by the call option's exercise. To this extent, Pye (1966) predicts that the higher the degree of asymmetric information about interest rates and the stronger the manager's expectations of a decrease in interest rates, the higher the probability of bond issues to include call back options.

Several authors (see e.g. Myers (1971) and Bodie and Taggart (1978)) contradict the aforementioned prediction, arguing that unless managers possess special expertise in forecasting interest rates, firms will not profit with the issuance of callable bonds. More specifically, these authors contend that even in the presence of market imperfections, like asymmetry of information about interest rates, the arbitrage-free mechanisms will assure that no benefit will be retained by the firm from the issuance of callable rather than call-free bonds. In other words, authors like Myers (1971) and Bodie and Taggart (1978)) contest the relevance of risk hedging purposes on the issuance of callable bonds.

6.4. Multicollinearity and model design

Maddala (1989, p. 223) refers to multicollinearity as the situation where the independent variables of a model are highly intercorrelated. Although multicollinearity might not be a problem for various objectives of regression analysis, it tends to be a serious problem when the aim is to assess the relative influence of independent variables (see Hedben (1981), Chapter 5). As this is one of the main objectives of this study, the issue of multicollinearity is carefully approached.

As it will be further discussed in this section, there is no criterion to measure the presence of multicollinearity in non-linear models as those specified for the inclusion of call options, convertible provisions or protective covenants in debt contracts. On the other hand, for linear regression models although there is also no unique method of detecting or measuring the degree of multicollinearity, some progress has been

made in this area with the definition of some rules of thumb. Some of these rules rely on the analysis of the matrix of correlation, the estimation of auxiliary regressions, and the computation of Variance Inflation Factors (VIF) and condition indices. Considering the limitations and the complexity in applying some of these tests to the generalised random-effects model, the multicollinearity diagnostics used for the maturity regression model rely only on the analysis of the correlation matrix and the condition index values.

The analysis of the Pearson correlation matrix reported in Table 6.1 reveals that there is a strong linear dependence between two variables that enter in the maturity regression model. These are the proxy for firm's credit quality ($ZSCOREadj$) and its square value ($ZSCOREadj^2$). The correlation coefficient for these two variables is 0.96 much higher than the second highest correlation coefficient of 0.41 between firm's market-to-book value ($MBOOK$) and firm's earnings variance (%) ($EVAR$).[32] Although there is no precise threshold for the presence of severe multicollinearity, several authors (e.g. Gujarati (1988), Huang (1970), Berry and Feldman (1985)) suggest that a value in excess of 0.8 for the correlation coefficient is associated with imprecise estimation of the coefficients for the variables of concern. Nevertheless, as Gujarati (1988) points out taking into account the complex interrelationships among the explanatory variables, even lower values of linear dependencies (i.e., less than 0.5) can be associated with multicollinearity problems.

[32] A definition of all the variables used in the regression models is provided in Section 6.5 and in Table 6.2.

Due to the limitations of the correlation matrix analysis, an additional collinearity test evolving the computation of condition indices for the regressors in the generalised maturity regression is implemented. In analytical terms, the condition index (CI) is defined as:

$$CI = \sqrt{\frac{Max\ eigenvalue}{Min\ eignvalue}}$$

where each eigenvalue correspondents to one characteristic root of the moment matrix in the linear model. Judge et al. (1985) consider that condition indices spanning between 30 and 100 are associated with moderate to strong multicollinearity while Greene (2000) refers to values in excess 20 as indicative of potential interdependencies problems. The maximum condition index for the maturity model that includes both variables $ZSCOREadj$ and $ZSCOREadj^2$ is 44.47, which corroborates the correlation matrix diagnostic regarding the presence of multicollinearity problems affecting the regression estimation. Following standard procedures, two additional regression estimations were run in which the explanatory variables $ZSCOREadj$ and $ZSCOREadj^2$ were removed one at the time. The maximum condition index dropped to 14.01 and 9.09 when the variables $ZSCOREadj^2$ and $ZSCOREadj$ were removed, respectively, which indicates that none of these variables is significantly correlated with the remaining regressors in the model. Considering that there is a theoretical justification for the observed interdependence between the variables $ZSCOREadj$ and $ZSCOREadj^2$ as they proxy for the predicted non-monotonic relationship between firm's credit quality and

issue maturity and that no further indication of severe collinearity was found, the final maturity model includes all the theoretically relevant variables.

While a set of diagnostics is available for detecting collinearity in linear estimation models, the equivalence has not yet been developed for non-linear models (Judge et al. (1985)). Cox and Snell (1989) note that, in the analysis of highly balanced sets of data (e.g. random data sets where the probability of being included is the same for all individuals), the assumption of exact or near exact orthogonality underlying Ordinary Least-Squares (OLS) theory implies that estimates of certain parameters are unaffected by the inclusion or exclusion of some other parameters. Therefore, it is possible to begin the analysis of a balanced design by the inspection of a "full" analysis of variance in which possibly large numbers of main effects and interactions are included. However, for models with qualitative dependent variables, such as those related to the choice of callable, convertible or protected Eurobond issues, the use of linear regression estimation methods like ordinary or generalised least-square methods does not produce consistent estimators. On the other hand, Cox and Snell (1989, p.188) argue that for non-linear models,

> *"...a balanced design leads to only approximate orthogonality of the estimated parameters and it is not always possible to see immediately the precise effect of such inclusion or exclusion. For this reason it is commonly sensible to begin with some relatively simple model and then to examine the need to amplify and indeed simplify the initial model."*

In order to avoid omitting relevant variables from the Probit estimation for callable, convertible, and protective covenants models but simultaneously control for undetected and potentially impairing interdependencies between the explanatory variables, an initial univariate analysis of the relationship between the dependent and the each individual variable is performed. The comparison between the preliminary results from the univariate analysis and the multivariate analysis (where all the explanatory variables are included) found evidence of a potential multicollinearity bias affecting the estimation of the call option binary model. More specifically, the sign and significance of the coefficient for the firm's growth opportunity proxy ($MBOOK$) changed when all other explanatory variables are considered in the call option model.[33] A remedy for multicollinearity typically suggested in the literature (see e.g. Gujarati (1988), Greene (2000), and Judge et al. (1985)) is to use other information available and replace the "correlated" variable by a new variable that proxied for the same unobserved predictor. Previous empirical studies e.g. Long and Malitz (1985) and Myers (1984) provide evidence that is consistent with the use of firm's intangible assets as a proxy for firm's growth opportunities. Based on this evidence and in order to purge the call option estimation analysis from multicollinearity bias the variable firm's intangibles scaled by total assets (INT) replaces the variable market-to-book value ($MBOOK$) as a proxy for firm's future growth opportunities.

No significant multicollinearity problems were found for the other two binary models for the choice of convertible and protected Eurobond issues.

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[33] An analysis of the Pearson correlation matrix in Table 6.1 reveals significant interdependencies between the variable ($MBOOK$) and other variables in the call option model namely the proxies for firm size ($SIZE$), tax paid ($TAXA$), and interest level ($INTLEV$) with associated correlation coefficients of 0.32, 0.24, and -0.24, respectively.

6.5. Model specification

In order to test the hypotheses stated in section 6.3, four models were specified for each of the Eurobond contracted terms analysed namely, maturity, call options, convertible provisions, and protective covenants. Several proxies for firm-specific characteristics and market conditions before or at the time of the issue announcement date were devised and a detailed explanation underlying these measures is provided below. Most of the proxies for firm-specific characteristics were constructed using financial statements for financial year-end date close to and preceding the announcement of the Eurobond issue. The reason for using *ex-ante* characteristics is to ensure that all the information has been fully disclosed and was made available to market participants at the announcement date of the Eurobond issue.

Table 6.2 provides a detailed description of the variables used and a theoretical justification for their inclusion in the specified debt structure design models.

6.5.1. Maturity (*MAT*) equation

$$MAT_{it} = \alpha_0 + \alpha_1 CALL_{it} + \alpha_2 MBOOK_{it} + \alpha_3 ASSMAT_{it} + \alpha_4 TAXA_{it} +$$

$$\alpha_5 EVAR_{it} + \alpha_6 TERMP_{it} + \alpha_7 INTVOL_{it} +$$

$$\alpha_8 RET1YB_{it} + \alpha_9 UEXP_{it} + \alpha_{10} ZSCOREadj_{it} +$$

$$\alpha_{11} ZSCOREadj_{it}^{2} + \alpha_{12} SIZE_{it} + \alpha_{13} LEVEQ_{it} + \mu_i + \varepsilon_{it} \qquad (6.12)$$

where

α = regression coefficients

i = index of the ith firm

t = time period, from first half-year in 1986 to second half-year in 1999

μ = unit-specific disturbance term (random-effects)

ε = regression disturbance term

To test Hypothesis one that managers should be indifferent between issuing short-term or callable Eurobond contract, the variable $CALL$ was introduced in the equation (6.12). It is a dummy variable that takes the value of one if the issue includes a call option and zero otherwise. Hypothesis one predicts a positive and significant for the coefficient of the dummy variable $CALL$.

The variables $MBOOK$, $ASSMAT$ and $LEVEQ$ are included in the equation (6.12) to test Hypothesis two that the agency costs have an impact on the maturity choice of Eurobond issues. Specifically, these variables stand for:

$MBOOK$: The market-to-book value of the issuing firm. This measure proxies for the firm's investment opportunity set and as in Barclay and Smith (1995), Dennis et al. (2000), and Guedes and Opler (1996) is obtained by dividing the firm's market value (i.e. total assets + equity market value – book value of equity) by the firm's total assets. Hypothesis two predicts a significant and inverse relationship between the level of firm's growth opportunities proxied by $MBOOK$ variable and the Eurobond issue maturity. Therefore, a negative sign is expected for the regression coefficient of $MBOOK$.

ASSMAT : The proxy for the issuing firm's asset maturity. Similar to Dennis et al. (2000) and Guedes and Opler (1996), the firm's asset maturity is defined as the natural log of the product between the net fixed assets scaled by the total assets and the net fixed assets divided by the total depreciation. The intuition behind this proxy is that the longer maturity assets are depreciated at slower rates. According to Hypothesis two, firms holding assets with longer maturity should issue longer maturity Eurobonds in an attempt to match the debt service with the exercise of future growth options. This, in turn, would reduce the incentives to pursue non-value maximising investment policies and ultimately decrease the inefficiencies of debt financing. Thus, the hypothesis two predicts a positive sign for the coefficient of *ASSMAT* .

LEVEQ: The proxy for firm financial leverage is computed as the firm's total debt[34] divided by the firm's book value of equity. It is argued in the agency costs literature that the incentive for shareholders to pursue non-value maximising policies is particularly strong in firms with high leverage levels. The issuance of shorter-term debt limits this incentive, as the gains that shareholders obtain from pursuing non-value maximising policies are reduced. In other words, Hypothesis two predicts an inverse and significant relationship between firm's leverage and Eurobond maturity. Another proxy for leverage i.e. the ratio of total debt to total assets was used in preliminary tests following the procedure adopted by Dennis et al. (2000) and Stohs and Mauer (1996). Nevertheless, these tests reveal the existence of serious multicollinearity problems between this proxy for leverage and proxy for firm's

[34] The firm's total debt is taken as the sum of the total loan capital and the total current liabilities.

growth opportunities. To overcome these problems total equity value instead of total assets value is used as the denominator of the leverage proxy.

The variable *SIZE* is introduced in equation (6.12) for testing Hypothesis four. This variable is defined as follows:

SIZE : Similar to previous empirical works (see e.g. Dennis et al. (2000), Barclay and Smith (1995), and Stohs and Mauer (1996)) firm size is calculated as the natural log of 100 times the firm's market value deflated by the UK consumer price index (using 1982 as the base year)[35]. Typically, it is argued that smaller firms face higher liquidity risk due to their lower credit quality (Queen and Roll (1987)) or insufficient amount of collateral assets (see Sharpe (1991)). In this context, liquidity risk theory postulates that smaller and potentially less credible firms should issue longer-term debt to avoid liquidity costs associated with financial distress (lost of clients, managerial distraction) or in the extreme case forced bankruptcy.

Nevertheless, the variable *SIZE* can also depict a mechanical relationship between firm size and issue maturity that it is observed in some empirical studies like e.g. Stohs and Mauer (1996). To this extent, it is argued that large firm are more likely to issue long-term debt due to the economies of scale that result from the prevalence of fixed transaction costs in public placed issues. Thus, contrary to the liquidity risk argument the mechanical relationship between issues maturity and firm size predicts a positive sign for the coefficient of the variable *SIZE* .

To empirically assess Hypothesis five, four variables related to taxability arguments were computed. These variables are:

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[35] The UK consumer price index data was obtained from the Monetary and Financial Statistics Division of the Bank of England.

TAXA: The proxy for firm's marginal effective tax rate. Similar to Dennis et al. (2000) and Guedes and Opler (1996) this proxy is defined as the ratio of tax paid to total assets and is expressed in percentage. The tax relevance argument (see Kane et al. (1985)) contends that firms, for which the tax rate and earnings volatility are particularly high, maximise their tax shield gains by rebalancing their capital structure more frequently. To be able to rebalance their capital structures regularly, these firms should issue short-term debt contracts. To this extent, the tax relevance rationale underlying Hypothesis five predicts negative regression coefficient for both *TAXA* and *EVAR* (defined below).

EVAR: The proxy for the variance of firm's earnings and like in Dennis et al. (2000) and Stohs and Mauer (1996) is measured as the standard deviation of the earnings before interest, tax, and depreciation (EBITD) over the last three financial years-ends preceding the issue announcement date scaled by the average total assets over the same period. For five companies in our sample there was no information about the EBITD for all three 3 financial years-ends prior to the issue announcement as these companies were recently privatised (e.g. Anglian Water Plc, National Power Plc, and Severn Trent Plc) or incorporated (e.g. Storehouse Plc and Thorn Plc). Similar to the practice followed by Dennis et al. (2000), we replace these missing values with the correspondent average values for Eurobond issuers from the same industry.

TERMP: The measure for the interest rate term premium is defined as the difference between the 10-year UK government bond and the 3-month UK Treasury bill daily yields average over one year prior to the issuance of the Eurobond. The calculation of this proxy follows a similar approach adopted by Dennis at al. (2000),

Barclay and Smith (1995), and Stohs and Mauer (1996). It should be noted here that as the denomination currency of the Eurobond issues is not restricted to Sterling pounds, so interest term premium in other currencies could have been taken into account. However, that fact of all the companies in the sample are UK-base together with the evidence that 71% of the total issues made by these companies are denominated in Sterling pounds supports the use of single Sterling term spread. Brick and Ravid (1987) and Mauer and Lewellen (1987) argue that managers capture tax benefits by issuing long-term debt when the slope of the interest rate term is positive and the interest volatility is high. Therefore, we expect positive regression coefficient for both *TERMP* and *INTVOL* (defined below) is positive. These variables are expressed in percentage.

INTVOL: This is the proxy for the interest rate volatility and similar to Dennis et al. (2000) is measured by the standard deviation of the daily 10-year UK government bond daily yields over the year prior to the announcement date.

In the case of information asymmetry, several predictions have been made about the impact of signalling and credit quality on the design of debt contracts. To assess the pertinence of these predictions in Eurobond markets (as stated in Hypothesis three) four variables were introduced in equation (6.12). These variables are described as follows:

*RET*1*YB*: This is an indicator of firm's prosperity and it is calculated as the firm's stock return over one year prior to the issue announcement, following the procedure adopted by Guedes and Opler (1996) and Dennis et al. (2000). In context of asymmetric information, it is expected (see e.g. Lucas and McDonald (1990)) that

firms take advantage of the existence of uniformed investors and issue longer and necessarily more mispriced debt after a period of good performance in the market. Therefore, the asymmetric information theory predicts a significant and positive sign for the coefficient of $RET1YB$.

$UEXP$: This is a proxy for firm's unexpected earnings and as in Dennis et al. (2000) is calculated as the difference the earnings per share at the financial year-end following the issue announcement and the earnings per share at the financial year-end of the announcement scaled by the stock price at the financial year-end of the announcement. Similar to the procedure adopted before, the five missing values for this variable were replaced by the correspondent average values for the Eurobond issuers from the same industry. According to the asymmetric information theory (see Flannery (1986), Kale and Noe (1990)) managers use short-term debt to signal the superior quality of the firm's future prospects. Therefore, in environments where the information asymmetry is high a negative and significant sign is expected for the coefficient of $UEXP$. This variable is computed as a percentage.

$ZSCOREadj$: This is the proxy for firm's credit quality and, similar to Dennis et al. (2000) and Hulburt and Scherr (2001), is obtained by excluding the term assessing "firm solvency" (i.e. the ratio of the market value of equity to total debt) from the original expression proposed by Altman (1968). A reduced formulation for the proxy of firm's credit quality is used due to the high correlation observed between the standard Altman's measure and the explanatory variable market-to-book value (preliminarily tests report a partial correlation coefficient of 0.71). Furthermore, as the impact of "firm solvency" factor on the dependent variable is accounted for by the proxy for firm leverage ($LEVEQ$), the precision of the model estimation is

likely to increase with the elimination of the double effect induced by these two concurrent ratios (see Gujarati (1988)). Analytically, the measure used for firm's credit quality is defined as 3.3 * EBIT/Total sales + 1.0 * Total sales/TA + 1.4 * RE/TA + 1.2 * WC/TA where EBIT is firm's earnings before interest and taxes, RE is the firm's retained earnings, WC is the firm's working capital, and TA is the firm's total assets. To exclude the negative values from the proxy for firm credit quality this variable is censored from below at zero. Diamond (1993) points out that in asymmetric information environments, high quality firms issue mainly short-term debt in order to increase the sensibility of the underlying costs of debt to the release of future favourable information decreasing therefore the adverse-selection costs. Nevertheless, as the uniformed investors are unable to separate good quality firms from bad quality firms, no separating equilibrium is achievable and bad quality firms also will issue short-term debt. On the other hand, Diamond (1991, 1993) stresses the fact that although middle quality firms tend to issue long-term debt to avoid excessive liquidity costs these firms are screened off from the longer-end of the maturity spectrum due to agency related inefficiencies. To this extend, Diamond (1991, 1993) contends that the relationship between firm's credit risk and debt maturity is non-monotonic whenever asymmetric information and liquidity costs are significant. If this non-monotonic relationship follows the pattern predicted by Diamond (1991, 1993), one should expect a positive sign for the coefficient of *ZSCOREadj* and a negative sign for the squared value of this variable i.e. for $ZSCOREadj^2$.

6.5.2. Call provisions (*CALL*) equation

$$CALL_{it} = \beta_0 + \beta_1 MAT_{it} + \beta_2 INTLEV_{it} + \beta_3 INTVOL_{it} + \beta_4 INT_{it} +$$

$$\beta_5 LEVEQ_{it} + \beta_6 TAXA_{it} + \beta_7 UEXP_{it} + \tag{6.13}$$

$$\beta_8 ZSCOREadj_{it} + \beta_9 SIZE_{it} + \varepsilon_{it}$$

where:

β = regression coefficients and

i, t, ε are as before.

The variable issue maturity (MAT) is included in equation (6.13) to test the prediction underlying Hypothesis one that either short-term Eurobonds or Eurobonds with embedded call options can be used as mechanisms to control the excessive contracting costs. The substitute relationship implied by this hypothesis predicts a positive and significant coefficient for the variable measuring the issue maturity (MAT).

To test the agency costs arguments underlying Hypothesis two, the variables INT and $LEVEQ$ are included in equation (6.13).

INT : This is the proxy for firm's growth opportunities and, as in Long and Malitz (1985) and Myers (1984), is defined as the percentage ratio of intangible assets to total assets. Considering that high growth firms have comparative advantages in using callable bonds to reduce agency costs (see Bodie and Taggart (1978)),

Hypothesis two predicts a positive sign for the coefficient of *INT*. A positive sign is also expected for the proxy for firm leverage (*LEVEQ*), following Barnea et al.'s (1980) prediction that high levered firms tend to issue callable debt to control shareholder's incentive to pursue low-value, higher risk projects.

To test Hypotheses three and four the variables *UEXP*, *ZSCOREadj*, and *SIZE* are included in equation (6.13). *UEXP* and *ZSCOREadj* test the relevance of signalling theories. A positive and significant sign is expected for the variables *UEXP* and *ZSCOREadj* if the argument by Robbins and Schatzberg (1986) that firms use callable debt to signal the superior quality of their projects applies to the Eurobond financing. The variable *SIZE* tests for the importance of liquidity risk. Smaller and typically less credible firms benefit from the managerial flexibility provided by the call option exercise. Thus, a negative sign is expected for the variable *SIZE*.

The variable *TAXA* is used to test Hypothesis five. If the argument about the dominance of callable debt due to inherent tax advantages (see Boyce and Kalotay (1979) and Marshall and Yatwitz (1980)) prevails, a positive sign is expected for the variable *TAXA*. On the other hand, if tax costs are associated with the issuance of callable Eurobonds (see Brick and Wallingford (1985) and Mauer et al. (1991)) arguments, the expected sign for *TAXA* is negative.

Finally, Hypothesis seven regarding the impact of interest rate risk in the issuance of callable Eurobonds is tested with the inclusion of the interest rate level (*INTLEV*) and the interest rate volatility (*INTVOL*) (defined previously).

INTLEV : Similar to Kish and Livingston (1992) this proxy is defined as the 3-month UK Treasury bill rate prevailing at the time of the issue announcement. Pye (1966) argues that the benefit from including call options in bond indentures is greater the higher the interest rate volatility and the interest rate level prevailing at the time of the bond issue. The higher the interest volatility and the higher the level of rates at the time of the issue the higher the probability for the firm to refund the debt at lower cost through the exercise of the call option. Therefore, a positive sign is expected for the coefficients of both variables: *INTLEV* and *INTVOL* .

6.5.3. Convertible provisions (*COV*) equation

$$COV_{it} = \chi_0 + \chi_1 MAT_{it} + \chi_2 PROTC_{it} + \chi_3 MBOOK_{it} + \chi_4 UEXP_{it} +$$

$$\chi_5 ZSCOREadj + \chi_4 EVAR_{it} + \chi_5 SIZE_{it} + \chi_6 LEVEQ_{it} + \qquad (6.14)$$

$$\chi_7 SDR3M_{it} + \chi_8 BRISK_{it} + \chi_9 DTARG_{it} + \mu_i + \varepsilon_{it}$$

where:

χ = regression coefficients and

i , t , μ , ε are as before.

The study of the interrelationship between the use of convertible provisions and other Eurobond features, is undertaken by considering the variables issue maturity (MAT) and the dummy for protective covenants ($PROTC$) in the right-hand side of equation (6.14). Several authors (e.g. Jensen and Meckling (1976), Mikkelson (1980), and Smith and Warner (1979)) point out that the inclusion of convertible provisions in debt agreements reduces debt agency costs because it brings closer the interests of shareholders and bondholders. On the other hand, Myers (1977) argue that the issuance of short-term debt or debt with embedded protective covenants play the same role in reducing costly conflicts of interest between shareholders and bondholders. Under these arguments, a positive and negative sign is expected respectively for the coefficients of MAT and $PROTC$.

To test Hypothesis four, two variables proxying for the quality of firm's prospects are included in (6.14), namely $UEXP$ and $ZSCOREadj$. Constantinides and Grundy (1989), Stein (1992), and Nyborg (1995) argue that convertible issues act as a signalling mechanism conveying the firm's true credit quality to the market and assuring the prevalence a separating equilibrium between higher and lower credit rating firms. In particular, Stein (1992) and Nyborg (1995) postulate that medium quality firms have special advantages in issuing convertible bonds as these firms are less prone than lower quality firms to incur in financial distress or forced conversion costs but are not as strong as higher quality firms to give up of the insurance against adverse future cash-flow movements. According to these arguments and considering the particular importance of higher quality firms in Eurobond markets, we should

expect a negative coefficient for the proxy for firm's credit quality $ZSCOREadj$ and a positive coefficient for firm's unexpected earnings $UEXP$.

To test Hypothesis six regarding the impact of firm's risk uncertainty on the decision to issue convertible Eurobonds, the variables market-to-book value ($MBOOK$), earnings variance ($EVAR$) and firm's size ($SIZE$) were considered. Brennan and Schwartz (1988) and Brennan and Kraus (1987) contend that high risk firms or firm's for which the business risk is more difficult to be estimate, have comparative advantages in issuing a type of debt whose value is insensitive to the variability of firm's cash-flows – i.e. convertible debt. Considering that high growth firms, with higher earnings volatility and relatively small size tend to face a higher business risk and/or a greater uncertainty surrounding the estimation of this risk, a positive coefficient is predicted for the variables $MBOOK$ and $EVAR$ and a negative coefficient is predicted for $SIZE$.

It is important to note that the variable $MBOOK$ can also proxy for the degree of agency inefficiencies that hinder firm's optimal debt financing. In this case and based on Smith and Warner's (1979) argument that convertible securities tend to exacerbate the underinvestment in high growth firms, Hypothesis two predicts a negative coefficient for $MBOOK$. Other variable is included to test the agency costs hypothesis. This variable is the proxy for firm leverage ($LEVEQ$) and according to asset substitution theory (see Jensen and Meckling (1976) and Green

(1984)) is directly related to the propensity to include convertible provision in bond offerings.

Finally, the variables $SDR3M$, $BRISK$, and $DTARG$ were included in equation (6.14) as control variables. Empirical studies (see e.g. Billingsley et al. (1988)) have shown that the propensity for firms to issue more equity-like or more debt-like issues depends on the total market performance, the firm's risk, and the deviation from firm's debt-equity target. To simplify the analysis and to avoid a severe reduction in the degrees of freedom, only proxies for firm's risk ($SDR3M$ and $BRISK$) and for the deviation from firm's debt-equity target ($DTARG$) were considered. Specifically, these variables are defined as follows:

$SDR3M$: This is the proxy for firm's total risk. As in Billingsley et al. (1988) this proxy is calculated as the standard deviation of the firm's daily stock returns over the three months prior to the issue announcement. According to Billingsley et al. (1988), the higher the firm's risk the higher the propensity for the firm to issue equity-like securities. The convertible option in Eurobonds allows for the replacement of debt claims by equity claims. Hence, a positive coefficient is expected for $SDR3M$.

$BRISK$: This is the proxy for firm's operational risk. Like in White and Turnbull (1974) and Billingsley et al. (1988), it is defined as the difference between firm's fixed charges[36] and firm's earnings before interest and taxes (EBIT) scaled by the standard deviation of the EBIT for the three financial years-ends prior to the issue announcement. Again, a positive coefficient is expected.

[36] The fixed charges are defined as the sum of total employment costs, directors' remuneration, auditors' remuneration and total depreciation expenses.

DTARG: This is the proxy for the deviation from firm's debt-equity target ratio and similar to Marsh (1982) and Billingsley et al. (1988) is computed as the difference between the ratio of total debt to book value of equity for the last financial year-end and the average of this ratio for the three financial years-ends prior to the issue announcement. Billingsley et al. (1988) provide evidence suggesting that the higher the deviation from firm's debt-equity ratio target the higher the propensity for the firm to issue more debt-like securities. To this extent, the lower (higher) the current level of the firm gearing compared with its historical target the lower (higher) the propensity to issue a hybrid security such as convertible Eurobonds. Therefore, a positive sign is expected for the coefficient of the variable $DTARG$.

6.5.4. Protective covenants (*PROT*) equation

$$PROTC_{it} = \delta_0 + \delta_1 COV_{it} + \delta_2 MAT_{it} + \delta_3 MBOOK_{it} + \delta_4 ZSCOREadj_{it} + \delta_5 SIZE_{it} + \delta_6 BRISK_{it} + \delta_7 LEVEQ_{it} + \mu_i + \varepsilon_{it} \quad (6.15)$$

Myers (1977) predicts that protective covenants play the same role as short-term debt in reducing contracting costs. On the other hand, as it was pointed out before several authors (see Jensen and Meckling (1976), Mikkelson (1980), and Smith and Warner (1979)) argue that convertible provisions also contribute to the reduction of contracting costs by aligning shareholders' and bondholders' interests. In this context, Hypothesis one predicts, respectively, a positive coefficient for issue maturity (MAT) and a negative coefficient for the convertible options (COV).

The agency theory underlying Hypothesis two predicts that high growth and/or risky firms are more likely to issue debt with protective covenants to avoid agency costs related to possible underinvestment (see Myers (1977)) and risk-shifting or claims dilution costs (see Smith and Warner (1979)). Therefore, positive coefficients are expected for the proxies for firm's growth opportunities ($MBOOK$), for firm's financial risk ($LEVEQ$), and operational risk ($BRISK$).

Finally, in order to test the validity of asymmetric information theories related to Hypothesis three, the variables $ZSCOREadj$ and $SIZE$ were included in equation (6.15). Chan and Kanatas (1986) and Chan and Thakor (1987) argue that, whenever good quality firms face significant adverse-selection costs, the inclusion of collateral provisions in contract agreements allow for a decrease in these costs that more that compensate the increase in inherent transaction costs (e.g. legal documentation, monitoring, and costs of restricting managerial actions). To this extent, unless the asymmetry of information in Eurobond markets is not relevant, a positive and significant relationship is expected between the propensity of the issue to include protective covenants and the proxies for firm's size ($SIZE$) and firm's credit quality ($ZSCOREadj$).

6.6. Data and sample design

The original data set contains 377 Eurobond issues launched by 109 non-financial UK-based companies over the period from January 1986 to December 1999. As it

was mentioned in the previous chapter, this data set excludes all Floating Rate Notes (FRN) issued during this period, as the particularities associated to this variable rate instrument would impair the accurate analysis of the determinants for the standard Eurobonds terms choice.

As the panel data estimation requires the time-series observations to be evenly spaced across cross-sectional units, a decision had to be made about the relevant sub-periods to be considered for the estimation sample. In order to retain a reasonable number of degrees of freedom in the time-series aspect and to avoid a large number of missing observations across issuing firms, we decide to aggregate the original data set into half-yearly observations across all firms in analysis. Thus, whenever a firm issued more than once during a half-yearly period, the firm, market, and issue proxies were averaged across time and a single observation entered for this firm at this particular six-month period. For the case of the dichotomous dependent variables, a value of one was assumed when the average value is equal to or greater than 0.5, and zero otherwise. The aggregation of the time-series into evenly spaced half-year intervals, reduces the number of issues used in the estimation from 377 to 289. This data set was further reduced as all firms that issue only once were excluded to satisfy the required number of degrees of freedom for an accurate estimation of the regression parameters. As Matyas and Sevestre (1992) point out, the generalised least square random-effect model yields unbiased estimators if and only if $N \geq K+5$ and $T \geq 2$, where N is the number of cross-section units, K is the number of regressors and T is the number of observations per cross-section unit.

Overall, the final sample corresponds to an unbalanced panel data of 245 Eurobond issues made by 65 companies from January 1986 to December 1999. This

unbalanced panel data aggregates 94 callable, 57 convertible, and 85 protected provisions.

Table 6.3 - Panel A reports a series of descriptive statistics on the 245 observations sample regarding the issues features and the relevant proxies for firms and market's characteristics. An analysis of the percentile ranks reveals that, for most of the variables, there is a small proportion of observations with extreme upper values. In particular, the variables like maturity, market-to-book value, intangibles to total assets (%), bankruptcy risk, and unexpected earnings (%) present a relatively high maximum compared to the correspondent 75% percentile rank (50.09 to 15.08, 10.56 to 1.75, 66.08 to 2.67, 249.73 to 12.35, and 12.78 to 1.54, respectively). Notably, both bankruptcy risk and unexpected earnings (%) proxies show also significant extreme values in the lower bound of the correspondent percentile structure. On the other hand, some variables have a relatively smaller dispersion in their percentile structure. These include are firm size ($SIZE$), interest volatility (%)($INTVOL$), firm credit quality ($ZSCOREadj$), firm total risk ($SDR3M$), firm past market performance ($RET1YB$), and interest level (%) ($INTLEV$). The small dispersion for the proxies for firm size and firm credit quality is consistent with the observation that smaller firms with relatively low credit quality are excluded from issuing in Eurobond markets. The relative homogeneity among Eurobond issuers is also evident by the small dispersion observed for the proxies for firm's total risk and market performance. Moreover, the clustering around the mean of the values for the interest level (%) and interest volatility (%) proxies is in line with a relative stability

observed in the short-term and long-term UK governmental bonds yields in the first half of the 80's and during the 90's.

Table 6.3 - Panel B reports the frequencies for the binary dependent variables. There is a substantially high proportion of issues carrying no convertible provisions. Thus, for the period from 1986 to 1999, 77% of the Eurobonds offered by companies that issue more than once have no embedded convertible options. On the other hand, a relatively more balanced proportion of issues embed call and protective provisions. Specifically, 35% and 38% of the total Eurobonds issued by "recurrent" issuers in this period include call provisions and protective covenants (respectively) in the debt indentures.

6.7. Results

Table 6.4 shows the multivariate panel data estimation results for the continuous dependent variable - maturity - regression and binary dependent variables - call option, convertible option, and protective covenants - regressions. The diagnostic tests in Table 6.4 – Column A indicate that the random-effects Generalised Least Squares (GLS) approach is well specified for the estimation of the maturity model. Thus, at 5% level of significance, the Lagrange multiplier test rejects the null hypothesis of absence of individual effects across issuing firms and the Hausman test fails to reject the hypothesis of absence of correlation between individual effects and the model regressors. Furthermore, the diagnostic tests in Table 6.4 – Columns C and D indicate that the random-effects Probit approach is the adequate estimation method for the convertible provision and protective covenant regression models. For these

models, both the Wald and the Likelihood ratio tests reject the null hypothesis of no unit-specific effects at a significance level of 5%.

As it was pointed in section 6.2.2, preliminary results show that for the call option model, both the Wald and the Likelihood ratio tests fail to reject the hypothesis of absence of unit-specific effects, at the 5% significance level. For this reason the estimation results reported in Table 6.4 – Column B are obtained using a pooled Probit regression model.

6.7.1. Maturity

Table 6.4 - Column A reports the estimation results for the multivariate random-effects model in (6.12).

The results show a significant and positive relation between the inclusion of call options and the maturity of Eurobond issues. This result is not only statistically significant (at 1% level) but also economically considering that the inclusion of a call provision leads to an increase in the maturity of the Eurobond issue of approximately 7 years, on average. Therefore, strong support is provided to Hypothesis one that argues that either call feature or short-term debt can be used to mitigate contracting costs that could have arisen from underinvestment, asset substitution or moral hazard problems (Barnea et al. (1980)). On the other hand, consistent with Myers' (1977) maturity matching argument stated in Hypothesis two, the significant positive coefficient for firm's asset maturity indicates that issuers with long-term (short-term) assets-in-place tend to offer long-term (short-term) Eurobond contracts. Interestingly, the decision to match debt refinancing with the exercise of firm's investment options might not only be motivated by the reduction of agency costs but also by the

elimination of excessive liquidity risk. Indeed, Diamond (1991) contends that firms reduce the probability of incurring in inefficient liquidation whenever they finance long-term assets with long-term debt. The evidence of issue/assets maturity matching suggests, therefore, that liquidity arguments from Hypothesis four might also play an important role in explaining the maturity choice of Eurobond issues.

No additional support is found, however, for both the agency costs and liquidity risk arguments in Hypotheses two and four (respectively). To this extent, the coefficients of the proxies for firm's financial risk ($LEVEQ$) and firm's growth opportunities ($MBOOK$) are statistically insignificant which contradicts Barnea et al. (1980) and Myers (1977) arguments that more levered or high growth firms should issue shorter-term debt to mitigate debt agency costs. This result is also out of line with most of the empirical evidence from previous studies on the maturity choice of new issues or aggregate balance-sheet debt (e.g. Barclay and Smith (1995), Stohs and Mauer (1996), Guedes and Opler (1996)). This unexpected result suggests that either the financing inefficiencies associated with high gearing or uncertain investment prospects are not relevant for the Eurobonds maturity decision or the ignorance of the simultaneous character between debt design and capital structure decisions prevents the fundamental dynamics underlying this decision process to be unveiled. The empirical analysis in Chapter VII takes into account the simultaneous character of these decisions and constitutes therefore a benchmark against which the results from this chapter should be confronted.

The insignificance of the coefficient for firm size ($SIZE$) is also not consistent with liquidity risk argument as stated in Hypotheses four of this chapter. The relative lack

of dispersion pointed out in section 6.6 for the proxy of firm size is likely to affect the relevance of this variable on the choice of the maturity for the Eurobond issues.

Finally, no support is also provided for asymmetric information and tax-related arguments described in Hypotheses three and five (respectively). Indeed, contradicting Flannery (1986) no evidence is found that Eurobond issuers take advantage of uninformed investors by issuing disadvantageously mispriced long-term debt after a stock price run-up or by offering short-term debt to signal unexpected future earnings. Furthermore, the non-monotonic relationship between firm credit quality and debt maturity that, according to Diamond (1993) prevails in asymmetric information environments is not supported by the data. On the other hand, inconsistent with Brick and Ravid (1985) and Kane et al. (1985) arguments none of the variables proxying for the advantage of interest tax shields is significantly related to the maturity choice of Eurobonds. This result corroborates Lewis (1990) argument that whenever debt maturity and capital structure are defined simultaneously no tax gains arise from changing the proportion of short-term (or long-term) debt in the firm's liability set.

6.7.2. Call option

6.7.2.1. Univariate results

Table 6.5 – Column A shows the univariate Probit estimation results for the binary dependent variable ($CALL$). Succinctly, these results show that five variables are individually significant in explaining the propensity to include call options in Eurobond agreements. These variables are: issue maturity (MAT), interest volatility

(*INTVOL*), tax paid (*TAXA*), firm credit quality (*ZSCOREadj*), and firm size (*SIZE*). Although the univariate analysis has limitations as it ignores the relationships among concurrent explanatory factors, it provides some insight about the theories that are relevant for the firm financial decision process. To this extent, strong support is provided to the alternative use of short-term and callable debt proposed by Barnea et al. (1980), to the callable debt's tax disadvantage hypothesis by Mauer et al. (1991), and to the liquidity risk effects relating to Diamond (1991) and Pye's (1966) arguments. All the coefficients of these theories related variables i.e. issue maturity (*MAT*), tax paid (*TAXA*), and firm size (*SIZE*) have the predicted sign and are significant at 1% level. On the other hand, while a weak support is conferred to the interest rate risk hedging theory (see Pye (1966)), the signalling theory of Robbins and Schatzberg (1986) is contradicted by the data. Thus, although the sign and significance of the coefficient for interest volatility (*INTVOL*) is consistent with the interest hedging theory, the lack of statistical significance found for the coefficient of the interest level proxy (*INTLEV*) raises questions about the validity of this theory. Moreover, the negative and statistically significant coefficient for the proxy of firm credit quality (*ZSCOREadj*) contradicts Robbins and Schatzberg (1986) argument that managers of "good" quality firms use callable debt issues to signal the superior quality of the firm's prospects.

6.7.2.2. Multivariate results

Table 6.4 – Column B reports the estimation results for the multivariate Probit model in (6.13). The χ^2 statistic for the Likelihood ratio test indicates that the inclusion of

the explanatory variables in addition to the constant term leads to an improvement in the goodness-of-fit of the model that is significant at 1% level.

Similar to the result obtained in the maturity model (6.12), callable Eurobonds seem to represent an alternative instrument to short-term debt as the coefficient for issue maturity (MAT) is positive and significantly related to the propensity to include call provisions. Again, this evidence is consistent with Hypothesis one and corroborates Barnea et al. (1980) argument that the agency costs arisen from the shareholders/creditors conflicts of interest can be reduced either by shortening the maturity of debt or by including call provisions in the contracts' indentures. Nevertheless, in line with the results from the maturity model no support is provided to the debt agency costs arguments underlying Hypothesis two of this thesis. Thus, both proxies for firm's future growth opportunities - total intangibles scaled by total assets (INT) – and firm's financial risk – total debt to total equity ($LEVEQ$) - are statistically insignificant. Clearly, this result contradicts Barnea et al. (1980) and Bodie and Taggart's (1978) prediction that the issuance of callable debt to control shareholder's discretionary investment policies is particularly relevant for firms with high proportion of growth options in their investment set and/or high level of risky debt in their capital structure. The lack of significance for the proxy of firm growth opportunities is also found in the empirical study by Kish and Livingston (1992) who focused on public corporate debt issues by US companies during 1977 to 1986. However, in their study the proxy for firm's leverage was positively and significantly related to the incidence of callable bonds. It seems, therefore, that contrary to other

type of public debt the issuance of callable Eurobond issues by UK companies is not determined by the level of financial risk of the issuer.

The interest risk hedging argument from Hypothesis seven is weakly supported by the estimation results. Thus, the results suggest that although managers are more likely to issue callable Eurobonds when the interest rate is more volatile (the coefficient for *INTVOL* is positive and significant at 10% level), their decision seems to be unaffected by the level of interest rate at the time of the issue. Thus, no clear evidence is found for Pye (1966) argument that managers benefit from issuing debt with a call option for earlier redemption in order to avoid the financial loss associated with a decrease in the market interest rate following the debt offering.

The evidence provides, however, strong support to liquidity risk (see Diamond (1991) and Pye (1966)) and callable debt's tax disadvantage (see Mauer et al. (1991)) theories stated in Hypotheses four and five (respectively). Mauer et al. (1991) argue that taking into account the empirical evidence that interest rates and future marginal personal rates are uncertain and positively related to the level of general business conditions, investors will value the bond income more highly in those states when it is more likely for the manager to exercise the call option with profit. Furthermore, the higher the firm corporate tax bracket the more valuable will be the call option from investors' point of view compared to that of issuers. To this extent, the significantly negative coefficient for the tax paid proxy (*TAXA*) supports Mauer et al. (1991) hypothesis that highly taxed firms are more likely to issue non-callable bonds to avoid excessive tax-premiums.

On the other hand, the significantly negative sign found for the firm size (*SIZE*) is consistent with the liquidity risk theory that smaller and typically less credible firms are more likely to issue callable debt to avoid excessive financial distress costs or in the extreme case inefficient liquidation. Indeed, considering that call option provide managers with additional flexibility for decreasing the amount of borrowings before maturity date (see Pye (1966)) or to remove restrictive covenants, the inclusion of this debt feature is relevant for those firms where the refinancing of existing debt can be particularly cumbersome.

Finally, no support is found for the signalling theory of Robbins and Schatzberg (1986). The coefficients of the variables that proxy for firm's future "prosperity" (i.e. unexpected earnings (*UEXP*) and credit quality (*ZSCOREadj*) are statistically insignificant. The degree of information disclosure demanded to Eurobond issuers by regulators, domestic and foreigner investors, and financial analysts that closely scrutinise firm's earnings and prospects might explain the observed irrelevance of signalling arguments. Overall, this result provides strong support to Hypothesis three of this thesis as it contradicts the relevance of the signalling arguments in markets where the information disclosure is particularly high.

6.7.3. Convertible option

6.7.3.1. Univariate results

Table 6.5 – Column B reports the univariate random-effects estimation results for the propensity of including convertible options in Eurobond issues. An analysis of this

table shows that three explanatory variables are, per se, relevant in explaining the propensity to issue convertible Eurobonds. These variables are: the dummy variable for protective covenants ($PROTC$), firm unexpected earnings ($UEXP$), and firm size ($SIZE$). Therefore, the analysis of the explanatory power associated to each explanatory variable provides strong support to the hypothesis of the alternative use between convertible privileges and protective covenants (see Smith and Warner (1988) and Jensen and Meckling (1976), amongst others) and partial support to signalling and risk uncertainty hypotheses (see Constantinides and Grundy (1989), Stein (1992) and Brennan and Kraus (1987), amongst others). A full analysis on the relevance of these hypotheses and on their joint impact on the convertible issuance process is provided in the next subsection where the multivariate results are discussed.

6.7.3.2. Multivariate results

The estimation results for the random-effects estimation of the model in (6.14) are reported in Table 6.4 – Column C. The χ^2 statistic for the Likelihood ratio test indicates that the null hypothesis that the parameters for the explanatory variables and unit-specific effects are zero is rejected at 1% significance level.

Similar to the evidence found in the univariate analysis and consistent with Hypothesis one of this thesis, convertible provisions play a similar role as protective covenants in reducing shareholders incentive to transfer wealth from bondholders by pursuing low-value, high risk investment policies. To this extent, the coefficient for the dummy variable that proxy for the incidence of protected Eurobond issues

($PROTC$) is significantly and inversely related to the propensity to issue convertible contracts. Nevertheless, inconsistent with Hypothesis one, the issue maturity (MAT) seems to be irrelevant for the decision to include convertible provisions in Eurobond indentures. This result contradicts the evidence from agency costs theory (see e.g. Jensen and Meckling (1976) and Myers (1977)) and raises important questions about the nature of financing inefficiencies that seem to be mitigated by either convertible or protected Eurobond issues but not by short-term contracts.

No support is also found for debt agency cost arguments underlying Hypothesis two. To this extend, the proxies for market-to-book value ($MBOOK$) and firm's financial risk ($LEVEQ$) are statistically unrelated with the propensity to issue convertible Eurobonds. Again, this result seems to suggest that financing inefficiencies other than debt agency costs are pertinent for the choice of convertible Eurobonds. The risk uncertainty theory underlying Hypothesis six is partially supported by the data. Indeed, the coefficient for firm size ($SIZE$) is significantly and negatively related to the issuance of convertible Eurobonds providing support to the argument that smaller firm, whose risk is more difficult to be estimated, are more likely to issue an instrument that is relatively insensitive to the variations of firm's risk such as convertible securities. Nevertheless, the statistical insignificance of the other proxies for firm's risk uncertainty (i.e. earnings variance ($EVAR$) and level of growth opportunities ($MBOOK$)) mitigates the explanation power of risk uncertainty hypothesis.

Finally, mixed support is found for the signalling theory of Constantinides and Grundy (1989), Stein (1992), and Nyborg (1995) described in Hypothesis three. Thus, while no statistical significance is observed for the coefficient of firm's credit quality proxy (*ZSCOREadj*), the coefficient for firm's unexpected earnings (*UEXP*) is significant and has the expected positive sign. Although not completely supported by the data it seems that even in high disclosure markets such as Eurobonds markets, only managers that possess favourable information about firm's future performance are able to benefit from issuing convertible securities.

All the coefficients for the variables that control for the firm's propensity to issue more debt or equity-like securities are insignificant. Thus, the decision to issue convertibles seems to be independent from the firm's total and operational risk proxies (*STD3M* and *BRISK*, respectively) and the deviation from firm's debt target (*DTARG*).

6.7.4. Protective covenants

6.7.4.1. Univariate analysis

Table 6.5 – Column C presents the results for the univariate regression estimation of the propensity to issue protected Eurobonds using the random-effects Probit approach. An analysis of this table reveals that most of explanatory variables in the model (6.15) are individually and significantly related to the issuance of protected Eurobonds. More specifically, the variables proxying for the propensity to include convertible privileges (*CONV*), the issue maturity (*MAT*), the firm credit quality

(*ZSCOREadj*), the firm size (*SIZE*), and the firm bankruptcy risk (*BRISK*) are statistically significant although the latter variable at only 10% significance level. Nevertheless, only the substitute hypothesis between protected debt and convertible or short-term debt (see Myers (1977), Jensen and Meckling (1976) and Smith and Warner (1979)) seems to be validated by the data with the parameters' estimates for the variables *CONV* and *MAT* presenting the "correct" signs. To this extent, both signalling hypothesis (see Chan and Kanatas (1986) and Chan and Thakor (1987)) and agency costs hypothesis (see Smith and Warner (1979), amongst others) are contradicted by the data. An elaborate analysis and discussion of these unexpected results is provided in the next subsection where all the relevant theories are jointly tested.

6.7.4.2. Multivariate analysis

Table 6.4 – Column D reports the multivariate random-effects Probit results for the model in (6.15). The null hypothesis that the parameters for the explanatory variables and the unit-specific effect are equal to zero is rejected at 1% of significance level (i.e. the Likelihood ratio test statistics presents a statistically significant value of 108.57).

Similar to the results from the univariate analysis, the Hypothesis one that predicts that short-term debt and protective covenants (see Myers (1977)) or protective covenants and convertible privileges (see Jensen and Meckling (1976), Mikkelson (1980), and Smith and Warner (1979)) act as substitute control mechanisms is validate by the data. Thus, both coefficients for the convertible options dummy

variable and issue maturity present the expected signs (negative and positive, respectively) and are statistically significant at 1% level. The decision to include a convertible option seems also to be particularly relevant in economic terms. Specifically, the marginal coefficient for this variable indicates that the inclusion of a convertible option in a Eurobond agreement leads to a decrease on the propensity to issue a protected contract of 42%.

Nevertheless, no support is provided to agency costs arguments underlying Hypothesis two. Thus, contradicting Myers (1977) argument that high growth firms issue protected debt to reduce the shareholders' incentive to forsake profitable investment options, the coefficient of the proxy for firm's growth opportunities ($MBOOK$) is statistically insignificant. Furthermore, the statistical insignificance of the coefficient of firm's leverage ($LEVEQ$) and the significant but negative coefficient for bankruptcy proxy ($BRISK$) contradict Smith and Warner (1979) argument that high levered and/or riskier firms include protective covenants in debt issues to control for the risk-shifting and claims dilution costs.

Finally, in line with Hypothesis three the signalling arguments by Chan and Kanatas (1986) and Chan and Thakor (1987) are contradicted by the empirical evidence. Indeed, the coefficients for both proxies for the "unobserved" firm's quality (i.e. firm size ($SIZE$) and credit quality ($ZSCOREadj$) are significant but inversely related to the propensity of including protective covenants in Eurobond issues. The absence of significant informational hurdles in Eurobond market might explain this result as well-informed investors seem to be able to separate higher quality from lower quality

firm and demand from the latter the inclusion of protective covenants in order to accept the inherent higher level of credit risk. In other words, the strong disclosure regulation, the close market scrutiny and the international exposure that characterise the Eurobond market guarantee a level of information symmetry among investors which seems to impel lower quality firms to issue protected debt to obtain the required funds at favourable interest yield terms.

6.8. Summary and discussion of findings

In this chapter a panel data estimation method was used to study the determinants of the contract terms of Eurobond issues offered by UK-based companies during the period 1986 to 1999. Four different features of the Eurobond design were analysed. Specifically, the analysis focused on the choice of Eurobond maturity, the inclusion of call options, the use of convertible privileges, and the attachment of protective covenants.

The main insights provided by the panel data regression analysis for Eurobond issues can be summarised in the following points. First, strong support is provided to Hypothesis one of this thesis that suggests that contracts terms function as alternative control devices for reducing agency costs. Hence, the results show that there are significant interrelationships between various Eurobond features, namely between short-term and callable debt (see Barnea et al. (1980)), between protective covenants and convertible options (see Jensen and Meckling (1976), amongst others), and between short-term debt and protective covenants (see Myers (1977)). Furthermore, the validation of the issue/assets maturity-matching prediction stated in Hypothesis

two strengths the relevance provided to agency costs arguments for the case of Eurobond's maturity choice.

Second, partial support is provided to the liquidity risk and risk uncertainty theories stated in Hypotheses four and six, respectively. Thus, in order to avoid inefficient liquidation, firms with longer maturity assets are more likely to issue longer maturity Eurobonds while smaller and typically less credible firms tend to attach call options to Eurobond contracts. On the other hand, in order to avoid excessive issuance costs firms whose business risk is more difficult to assess seem to be more prone to issue convertible Eurobonds.

Third, weak support is found for the signalling theories described in Hypothesis three. Thus, only the use of convertible provisions seems to be determined, at least partially, by signalling motivations. Notably, for all the other debt features analysed signalling arguments are strongly rejected by the data reinforcing the view that information in Eurobond market is extensively available.

Finally, no evidence is provided to support Hypothesis five regarding the impact of tax considerations on the Eurobond design process. More specifically, the estimation results for both maturity and call options equations contradict the predictions that managers uses these features to maximise the tax shield obtained from servicing Eurobond obligations.

Overall, the panel data analysis of Eurobond issues shed some light about the relevant determinants for debt design namely the interrelationship between contract features and the impact of liquidity risk and risk uncertainty on the issuance of callable and convertible securities. Nevertheless, some inconclusive results are found

for debt agency costs predictions (in particular, regarding the use of call, convertible and protective covenants on Eurobonds) and for the signalling theory.

APPENDIX 6.1: Generalised Least Square Estimation for the Random-Effects Model

Judge et al. (1985) formulate the random-effects model that includes all the individuals in a given panel data set, as the following:

$$y = X\beta + \mu \otimes j_T + e \qquad (6.1.1)$$

where $y' = (y_1', y_2', ..., y_N')$ given that $y_1', y_2', ..., y_N'$ are the vectors of dimension [T x 1] containing the values of the dependent variable for each of the units 1, 2, …., N, respectively; $X' = (X_1', X_2', ..., X_N')$ given that $X_1', X_2', ..., X_N'$ are the [K x T] matrices of the observations for the explanatory variables including the constant term for each of the units 1, 2, …., N, respectively; β is the vector of dimension [K x1] containing the slope coefficients and the constant term; μ is the N column vector of unit-specific disturbance terms; j_T is the T vector column with all elements equal to the unity; and $e' = (e_1', e_2', ..., e_N')$ given that $e_1', e_2', ..., e_N'$ are the vectors of dimension [T x 1] of the regression disturbance terms for each of the units 1, 2,…, N, respectively.

The generalised least square (GLS) estimators for β is given by

$$\hat{\beta} = (X'\Phi^{-1}X)^{-1}X'\Phi^{-1}y \tag{6.1.2}$$

where Φ^{-1} is the inverse of the regression covariance matrix that is given by

$$\Phi^{-1} = E[(\mu \otimes j_T + e)(\mu \otimes j_T + e)']^{-1} \tag{6.1.3}$$

In practice, the estimator $\hat{\beta}$ is calculated by applying the least square estimation method to the equation (6.1.1) transformed by a weight matrix P, such that $P'P = c\Phi^{-1}$ where c is any scalar. The weight matrix P is given by

$$P = I_N \otimes \left[I_T - \left(1 - \frac{\sigma_e}{\sigma_1} \right) \right] \frac{j_T j_T'}{T} \tag{6.1.4}$$

where I_N and I_T are the identity matrices of dimension [N x N] and [T x T], respectively; $\sigma_1 = \sqrt{T\sigma_\mu^2 + \sigma_e^2}$ with σ_μ and σ_e defined as the standard deviations of the unit-specific disturbance terms and the regression stochastic errors, respectively; and j_T is as before.

The reformulation of the equation (6.1.1) transformed by the weight matrix P is provided by Judge et al. (1985) and is defined, for the *i*th unit, as:

$$y_{it} - \alpha\overline{y}_{i.} = (1-\alpha)\overline{\beta}_1 + \sum_{k=2}^{K}\beta_k(x_{kit} - \alpha\overline{x}_{ki.}) + v_{it} \qquad (6.1.5)$$

where y_{it} and x_{kit} are, respectively, the values of the dependent and the kth explanatory variable at time t and for unit i; $\overline{y}_{i.}$ and $\overline{x}_{ki.}$ are, respectively, the means of the dependent variable and the kth explanatory variable for the unit i over the T observations; $\alpha = 1 - \frac{\sigma_e}{\sigma_1}$ with σ_1 and σ_e defined as before; $\overline{\beta}_1$ and β_k are the partitioning elements of the vector β and correspond, respectively, to the regression constant term and the slope coefficient of the kth explanatory variable; finally, v_{it} correspond to the disturbance terms of the transformed regression for unit i and at time t.

Table 6.1: Pearson Correlation Matrix

This table provides a measure of linear association for each pair of dependent and independent variables included in the Panel data models for maturity, call option, convertible option, and protective covenants. The correlation coefficients are computed for a sample of 245 observations. *,** indicate significance at the 10% and 5% levels, respectively (two-tailed test). The variables are defined at the end of the table.

	Protective Covenants (*PROTC*)	Convertible option (*COV*)	Call option (*CALL*)	Maturity (*MAT*)	Size (*SIZE*)	Market-to-book value (*MBOOK*)	Intangibles (%) (*INT*)	Asset Maturity (*ASSMAT*)
Convertible option (*COV*)	-0.18**							
Call option (*CALL*)	0.17**	0.50**						
Maturity (*MAT*)	0.29**	0.03	0.41**					
Size (*SIZE*)	-0.20**	-0.26**	-0.28**	-0.06				
Market-to-book value (*MBOOK*)	-0.08	-0.04	-0.03	-0.13*	0.32**			
Intangibles (%) (*INT*)	-0.23**	0.01	0.01	-0.14*	0.02	0.01		
Asset Maturity (*ASSMAT*)	0.29**	0.00	0.08	0.20*	0.01	-0.22**	-0.53**	
Interest Volatility (%) (*INTVOL*)	-0.22**	0.30**	0.11	0.00	-0.09	0.01	-0.05	-0.05
Term premium (%) (*TERMP*)	0.03	-0.13*	-0.03	-0.02	0.00	0.01	0.07	-0.09
Earning variance (%) (*EVAR*)	0.04	0.05	0.09	0.01	-0.03	0.41**	0.12	-0.13*
Tax paid (%) (*TAXA*)	-0.06	-0.21**	-0.25**	-0.12	0.24**	0.24**	0.05	-0.05
Leverage (*LEVEQ*)	-0.14*	0.00	-0.09	-0.07	-0.01	-0.07	0.18**	-0.26**
Bankruptcy risk (*BRISK*)	-0.16*	-0.01	-0.08	-0.02	0.05	-0.05	0.04	-0.14*
Z-score (adj.) (*ZSCOREadj*)	-0.17**	-0.02	-0.11	-0.12	-0.06	0.14*	-0.16*	-0.21**
Z-score squared (adj.) ($_{ZSCOREadj}^{2}$)	-0.14*	0.00	-0.07	-0.11	-0.07	0.19**	-0.16*	-0.22**
Stock return_1 y before (*RET1YB*)	0.01	0.26**	0.22**	0.03	-0.02	0.29**	-0.03	-0.06
Unexpected earnings (%) (*UEXP*)	-0.04	0.15*	0.09	0.02	-0.02	-0.03	-0.02	0.08
Std.dev. Return_3 m before (*SDR3M*)	0.02	-0.07	-0.08	-0.08	0.09	0.24**	-0.02	-0.16*
Deviation target (*DTARG*)	0.04	-0.01	0.04	0.02	-0.08	-0.06	-0.06	0.09
Interest level (%)(*INTLEV*)	-0.02	0.27**	0.01	-0.02	-0.23**	-0.24**	-0.11	0.04

	Interest volatility (%) (*INTVOL*)	Term premium (%) (*TERMP*)	Earning variance (%) (*EVAR*)	Tax paid (%) (*TAXA*)	Leverage (*LEVEQ*)	Bankruptcy Risk (*BRISK*)	Z-score (adj.) (*ZSCOREadj*)	Z-score squared (adj.) ($ZSCOREadj^2$)
Term premium (%) (*TERMP*)	-0.35**							
Earning variance (%) (*EVAR*)	0.01	-0.12						
Tax paid (%) (*TAXA*)	-0.11	0.09	0.12					
Leverage (*LEVEQ*)	-0.04	0.07	-0.07	0.09				
Bankruptcy risk (*BRISK*)	0.14*	0.14*	0.22**	-0.09	0.00			
Z-score (adj.) (*ZSCOREadj*)	0.07	-0.01	0.06	0.31**	0.06	-0.04		
Z-score squared (adj.) ($ZSCOREadj^2$)	0.08	-0.03	0.11	0.28**	0.01	-0.05	0.96**	
Stock return_1 y before (*RET1YB*)	0.08	-0.01	0.12	-0.14*	-0.14*	-0.09	-0.20**	-0.13*
Unexpected earnings (%) (*UEXP*)	-0.08	0.13*	0.03	-0.03	-0.08	-0.01	-0.01	0.01
Std.dev. return_3 m before (*SDR3M*)	0.11	-0.20**	0.02	-0.13*	0.02	0.03	-0.19**	-0.12
Deviation target (*DTARG*)	-0.10	0.12	0.10	0.11	0.45**	-0.01	-0.09	-0.12
Interest level (%)(*INTLEV*)	0.14*	-0.17**	0.13*	0.00	0.01	-0.04	0.28**	0.23**

	Stock return_1 year before (*RET1YB*)	Unexpected earnings (*UEXP*)	Std.dev. return_3 m before (*SDR3M*)	Deviation target (*DTARG*)
Unexpected earnings (%) (*UEXP*)	0.16*			
Std.dev. return_3 m before (*SDR3M*)	0.08	-0.06		
Deviation target (*DTARG*)	-0.12	0.00	-0.08	
Interest level (%)(*INTLEV*)	-0.06	0.06	-0.35**	0.01

Definitions:

MAT - years-to-maturity for each sample issue; *CALL* - dummy variable for the propensity of Eurobonds to include call provisions; *COV* - dummy variable for the propensity of Eurobonds to include convertible provisions; *PROTC* - dummy variable for the propensity of Eurobonds to include protective covenants; *LEVEQ* - total debt divided by equity; *SIZE* - natural log of 100 times firm's market value (total assets plus market value of equity less book value of equity) scaled by the UK consumer price index; *MBOOK* - market-to-book value, defined as firm's market value divided by total assets; *INT* - percentage of intangible assets on total assets; *ASSMAT* - maturity of assets-in-place, defined as the natural log of the product between the ratio of total net fixed assets to total assets and the ratio of total net fixed assets to total depreciation; *INTVOL* - standard deviation of 10-year UK government bond yields over one year prior the Eurobond issue announcement (in percentage); *TERMP* - one year prior announcement average of the difference between 10-years UK government bond and 3-months UK Treasury bond yields; *EVAR* - standard deviation of the earnings before interest, tax, and depreciation (EBITD) over the 3 financial years-ends prior to the issue announcement date scaled by the average of total assets for this period; *TAXA* - ratio of tax paid to total assets (in percentage); *BRISK* - difference between fixed charges and earnings before interest and taxes (EBIT) scaled by the standard deviation of the 3 financial years-ends EBIT prior to the issue announcement. Firm fixed charges are defined as the sum of total employment costs, directors remuneration, auditors remuneration, and depreciation; *ZSCOREadj* - Altman's Z-score adjusted measure used in Dennis et al. (2000) and defined as 3.3 * EBIT/Sales + 1.0 * Sales/TA + 1.4 * RE/TA + 1.2 * WC/TA where EBIT is earnings before interest and taxes, RE is retained earnings, and WC is working capital. *ZSCOREadj* is censored from below at zero; $ZSCOREadj^2$ - squared value of Altman's Z-score adjusted; *RET1YB* - stock return over the year prior the issue announcement date; *UEXP* - unexpected returns defined as the difference between the earnings per share at the financial year-end following the announcement date and the earning per share at financial year-end of the issue announcement scaled by the stock price at the financial year-end of the issue announcement (in percentage); *SDR3M* - firm's total risk, defined as the standard deviation of the daily stock returns over the 3 months preceding the announcement date (in percentage); *DTARG* - deviation from the target leverage defined as the difference between the ratio of total debt to equity at the financial year-end prior to announcement date and the average of this ratio for the 3 financial years-ends preceding the announcement date; *INTLEV* - interest rate level of the 3 months UK-Treasury bond at the announcement date (in percentage).

Table 6.2: Basic Variables Employed and Hypothesised Signs

Variables	Description	Hypothesised Sign	Justification
MAT	Years-to-maturity of each Eurobond issued over 1986-1999.	Maturity equation: n/a	Dependent variable.
		Call option equation: (+)	Substitution effect hypothesis: Alternative devise to reduce debt agency costs.
		Convertible option equation: (+)	Substitution effect hypothesis.
		Protective covenants equation: (+)	Substitution effect hypothesis.
CALL	Dummy taking the value of 1 for callable issues.	Maturity equation: (+)	Substitution effect hypothesis.
		Call option equation: n/a	Dependent variable.
COV	Dummy taking the value of 1 for convertible issues.	Maturity equation: (+)	Substitution effect hypothesis.
		Convertible option equation: n/a	Dependent variable.
		Protective covenants equation: (+)	Substitution effect hypothesis.
PROTC	Dummy taking the value of 1 for issues with protective covenants.	Maturity equation: (+)	Substitution effect hypothesis.
		Convertible option equation: (+)	Substitution effect hypothesis.
		Protective covenants equation: n/a	Dependent variable.
MBOOK	Market-to-book value for issuing firm. Proxy for firm's growth opportunities.	Maturity equation: (-)	Agency costs theory. Short-term bonds reduce underinvestment incentives.
		Convertible option equation: (+) or (-)	Convertibles hedge against firm's risk uncertainty or enhance underinvestment incentives.
		Protective covenants equation: (+)	Restrictive covenants reduce underinvestment costs.
INT	Ratio of intangible assets to total assets (percentage). Proxy for firm's growth opportunities.	Call option equation: (+)	Agency costs theory. Callable bonds reduce possible underinvestment incentives.

ASSMAT	Natural log of the net fixed assets to total assets times the net fixed assets to total depreciation.	Maturity equation: (+)	Maturity matching theory.
LEVEQ	Total debt to book value of equity. Proxy for firm's financial leverage.	Maturity equation: (-)	Asset substitution theory. Short-term bonds reduce risk-shifting incentives.
		Call option equation: (+)	Asset substitution theory. Callable bonds reduce risk-shifting incentives.
		Convertible option equation: (+)	Asset substitution theory. Convertible bonds reduce risk-shifting incentives.
		Protective covenants equation: (+)	Restrictive covenants reduce possible risk-shifting and claim dilution costs.
SIZE	Natural log of 100 times market capitalisation deflated by the UK consumer price index (using 1982 as the base year).	Maturity equation: (-) or (+)	Liquidity risk theory: long-term bonds reduce potential financial distress costs or large firms benefit from significant economies of scale in issuance costs.
		Call option equation: (-)	Managerial flexibility hypothesis: callable bonds allow for the reduction of excessive liquidity costs.
		Convertible option equation: (-)	Firm's risk uncertainty hypothesis.
		Protective covenants equation: (+)	Signalling hypothesis. Restrictive covenants convey a positive sign to the market about firm's credit worthiness.
TAXA	Tax paid to total assets.	Maturity equation: (-)	Interest tax shield hypothesis. Firms with higher marginal effect tax rate should rebalance more often their capital structure and therefore issue short-term debt.
		Call option equation: (+) or (-)	Interest and call premium's tax advantage hypothesis or negative tax effect on investors associated with the call exercise.
EVAR	Standard deviation of EBITD over 3 years prior the issuance scaled by the average of total assets over the same period.	Maturity equation: (-)	Interest tax shield hypothesis. Firms with more volatile earnings should rebalance more often their capital structure and issue more short-term debt.
		Convertible option equation: (+)	Firm's risk uncertainty hypothesis.

TERMP	Difference between the 10-year UK government bond and the 3-month UK Treasury bill average daily yields over 1 year prior issuance.	Maturity equation: (+)	Interest tax shield hypothesis.
INTVOL	Standard deviation of the 10-year government bond daily yields over 1 year prior issuance.	Maturity equation: (+)	Interest tax shield hypothesis.
		Call option equation: (+)	Interest rate risk hypothesis.
RET1YB	One year stock return prior to the issuance.	Maturity equation: (+)	Asymmetric information theory. Firms are more likely to issue long-term debt following periods of positive market performance.
UEXP	Difference between the earnings per share at the financial year-end following the issuance and at the financial year-end of the issuance scaled by the stock price at the financial year-end of the issuance.	Maturity equation: (-)	Asymmetric information theory. Firms signal the superior quality of their future projects by issuing short-term bonds.
		Call option equation: (+)	Asymmetric information theory. Callable bonds' issues convey a positive sign about firm's prospects.
		Convertible option equation: (+)	Asymmetric information theory. Firms with favourable private information issue convertible bonds.
ZSCOREadj.	Proxy for credit quality defined as 3.3*EBIT/Total sales + 1.0*Total sales/Total assets + 1.4*Retained earnings/ Total assets + 1.2*Working capital/Total assets.	Maturity equation: (+)	Asymmetric information theory: Non-monotonic relationship between bonds maturity and firm's credit quality.
		Call option equation: (+)	Signalling hypothesis.
		Convertible option equation: (-)	Signalling hypothesis. Medium quality firms have comparative advantages to high quality firms in issuing convertible bonds.
		Protective covenants equation: (+)	Signalling hypothesis.
ZSCOREadj.^{2}	Squared value of ZSCOREadj.	Maturity equation: (-)	Asymmetric information theory: Non-monotonic relationship between bonds maturity and firm's credit quality.
INTLEV	3-month Treasury bill rate prevailing at the time of the issuance.	Call option equation: (+)	Interest risk hedging theory. Firms tend to issue callable bonds in periods of high interest rates.

SDR3M	Standard deviation of daily stock returns over the 3 months prior to the issuance.	Convertible option equation: (+)	Control variable. Riskier firms tend to issue more equity-like securities.
BRISK	Difference between fixed charges and EBIT scaled by the standard deviation of EBIT over the 3 financial years-ends prior to the issuance.	Convertible option equation: (+) Protective covenants equation: (+)	Control variable. Firms with higher operational leverage tend to issue more equity-like securities. Risk-shifting and claims dilution costs hypothesis. Restrictive covenants tend to reduce the excessive agency costs in risky firms.
DTARG	Difference between the ratio of total debt to equity for the last financial year-end before issuance and the average of this ratio over the three financial years-ends prior to the issuance.	Convertible option equation: (+)	Control variable. Firms that have excess of (insufficient) leverage in relation to their debt-equity target ratio tend to issue less (more) debt-like securities.

Table 6.3: Descriptive Statistics

Panel A: Descriptive statistics for the dependent and independent variables included in the panel data models for maturity, call option, convertible option, and protective covenants. The variables are defined at the end of table 6.1.

	N	Mean	Median	Std. Deviation	Range	Min	Max	Percentiles		
								25%	50%	75%
Protective covenants (*PROTC*)	245	0.35	0	0.48	1	0	1	0	0	1
Convertible option (*COV*)	245	0.23	0	0.42	1	0	1	0	0	0
Call option (*CALL*)	245	0.38	0	0.49	1	0	1	0	0	1
Maturity (*MAT*)	245	11.48	10.05	7.71	49.53	0.56	50.09	5.19	10.05	15.08
Size (*SIZE*)	245	14.85	14.80	1.08	6.64	10.84	17.49	14.28	14.80	15.44
Market-to-book value (*MBOOK*)	245	1.59	1.40	0.96	10.47	0.10	10.56	1.11	1.40	1.75
Intangibles (%) (*INT*)	245	4.62	0.00	10.48	66.80	0.00	66.80	0.00	0.00	2.67
Assets maturity (*ASSMAT*)	245	2.09	2.32	0.99	4.71	-0.62	4.09	1.50	2.32	2.77
Interest volatility (*INTVOL*)	245	0.45	0.44	0.17	0.67	0.19	0.86	0.30	0.44	0.59
Term premium (*TERMP*)	245	-0.24	-0.44	1.70	6.64	-3.76	2.88	-1.42	-0.44	1.47
Earning variance (%) (*EVAR*)	245	2.43	1.80	2.04	14.04	0.19	14.23	1.02	1.80	3.43
Z-score (adj.) (*ZSCOREadj*)	245	1,59	1,55	0,50	3,80	0,02	3,83	1,25	1,55	1,90
Z-score squared (adj.) ($ZSCOREadj^2$)	245	2,77	2,42	1,75	14,64	0,00	14,64	1,57	2,42	3,62
Tax paid (%) (*TAXA*)	245	2.69	2.36	2.04	19.13	-3.52	15.60	1.49	2.36	3.82
Leverage (*LEVEQ*)	245	1.45	1.10	1.66	17.81	-5.89	11.92	0.80	1.10	1.70
Bankruptcy risk (*BRISK*)	245	8.08	3.87	20.10	277.67	-27.94	249.73	0.04	3.87	12.35
Stock return_1 y before (*RET1YB*)	245	0.17	0.18	0.31	3.01	-0.83	2.18	0.02	0.18	0.31
Unexpected earnings (%) (*UEXP*)	245	0.23	0.51	3.00	36.87	-24.09	12.78	-0.58	0.51	1.54
Std.dev. return_3 m before (%) (*SDR3M*)	245	1.73	1.55	0.73	4.54	0.30	4.83	1.22	1.55	2.02
Deviation target (*DTARG*)	245	0.03	0.02	1.11	13.93	-4.84	9.09	-0.13	0.02	0.14
Interest level (%) (*INTLEV*)	245	7.78	8.09	2.03	7.41	4.19	11.60	5.85	8.09	9.41

Panel B: Frequencies of the dependent binary variables in the protective covenants, convertible option, and call option models.

	Protective covenants		Convertible option		Call option	
	Frequency		Frequency		Frequency	
0	160	65%	188	77%	151	62%
1	85	35%	57	23%	94	38%
Total	245	100%	245	100%	245	100%

Table 6.4: Panel Data Estimates of Continuous and Qualitative Dependent Variables

Independent Variables	(A) Maturity	(B) Call option		(C) Convertible option		(D) Protective covenants	
	Coefficient	Coefficient	Marginal effect	Coefficient	Marginal effect	Coefficient	Marginal effect
Intercept	1.66	3.49	1.28	6.97	1.42	11.03	2.74
	(0.20)	(2.27)**		(3.00)***		(3.16)***	
Maturity		0.08	0.03	0.02	0.00	0.08	0.02
		(5.95)***		(0.92)		(3.06)***	
Call option	6.58						
	(6.60)***						
Protective covenants				-1.42	-0.29		
				(-3.44)***			
Convertible option						-1.67	-0.42
						(-3.00)***	
Market/Book	-0.93			0.13	0.03	0.13	0.03
Intangibles/Assets (%)[a]		0.01	0.00				
	(-1.51)	(1.21)		(0.70)		(0.39)	
Asset maturity	1.23						
	(2.37)**						
Interest level (%)		-0.05	-0.02				
		(-0.94)					
Interest volatility (%)	-0.85	0.95	0.35				
	(-0.30)	(1.75)*					
Term premium (%)	0.10						
	(0.33)						
Tax paid/Assets (%)	0.00	-0.16	-0.06				
	(0.02)	(-2.60)***					
Earnings variance (%)	0.21			0.09	0.02		
	(0.83)			(1.07)			
Unexpected earnings (%)	-0.11	0.05	0.02	0.14	0.03		
	(0.72)	(1.34)		(1.76)*			
Altman's Z-score adj.	-2.04	0.05	0.02	-0.35	-0.07	-1.15	-0.29
	(-0.56)	(0.26)		(-1.06)		(-2.58)**	
Squared Altman's Z-score adj.	0.50						
	(0.48)						
Stock return 1-year-before	-0.91						
	(-0.54)						
Size	0.55	-0.31	-0.11	-0.51	-0.10	-0.7	-0.17
	(1.10)	(-3.32)***		(-3.57)***		(-2.91)***	
Bankruptcy risk				0.00	0.00	-0.04	-0.01
				(-0.18)		(-1.99)**	
Std. Returns 3-months -before				-0.15	-0.03		
				(-0.61)			
Deviation from leverage target				-0.10	-0.02		
				(-0.49)			
Leverage	-0.02	-0.04	-0.01	0.06	0.01	-0.15	-0.04
	(-0.08)	(-0.64)		(0.49)		(-0.97)	
Total observations	245	245		245		245	
R^2	0.21						
Model chi-square		$\chi^2(9)=$ 77.21***		$\chi^2(12)=$ 48.63***		$\chi^2(8)=$ 108.57***	

		Diagnostic tests		
Random-effects tests				
Hausman	11.07	–	–	–
	[0.61]			
Lagrange multiplier	7.62	–	–	–
	[0.00]			
Likelihood ratio	–	–	8.02	43.51
			[0.01]	[0.00]
Wald	–	–	2.36	6.63
			[0.02]	[0.00]

This table shows the regression estimators of maturity and three dummy variables that proxy for the propensity to include a call option, a convertible option or protective covenants (respectively) on a set of explanatory variables for the sample of 245 Eurobonds issued between 1986 and 1999. More specifically, maturity is regressed on a dummy that proxies for the propensity to include a call option, market-to-book value, asset maturity, interest volatility (%), interest term premium, earnings variance (%), tax paid to total assets (%), unexpected earnings (%), Altman's Z-score adjusted, square value of Altman's Z-score adjusted, stock return over one year prior to issue announcement, size, and leverage. The dummy variable proxying for the propensity to include a call option is regressed on maturity, intangibles to total assets (%), interest level (%), interest volatility (%), tax paid to total assets (%), unexpected earnings (%), Altman's Z-score adjusted, size, and leverage. The dummy variable proxying for the propensity to include a convertible option is regressed on maturity, a dummy that proxies for the propensity to include protective covenants, market-to-book value, earnings variance (%), unexpected earnings (%), Altman's Z-score adjusted, size, standard deviation of returns over 3 months prior to issue announcement, deviation of debt/equity ratio, and leverage. The dummy variable proxying for the propensity to include protective covenants is regressed on maturity, a dummy proxying for the propensity to include a convertible option, market-to-book value, bankruptcy risk, Altman's Z-score adjusted, size, and leverage. The estimators for maturity are obtained using the generalised random-effects model. The estimators for convertible option and protective covenants are obtained using the random-effects Probit model. The estimators for call option are obtained using the pooled Probit model. *t*-statistics in parentheses. p-values in square brackets. *,**,*** indicate significance at the 10%, 5%, and 1% levels.

(a) Intangibles/assets (%) replaces market/book as a proxy for growth opportunities in the call option regression.

Table 6.5: Univariate Panel Data Analysis for Binary Dependent Variables

Independent Variables	(A) Call option		(B) Convertible option		(C) Protective covenants	
	Coefficient	Marginal effect	Coefficient	Marginal effect	Coefficient	Marginal effect
Maturity	0.08 (6.18)***	0.08	0.01 (0.52)	0.00	0.07 (3.82)***	0.02
Protective covenants			-1.02 (2.97)***	-0.26		
Convertible option					-1.54 (3.48)***	-0.33
Market/Book			0.00	0.00	-0.29	-0.08
Intangibles/Assets (%)[a]	0.00 (0.12)	0.00	(-0.21)		(-1.34)	
Interest level (%)	0.01 (0.15)	0.00				
Interest volatility (%)	0.81 (1.71)*	0.31				
Tax paid/Assets (%)	-0.19 (-3.90)***	-0.11				
Earnings variance (%)			0.08 (1.57)	0.02		
Unexpected earnings (%)	0.04 (1.36)	0.02	0.13 (2.36)**	0.03		
Altman's Z-score adj.	-0.28 (-1.70)*	-0.06	0.06 (0.22)	0.02	-0.70 (-2.44)**	-0.21
Size	-0.35 (-4.28)***	-0.13	-0.38 (-3.91)***	-0.10	-0.42 (-2.17)**	-0.13
Bankruptcy risk			0.00 (-0.14)	0.00	-0.03 (-1.73)*	-0.01
Std. Returns 3-months -before			-0.21 (-1.25)	-0.06	-1.05 (-1.42)	
Deviation from leverage target			-0.02 (-0.16)	-0.01		
Leverage	-0.07 (-1.32)	-0.03	-0.01 (-0.14)	0.00	-0.22 (-1.53)	-0.06
Total observations	245		245		245	

This table shows the univariate regression estimators obtained by regressing the binary dependent variables that proxy for the propensity to include call option, convertible option or protective covenants on each of the correspondent explanatory variables using a sample of 245 observations of Eurobonds issued between January 1986 and December 1999. More specifically, the dummy variable that proxies for the propensity to include a call option is individually regressed on maturity, on intangibles to total assets (%), on interest level (%), on interest volatility (%), on tax paid to total assets (%), on unexpected earnings (%), on Altman's Z-score adjusted, on firm size, and on leverage. The dummy variable that proxies for the propensity to include a convertible option is regressed on maturity, on a dummy proxying for the propensity to include protective covenants, on market-to-book value, on earnings variance (%), on unexpected earnings (%), on Altman's Z-score adjusted, on firm size, on standard deviation of firm returns over 3 months prior to issue announcement, on deviation of debt/equity ratio, and on leverage. The dummy variable that proxies for the propensity to include protective covenants is regressed on maturity, on a dummy proxying for the propensity to include a convertible option, on market-to-book value, on bankruptcy risk, on Altman's Z-score adjusted, on firm size, and on leverage. The random effects Probit estimation model is used to obtain the convertible option and protective covenants univariate estimators. The pooled Probit estimation model is used to obtain the call option univariate estimators. *t*-statistics in parentheses. *,**,*** indicate significance at the 10%, 5%, and 1% levels.

(a) Intangibles/assets (%) replaces market/book as a proxy for growth opportunities in the call option regression.

CHAPTER VII: ANALYSIS OF THE SIMULTANEOUS CHOICE OF CONTRACT TERMS IN EUROBOND ISSUES

7.1. Introduction

In many economic and financial models, the dependent variables depend on factors driven by not only outside forces - exogenous variables - but also by the joint determination of variables within the model - endogenous variables. Myers (1977) was the first to argue that financial decisions concerning the optimal design of debt contract are influenced by the joint effect of variables that are themselves a function of a common set of factors. More specifically, Myers (1977) contends that high growth firms facing excessive agency costs when resorting to debt financing, can mitigate these costs by either shortening contracts maturity, including protective covenants or restricting firm's leverage level. Later on, Barnea et al. (1980) extended Myers' (1977) predictions arguing that embedded call options could be use as an alternative mechanism to short-term issues for reducing debt agency costs. Moreover, Jensen and Meckling (1976), Mikkelson (1980), and Smith and Warner (1979) point out that convertible privileges, maturity, and protective covenants play a substitute role to control for assets substitution incentives and therefore can be used concurrently by firms that bear significant agency costs. To this extent, a comprehensive study of the determinants for the optimal choice of debt terms calls for an econometric framework that takes into account the interdependencies established between concurrent financial policies. In particular, the empirical

analysis of the choice of a particular feature for Eurobond offerings should consider not only the impact of variables that are exogenous to the model i.e. firm and market characteristics but also the influence of decisions endogenously generated that are related to the choice of other contract features. Moreover, the simultaneous character of the decisions about firm's leverage and Eurobond offerings design should be also taken into account to adequately evaluate the influence of financial policies that concur for reducing the contracting costs associated with debt financing.

Typically, empirical studies about debt contract design have examined the determinants for the use of a single contract feature assuming that the choice of other contract features is pre-defined and unaffected by the variable of interest. Although this single equation approach has been largely used by the literature on the design of debt contracts, there are econometric issues about the treatment of other contract features that might be determined simultaneously and are affected by a common set of exogenous explanatory variables. Indeed, in these cases the basic assumption of orthogonality between the explanatory variables and the residual term of the regression is violated. To this extent, the estimators obtained for the model parameters are asymptotically inconsistent leading to erroneous inferences about the relevancy of theoretical predictions. A more elaborate insight about the econometric problems from the adoption of a single equation approach to a model where the dependent variables are jointly determined will be provided in section 7.2.2. Some previous studies (e.g. Guedes and Opler (1996), Barclay and Smith (1995), and Stohs and Mauer (1996)) tried to overcome the econometric issues associated with the treatment of the interdependent and jointly determined variables by excluding other

debt contract features from the regression models. Although in these cases the adoption of classic estimation methods, e.g. OLS or Probit methods, yields unbiased estimators, the alternative use of debt contract features discussed in the literature is not examined. Therefore, a richer analysis of debt contract design calls for the consideration of the interdependencies between debt features and the use of an econometric approach, simultaneous-equations approach, to overcome the potential bias associated with the classic estimation methods.

Moreover, contrary to the individual analysis of offerings characteristics underlying most of the incremental studies about debt design (e.g. Barclay and Smith (1995), Guedes and Opler (1996), Kish and Livingston (1992), amongst others), the simultaneous-equations approach adopted in this chapter uses an aggregate data set where the original sample of Eurobond issues is averaged across firms. The reasons for using an aggregate data set are twofold. First, misspecification bias can occur when a longitudinal data set is analysed without taking into account the joint impact of cross-section and time-series effects. The aggregation of the data simplifies the analysis by considering only time-series effects as the driving factors for the variance observed in the model's variables. Second, considering the specific characteristics of the Eurobond, an analysis of the behaviour by the average issuer can contribute to a more robust insight on the determinants of the Eurobond design process. Indeed, the Eurobond market distinguishes itself from other sources of debt financing in particular because the investors are well informed about the characteristics and credit quality status of the potential Eurobond issuers. To this extent, an analysis focusing

on the average issuer might shed light over some inconclusive results obtained previously for the choice of contract terms in Eurobond issues.

Further discussion and comparison between the different perspectives followed by studies adopting single and simultaneous-equations approaches will be provided in sections 7.4 and 7.5, where the model specification and the estimation results will be analysed and discussed. The other sections of this chapter will be organised as follows. Section 7.2.1 describes and analyses the identification conditions and the model design for the simultaneous-equations analysis. Section 7.2.2 describes the estimation method adopted for the simultaneous-equations approach. Section 7.3 pinpoints the main characteristics of the data set supporting the empirical study. Finally, the robustness tests to the regression estimation and the main conclusions from this chapter will be provided in sections 7.6 and 7.7, respectively.

7.2. Simultaneous-equations analysis

7.2.1. Identification conditions

One of the first issues on the simultaneous-equation estimation is the identification problem. Gujarati (Chapter 17, 1988) refers to the identification problem as the assessment of "...whether the numerical estimates of the parameters of a structural equation can be obtained from the estimated reduced-form coefficients." Typically, a structural-form equation is defined as the one that describes the structure or the behaviour of the jointly determined variables whereas a reduced-form equation corresponds to the one that relates each of the endogenous variables to the set of the

exogenous variables and the residual terms. According to whether or not the simultaneous equation models meet the conditions for identification, they can be classified as under-identified, just- or exact-identified or over-identified models. The necessary condition for identification, known as the *order condition*, is defined as follows:

In a system of M simultaneous equation, it is possible to identify an equation when the number of exogenous variables excluded from the equation is not less than the number of endogenous variables included in that equation less one; or in analytical terms:

$$K - k \geq m - 1 \qquad (7.1)$$

where:

M is the number of endogenous variables in the model;

m is the number of endogenous variables in a given equation;

K is the number of exogenous variables in the model;

k is the number of exogenous variables in a given equation,

If $K - k > m - 1$, the equation is said to be over-identified; on the other hand, if $K - k = m - 1$, the equation is said to be just identified.

The sufficient condition for the identification is known as the *rank condition*. It is defined as follows:

In a system containing M equations and M endogenous variables, an equation is identified *if and only if* there is at least one non zero determinant of order (M-1)(M-1) made up of the coefficients of the variables (endogenous and exogenous) excluded from this equation but included in the other equations of the model.

Table 7.1 - Panel A lists the coefficients of all endogenous and exogenous variables included and excluded from the equations for maturity, call option, convertible option, protective covenants, and leverage.

It can be easily verified that for each of these equations the number of excluded exogenous variables exceeds the number of included endogenous variables – i.e. the order condition is met. Table 7.1 - Panel B shows that it is possible to construct a 4 x 4 non-singular matrix made up of the coefficients of the variables excluded from each equation but included in the system. In other words, the rank condition for identification is also observed.

A close analysis of the Table 7.1 reveals that, comparing to the model design adopted in the panel analysis in Chapter VI, some explanatory variables were excluded from the regressions that model maturity, call options, convertible options, and protective covenants decision processes. The exclusion of these variables follows the need not only to respect the rank condition for the unique identification of the structural-parameter estimators but also to overcome the multicollinearity problems observed in the estimation of the reduced-form equation for the binary variable protective

covenants. More specifically, the selection and exclusion of some of the explanatory variables used on the panel data model rely on the following premises:

(1) The variable that proxies for the aggregate firm bankruptcy costs was removed from the convertible options equation to allow that unique estimators for this equation could be obtained i.e. the rank condition for the convertible equation was validated. This variable was chosen following the recommendation in Greene (1993, p.590) that if the underlying theory allows for a priori restrictions to the parameters, specific variables can be excluded to assure that there is exactly one solution for the structural parameters given the reduced-form parameters. Considering that other proxies for firm risk (e.g. the standard deviation of firm's stock returns) are pointed out by the theory as having a similar impact on the issuance of convertibles as the level of bankruptcy risk, the exclusion of this variable does not seem to impose serious problems to testing the hypotheses. A more detailed discussion about the choice of variables for hypotheses testing will be provided in section 7.4 where the model specification is analysed.

(2) The variable that proxies for aggregate firm credit quality (adjusted Altman's Z-score) and its squared value were removed from the estimation of the system of simultaneous-equations. The reason for excluding these variables is the high degree of linear dependence relating these variables to each other and to other variable in the model (i.e. the proxy for aggregate level of interest rates). Indeed, Table 7.2 reports significant correlation coefficients between the variable for aggregate firm credit quality, its square value and the proxy for the aggregate level of interest rates (the Pearson correlation coefficients are of 0.95 and 0.55,

respectively). Furthermore, the correlation coefficient between the square value of aggregate firm credit quality and aggregate level of interest rates is 0.45. Preliminary results show indeed that the interdependence between these variables hinders the estimation of the simultaneous-equations model as it is not possible to estimate the reduced-form parameters for the dependent variable protective covenants, due to the singularity of the matrix required for inversion in the iterative estimation process[37]. The exclusion of these variables has implications on testing the hypotheses on the theoretical framework. Thus, the assessment of asymmetric information theories that predict an association between firms credit quality and debt design process no longer rely on the adjusted Altman's proxy for credit quality. Nevertheless, as it will be pointed out in session 7.4 there are other proxies within the model that measure the quality of firm's projects and inherent financial risk and can be used to test these theories with the data.

7.2.2. Estimation methods

The use of the least-squares estimation approach to the simultaneous-equations models leads to asymptotically inconsistent estimators, the so-called simultaneous equation bias, as the basic assumption that the explanatory variables are fixed and independent of the residual term no longer holds (see Judge et al. (1985) and Greene (2000)).

Typically, for the systems of linear simultaneous equations the estimation method used is the so-called *two-stage least-squares estimator*. This method generates

[37] For more information about the estimation process for Probit models see Gujarati (1988, p. 491-499).

consistent estimators for the structural equation through the implementation of a two-steps procedure:

(1) Calculate the ordinary least square (OLS) predictions of the endogenous variables from the reduced-form equations;

(2) Obtain the OLS estimators of the structural parameters by replacing the endogenous variables in the right-hand side of the structural equations for the respective predictions obtained in the first stage of the estimation.

By decomposing the estimation of the structural parameters, the two-stage least squares procedure assures that, for large samples, the estimators obtained are "purified" from the simultaneous-equation bias. Therefore, as Greene (2000, Chapter 16) demonstrates the two stage estimators meet the basic conditions for statistical inference i.e. they are asymptotically consistent, efficient, and asymptotically normally distributed.

In spite of its generalised use in systems of simultaneous equations, the two-stage least squares procedures cannot be applied to this research project due to the dichotomous character of the endogenous variables proxying for the inclusion of call options, convertible options, and protective covenants[38]. Nelson and Olsen (1978) propose an alternative two-stage estimation method that yields consistent estimators for systems of jointly determined continuous and dichotomous variables. Similar to the two-stage least square procedure, this method also relies on the previous

[38] As it was demonstrated in the previous chapter ordinary least square estimation for qualitative dependent variables leads to inconsistent estimators.

estimation of the reduced-form predictions to obtain consistent estimates for the structural parameters. More specifically, in the first stage the predictions from the reduced-form equations are estimated using maximum likelihood (ML) method for the dichotomous endogenous variables and using ordinary least squares (OLS) method for the continuous variables. In the second stage, the OLS and ML estimators for the continuous and dichotomous variables structural parameters are obtained, respectively, by replacing the right-hand side endogenous variables by the respective reduced-form predictions. Amemiya (1979) has derived the asymptotic co-variance matrix for this model.

Mallar (1977) introduced a two-stage estimation method for a system of simultaneous equations where only binary dependent variables are considered. As expected, in Mallar's (1977) model only the maximum likelihood techniques are used to obtain the parameter's estimates of the reduced- and structural-form binary regressions. In both Nelson and Olsen (1978) and Mallar (1977) methods the first stage predicted values for the endogenous binary variables are computed in their unobserved or latent form. In spite of the similar procedures to obtain the structural-form estimators, these two methods yield substantially different asymptotic co-variance matrices for the structural regressions as it is demonstrated by Maddala (1983, Chapter 8).

Although, Nelson and Olsen (1978) and Mallar (1977) methods are widely regarded in the literature as frameworks that generate asymptotically consistent and relatively efficient estimators, their use in this research is cumbersome. The fundamental

problem is that there is more than one continuous and/or dichotomous variable involved in the simultaneous estimation of models (7.2) to (7.5). In this context, none of the estimation approaches proposed by Nelson and Olsen (1978) and Mallar (1977) can be directly applied due to their mutually exclusive character and incapacity to account for the simultaneous determination of all the endogenous variables in these models[39].

In order to avoid losing information provided by the relationships underlying the debt contract design and to use a manageable framework suitable for aggregate-data analysis, we adopt a two-stage estimation technique used by Taylor (1993) for the estimation of a macroeconomic system containing continuous and binary dependent variables. Similar to Nelson and Olsen (1978), Taylor (1993) obtains predicted values from the reduced-form equations for the continuous and the dichotomous variables applying OLS and ML procedures (respectively) and uses these predicted values to purge the estimation of the structural parameters of the simultaneous-equation bias. However, as Taylor (1993) uses more than one continuous and dichotomous variables the corrected derivation of the co-variance matrix is no longer possible. In fact, the statistical inference relies on the standard errors from the second-stage estimation of the structural equation. This is incorrect, as it ignores the fact that some explanatory variables are estimated. Nevertheless, this imprecision in statistical inference seems to be negligible. According to Maddala (1983, p. 238) the

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[39] Although Dennis et al. (2000) also estimate the structural parameters of a system of equations where more than one dichotomous and continuous variable are jointly determined, they adopt exclusively Nelson and Olsen approach. However, some allowance should be made on the interpretation of their results as no adjustment is made to account for the existence of additional binary and continuous variables on right-hand side of the structural equations.

previous studies "... indicate that the standard errors for the second stage of the two-stage procedure were not far from the correct standard errors for two stage estimation [using] reduced-form equations".

7.3. Sample description

As it was mentioned before the purpose of this chapter is to analyse the influence of simultaneous decisions in the debt design process and to make inferences about the role that market mechanisms play in this process. In order to simplify and to avoid potential misspecification errors, the original data panel sample of 377 Eurobond issues from 1986 to 1999 was aggregated and a times-series containing the quarterly average values for issues and firm characteristics was constructed.[40] For the special case of the binary dependent variables, a value of one was attributed when the correspondent average value was equal or greater than 0.5 and zero otherwise.

In spite of the inherent loss of information regarding individual issues and firm-specific characteristics, the aggregation of data allows us to make more accurate inferences about the behaviour of the average issuer in the context of Eurobond markets. Indeed, if one assumes that the participants of Eurobond markets are particularly well informed and have strong beliefs about the characteristics and credit quality shared by potential issuers in this market, then the analysis of the behaviour of the average firm more appropriately describes the Eurobond design process.

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[40] The developments made in the econometric literature for applying the simultaneous equation estimation methods to systems of panel data are still limited to continuous dependent variable models. For further details about these estimation methods see Matyas and Sevestre (1992, Chapter 7).

The different treatment conferred to "non-recurrent" issuers (i.e. issuers that have only one issue) might raise some problems in the comparison of the estimation results from the panel data analysis in Chapter VI with the simultaneous-equations analysis. Thus, as it was referred in Chapter VI the observations for "non-recurrent" issuers were excluded due to the methodological constraints imposed by the panel data estimation method. The reasons for considering these observations on the construction of the time-series for the simultaneous-equations analysis are twofold. First, a consistent analysis of the behaviour for the typical Eurobond issuer requires the use of all information available and compatible with the estimation method adopted. Second, the proportion of observations for "non-recurrent" issuers represents approximately 15% of the total sample. To this extent, the impact of these observations on the computation of quarterly average time-series is likely not to be expressive and should not impose serious problems for the comparison of the estimation results.

Table 7.3 - Panel A shows a number of descriptive statistics on the quarterly average data set for the variables used. Comparing to the sample analysed in the previous chapter it can be seen, firstly, that the number of observations reduces from 245 individual-firm issues to 56 quarterly average-firm issues. Secondly, as it would be expected, no significant changes are observed for the mean values. However, the proportional decrease on the standard deviation values is substantial for some variables, namely, size decreases 53% from 1.08 to 0.51 units, market-to-book value decreases 58% from 0.96 to 0.40 units, earnings variance decreases 52% from 2.04 to 0.98 percent units, leverage decreases 61% from 1.66 to 0.65 units, and deviation

from debt-equity target decreases 56% from 1.11 to 0.49 units. Finally, the influence of extreme values noted before for the variables intangibles to total assets (%) (INT), interest term premium (%) ($TERMP$), and bankruptcy risk ($BRISK$) is reduced but not eliminated. Hence, the figures of 4.87 and 2.32 for the mean and median of the quarterly average INT show that the presence of a relatively small number of issuers with high proportion of intangible assets having an important influence on the distribution of this variable, even after the data being averaged across firms. The same argument applies for the presence of a few periods with significantly positive trend for the interest term premium ($TERMP$) and for the existence of a small number of issuers facing high bankruptcy risk ($BRISK$).

Table 7.3 - Panel B reports the frequencies of the dependent binary variables. It is important to note that the reported frequencies correspond to adjusted average values and not to actual data. Considering this fact, the analysis of this table shows that the proportion of callable and non-callable issues is relatively balance whereas the issuance of "straight" Eurobonds clearly dominates compared to the issuance of securities embedding convertible provisions and protective covenants. For instance, non-convertible Eurobond issues and Eurobond issues with no restrictive covenants represent 77% and 70% (respectively) of the total quarterly issues from UK-based companies between 1986 and 1999.

7.4. Model specification

This section models four equations that relate to four alternative mechanisms used by managers to reduce inefficiencies surrounding the issuance of debt securities in capital markets. These mechanisms are the maturity of debt contracts, the inclusion of convertible privileges, the use of call options, and the introduction of protective covenants in the contract indentures. Following Dennis et al. (2000) we also considered a fifth endogenous variable, firm leverage, as an additional devise available to managers to mitigate potential contracting costs. Although the modelling of firm leverage is not the focus of this research, agency theory has suggested that maturity, debt covenants, and leverage can be used as substitutes for reducing agency costs in the firm. On the other hand, the optimal capital structure theory has related the firm leverage with a series of exogenous variables that are considered in our model as proxies for agency costs, asymmetric information, liquidity risk, and tax advantage hypotheses. Therefore, following Dennis et al. (2000) we first estimate the reduced-form predicted values of leverage by regressing this variable on the set of exogenous variables. These predicted values are then substituted for the observed values of leverage to obtain the estimates of the four structural equations analysed.

Table 7.1 - Panel A lists all the variables used in equations (7.2) to (7.5) and a detailed explanation about the expected sign and relevance of the variable used is provided below. The notation for the variables differs from the one adopted in Chapter VI since the data used refers to quarterly average rather then individual issue observations.

7.4.1. Quarterly Average Maturity ($\overline{MAT}$) equation

$$\overline{MAT_t} = \alpha_0 + \gamma_{mc}\,\overline{CALL_t} + \alpha_1\,\overline{MBOOK_t} + \alpha_2\,\overline{ASSMAT_t} + \alpha_3\,\overline{TAXA_t} +$$

$$\alpha_4\,\overline{EVAR_t} + \alpha_5\,\overline{TERMP_t} + \alpha_6\,\overline{INTVOL_t} + \tag{7.2}$$

$$\alpha_7\,\overline{RETIYB_t} + \alpha_8\,\overline{UEXP_t} + \alpha_9\,\overline{SIZE_t} + \gamma_{ml}\,\overline{LEVEQ_t} + \varepsilon_{mt}$$

Agency costs theory (see, e.g. Myers (1977) and Barnea et al. (1980)) predicts the interchangeable use of short-term debt, callable bonds or low levels of firm leverage as means to mitigate contracting costs that are determined by the conflicts of interest between shareholders and creditors. According to this theory, the contracted maturity is positively related to the propensity to include call provisions and negatively related to the level of firm leverage. As a value-maximising agent we would expect that, on average, the high leverage Eurobond issuer choose short- (long-) term contracts without (with) embedded call provisions. Due to the endogenous character of the variables $\overline{CALL}$ and $\overline{LEVEQ}$, their reduced-form predicted values rather than their observed values are used in the estimation of the parameters for the structural equation (7.2).

Following the underinvestment argument of Myers (1977) a negative and positive sign is expected for the coefficients of the exogenous variables market-to-book value ($\overline{MBOOK}$) and assets maturity ($\overline{ASSMAT}$), respectively. In other words, an average issuer with high growth opportunities should issue short-term Eurobonds when the

maturity of assets-in-place is relatively low so that the incentives to forego profitable investment opportunities and to prevent unfavourable wealth transfers are diluted.

Considering the trade off between interest tax shields and bankruptcy costs, Kane et al. (1985) argue that firms should rebalance their capital structure more frequently and therefore select a lower maturity for debt whenever their marginal tax rate and earnings volatility are particularly high. In this context, one should expect that, on average, a borrower would optimally issue short-term Eurobonds when its marginal effective tax rate ($\overline{TAXA}$) and its earnings variability ($\overline{EVAR}$) are relatively high. Moreover, assuming the independence between the capital structure and debt maturity decisions and underpinning their argument on the time value of the tax advantage, some authors suggest that the maturity should be positively related to the slope of the yield curve ($\overline{TERMP}$) and with the interest rate volatility ($\overline{INTVOL}$) (see Brick and Ravid (1985) and Mauer and Lewellen (1987)).

In a world of asymmetric information, several authors (see e.g. Barnea et al. (1980), Flannery (1986), Kale and Noe (1990), and Diamond (1993)) stress that the firm's financial decision involves ex-ante costs such as adverse selection costs and ex-post costs such as moral hazard costs. In order to assess the how well investors are informed about the quality of Eurobond issuers' prospects, we use two different proxies commonly accepted as indicators of firm's project quality – stock return over one year prior to the issue ($\overline{RET1YB}$) and unexpected earnings ($\overline{UEXP}$). According to asymmetric information theory, firms should gain an advantage from the existence of uninformed investors and should issue longer and necessarily more mispriced debt

following a period of high market performance but should use shorter debt in the periods that precede an unexpected increase in earnings. Therefore, a positive (negative) sign is expected for the coefficient of the average firm past market performance ($\overline{RET1YB}$) (average firm's unexpected earnings ($\overline{UEXP}$)).

Finally, average firm size ($\overline{SIZE}$) was introduced as a proxy for typical firm's liquidity risk. The liquidity risk argument (see Diamond (1991, 1993)) predicts a negative relationship between firm size and contract maturity. Nevertheless, as it was pointed out in Chapter V, a direct relationship between issue maturity and average firm size might prevail due to the economies of scale that induce large firms to issue long-term debt.

7.4.2. Quarterly Average Call Provisions ($\overline{CALL}$) equation

$$\overline{CALL_t} = \beta_0 + \gamma_{cm}\,\overline{MAT_t} + \beta_1\,\overline{INTLEV_t} + \beta_2\,\overline{INTVOL_t} + \beta_3\,\overline{INT_t} + \gamma_{cl}\,\overline{LEVEQ_t} + \beta_4\,\overline{TAXA_t} + \beta_5\,\overline{UEXP_t} + \beta_6\,\overline{SIZE_t} + \varepsilon_{ct} \tag{7.3}$$

In equation (7.3) we assess the reverse effect of Eurobond maturity ($\overline{MAT}$) and firm's leverage ($\overline{LEVEQ}$) on the decision of whether or not to include a call provision in the contract indenture, following the agency costs argument stated previously for the modelling of the maturity regression. The fitted values for maturity

and leverage replace the respective observed values to overcome the simultaneous-equations bias (see section 7.2.2).

Pye (1966) first related the choice of callable debt with the need to increase managerial flexibility for the interest risk hedging purposes. Empirically, we can test this hypothesis by assessing if there is a positive relationship between both the level of interest rate ($\overline{INTLEV}$) and the interest rate volatility ($\overline{INTVOL}$) in the UK economy and the average propensity of UK issuers to launch callable Eurobonds. On the other hand, Barnea et al. (1980) and Bodie and Taggart (1978) predict a negative relationship between the propensity to include call provisions and the level of growth opportunities available – proxied by the ratio of total intangibles to total assets ($\overline{INT}$) - in the firm. This prediction underpins on the agency costs and asymmetric information arguments that postulate that the conflicts of interest between creditors and borrowers can be mitigated by reducing the maturity of debt issues – through the inclusion of a call back option.

Following a different line of argument, Boyce and Kalotay (1979) and Marshall and Yatwitz (1980) argue that whenever there are tax advantages proxied by the ratio of taxes paid to total assets ($\overline{TAXA}$), firms benefit from issuing callable debt. Therefore, a positive relationship is expected between the variable $\overline{TAXA}$ and the quarterly average issuance of callable Eurobonds. In order to test the signalling hypothesis of Robbins and Schatzberg (1986) that contends that callable issues are used for signalling private favourable information about firm's prospects, we include in the

equation (7.3) a variable that proxies for the average firm's unexpected earnings ($\overline{UEXP}$).

Finally, an additional variable $\overline{SIZE}$ is introduced to proxy for the level of liquidity risk. Considering that the inclusion of call provisions provides additional managerial flexibility to remove restrictive covenants or to decrease firm leverage before the bond matures (see Pye (1966)), riskier and typically smaller firms would benefit the most from issuing callable Eurobonds. Therefore, a negative sign is expected for the coefficient of the variable $\overline{SIZE}$ in equation (7.3).

7.4.3. Quarterly Average Convertible Provisions ($\overline{COV}$) equation

$$COV_t = \chi_0 + \gamma_{cop}\, PROTC_t + \gamma_{com}\, MAT_t + \chi_1\, MBOOK_t + \chi_2\, UEXP_t +$$

$$+ \chi_3\, \overline{EVAR_t} + \chi_4\, \overline{SIZE_t} + \gamma_{col}\, \overline{LEVEQ_t} + \qquad (7.4)$$

$$\chi_5\, \overline{SDR3M_t} + \chi_6\, \overline{DTARG_t} + \varepsilon_{cot}$$

The alternative use of convertible options, short-term debt, and protective covenants to reduce agency costs is empirically tested for UK-based Eurobond issues by assessing the significance of the parameters for the proxies of the quarterly average issue maturity ($\overline{MAT}$) and the quarterly average issues with protective covenants ($\overline{PROTC}$). To this extent, several authors (see Jensen and Meckling (1976),

Mikkelson (1980), and Smith and Warner (1979)) have argued that convertible debt reduces agency costs because it aligns the interests of bondholders to the interest of the residual claimants in the firm – shareholders. This impact of convertibles on agency costs is even more evident when it is observed that the majority of the convertible issues is subordinated to other types of debt and therefore ranks closer to the equity claims in the event of bankruptcy (see e.g. the evidence provided by Citron (1995)). To this extent and considering the role played by short-term and protected debt in enforcing creditors control over firm's investment and financing decisions, a negative (positive) relationship is expected between the propensity of issuing convertible securities in the Eurobond market and the probability to issue protected debt (short-term debt). On the other hand, based on the asset substitution theory (see e.g. Jensen and Meckling (1976) and Green (1984)) one empirical test was devised to assess the alternative use between the inclusion of convertible privilege and the reduction of firm's leverage. Once more, due to the endogenous character of the variables $\overline{PROTC}$, $\overline{MAT}$, and $\overline{LEVEQ}$, the observed values in equation (7.4) were replaced by the correspondent reduced-form fitted values.

Brennan and Schwartz (1988) observe that, the firms that face greater uncertainty about their future cash flows or for which the inherent risk is more difficult to be assessed should issue convertible bonds. They argue that, because in these circumstances creditors are particularly less able to control firm's investment policies, the agency costs driven by shareholders risk-shifting incentives are particularly cumbersome. Following other empirical studies (see e.g. Essig (1991) and Mayers (1998)) proxies for investment growth opportunities ($\overline{MBOOK}$), firm's

earnings volatility ($\overline{EVAR}$) and size ($\overline{SIZE}$) are used to relate the firm's risk uncertainty characteristics to the issuance of convertible Eurobonds. More specifically, empirical evidence has shown that firms with larger growth opportunities set, higher earnings volatility, and relatively small size prefer to issue convertible securities that are immune to firm's business risk and therefore less likely to suffer from contracting costs. On the other hand, a theoretical study by Smith and Warner (1979) predicts a negative relationship between the issuance of convertibles and the firm's growth opportunities due to the increase in underinvestment costs driven by the outstanding convertible bonds. An empirical test to these contradicting arguments will be provided for the quarterly average Eurobond issues sample.

Consistent with the call option-structural equation (7.3), the variable $\overline{UEXP}$ is used as proxies for firm's unobserved future prosperity. Constantinides and Grundy (1989), Stein (1992), and Nyborg (1995) argue that convertible issues act as a signalling mechanism conveying the firm's true credit quality to the market and assuring the prevalence a separating equilibrium between higher and lower credit rating firms. Therefore, one should expect a direct and significant relationship between the average propensity of issuing convertible Eurobonds and the proxy for the average firm's unexpected earnings - $\overline{UEXP}$.

Finally, following Billingsley et al. (1988) two additional variables were introduced to control for the firm's propensity to issue more equity-like or more debt-like issues. These variables are: (1) firm total risk – proxied by the quarterly average standard

deviation of stock returns over three months before issuance ($\overline{SDR3M}$) and (2) average deviation from firms leverage target ($\overline{DTARG}$).

7.4.4. Quarterly Average Protective Covenants ($\overline{PROTC}$) equation

$$\overline{PROTC}_t = \delta_0 + \gamma_{pco}\,\overline{COV}_t + \gamma_{pm}\,\overline{MAT}_t + \delta_1\,\overline{MBOOK}_t + \delta_2\,\overline{SIZE}_t + \delta_3\,\overline{BRISK}_t + \gamma_{pl}\,\overline{LEVEQ}_t + \varepsilon_{pt} \tag{7.5}$$

According to Myers (1977) short-term contracts, reduced leverage, and protective covenants represent alternative ways of curbing the shareholders incentives that lead to underinvestment costs. Therefore, the coefficients for the proxies for the quarterly average contract maturity ($\overline{MAT}$) and for the average issuer's leverage ($\overline{LEVEQ}$) are expected to be significant and positively related to the average propensity of the Eurobond issues to embed restrictive covenants. On the other hand, to test the hypothesis that both protective covenants and convertible provisions can be alternatively used to align creditors interests with shareholders interests (see, e.g. Smith and Warner (1979)), the quarterly average propensity to include protective covenants is regressed on the quarterly average probability to issue convertible Eurobonds ($\overline{COV}$). Once again, to avoid simultaneous-equation bias, the estimates for the equation (7.5) were obtained using the fitted reduced form values for $\overline{MAT}$, $\overline{LEVEQ}$, and $\overline{COV}$.

Moreover, equation (7.5) tests Myers (1977) argument that firms with high growth opportunities (proxied by the quarterly average market-to-book value ($\overline{MBOOK}$)) should include protective covenants in their issues in order to control shareholders' incentives to forego profitable investments. Empirical assessment is also provided to Chan and Kanatas (1986) and Chan and Thakor (1987) predictions that, in context of asymmetric information, good quality firms avoid asymmetry valuations due to either information or beliefs by including collateral provisions in the issue agreement. In this content, one should expect a positive relationship between the proxy for firm size ($\overline{SIZE}$) and the amount of protective covenants included in Eurobond indentures.

Finally, the risk-shifting and claims dilution arguments proposed by Smith and Warner (1979) that affect firms facing particularly high bankruptcy risk is tested in this model by assessing the significance of the coefficient of the proxy for firm's bankruptcy risk ($\overline{BRISK}$). Specifically, according to Smith and Warner (1979) one should expect a positive sign on the coefficient for $\overline{BRISK}$ as an excessive bankruptcy risk induces creditors to require protective covenants in order to prevent risk-shifting or claim dilution (i.e. the acceptance of additional debt claims) policies being followed by the shareholders.

7.5. Results

Preliminary estimation results of the structural equation (7.2) suggest the existence of a well-determined trend component in the average issue maturity that should be

taken into account to avoid misspecification bias in the regression estimation. Specifically, the Durbin-Watson test could not reject the hypothesis of autocorrelation indicating that, a misspecification bias possibly due to omitted variables, was affecting the regression estimation. Moreover, the Hansen's (1992) instability test indicates the absence of constancy in the within sample estimation of one of the regression parameters which, according to Judge et al. (1985, p.260), might be resolved by removing the non-stochastic component from the time-series dependent variable. Following this recommendation, a trend variable that allocates a value from 1 to 56 to each of the quarter-period observations was introduced in the structural equation (7.2). Subsequent estimation results reveal that not only the trend variable is indeed relevant for the determination of the average Eurobond maturity (the null hypothesis of zero coefficient is rejected at 5% level of significance) but also the hypotheses of no autocorrelation and parameter stability could no longer be rejected by the Durbin-Watson and Hansen tests, respectively.

The final estimation results for the two-stage structural maturity equation (7.2) are reported in Table 7.4 – Column A. Although the trend variable is considered in the estimation of this structural equation, the sample estimate for this variable is not reported in this table. Moreover, three statistically insignificant explanatory variables namely, the average firm's tax paid ($\overline{TAXA}$), the average firm's unexpected earnings ($\overline{UEXP}$), and the average interest term premium ($\overline{TERMP}$) were excluded from the final estimation model following the recommendation by Greene (1993, p.590). The relevant F statistic confirms that the null hypothesis that the coefficients of these variables are zero cannot be reject (the p-value for this statistic is equal to 0.98).

Table 7.4 – Columns B to D shows the estimates for the binary dependent variables call option, convertible option, and protective covenants in equations (7.3) to (7.5). Once again, some explanatory variables were excluded from these equations due to their statistical insignificance and irrelevance for the validation of the rank identification condition (see Greene *ibid.*). Specifically, the variables average firm's unexpected earnings ($UEXP$) and tax paid ($TAXA$) are excluded from the call option equation (7.3). The variable average firm's unexpected earnings ($\overline{UEXP}$) is removed from the convertible option equation (7.4). Finally, the variable average firm size ($\overline{SIZE}$) is excluded from the protective covenants equation (7.5). The null hypothesis of the coefficients of these variables being equal to zero could not be rejected by the correspondent χ^2 statistics.

7.5.1. Maturity

The final estimation results of the structural equation in (7.2) report an adjusted R^2 of 0.096, which is lower than in other incremental debt studies (e.g. 0.163 for Dennis et al. (2000) and 0.147 for Guedes and Opler (1996)) but not unreasonable considering the size of the sample set and the aggregate-type of data.

Specifically, the estimation results show that the quarterly average maturity of Eurobond issues is significant and positively related to the fitted value for the propensity to issue callable Eurobonds. Similar to the result from the single-equation analysis (see Chapter VI), this evidence provides a strong support to Myers (1977) and Barnea et al. (1980) arguments that short-term and callable debt contracts can be

used alternatively to mitigate contracting costs driven by creditors/shareholders conflicts of interest. Notably, the significance and sign of the coefficient for the fitted value of firm leverage also confer strong support to Myers (1977) prediction about the interdependence between the decision of reducing the leverage level and issuing short-term debt. This evidence also corroborates Barnea et al. (1980) prediction that more levered firms are more likely to issue short-tem debt to avoid the financing inefficiencies driven by shareholders' risk shifting incentives. Generically, this result highlights the importance of taking into account the endogenous character of the explanatory variable $\overline{LEVEQ}$ and provides a similar outcome to the one obtained by Dennis et al. (2000), which focused on the choice of contract terms for Revolving Credit Agreements.

Contradicting the result from the panel data analysis (see Chapter VI) the coefficient for $\overline{ASSMAT}$ is statistically unrelated with the quarterly average maturity of the issue. Although this result is inconsistent with agency costs (Myers (1977)) and liquidity risk (Diamond (1993)) hypotheses, it suggests that whenever the decisions about the issue maturity and the inclusion of a call option are allowed to vary simultaneously the maturity of assets-in-place no longer plays a relevant role in the choice of the contracted Eurobond maturity. Indeed, it is plausible to consider that, if simultaneously with the maturity choice, managers can decide to include an option that grants them the flexibility to reduced the contracted maturity, the pertinence of the asset/issue maturity matching argument is substantially mitigated. Therefore, although apparently contradictory this evidence sheds some light about the impact

that an accurate treatment of the endogenously determined explanatory variables produces in the estimation results.

On the other hand, consistent with the results from panel data analysis in Chapter VI, no support is provided to tax-related and adverse-selection/signalling theories. Hence, the lack of significance of the proxies for the average firm earnings variance ($EVAR$) and the average firm tax paid ($TAXA$) contradicts the Kane et al.'s (1985) prediction that high taxable firms with volatile earnings are more likely to issue short-term debt in order to maximise the interest tax shields by rebalancing more frequently their capital structure. Moreover, the highly insignificant coefficient for the $\overline{TERMP}$ and the significant but negative coefficient for $\overline{INTVOL}$ provide no support to the Mauer and Lewellen's (1987) and Brick and Ravid's (1985) hypotheses that the debt maturity is directly related to the prevalent market conditions such as the interest term premium and the interest rate volatility. Overall, as it was pointed out in Chapter VI, lack of support provided to tax advantage-related theories is in line with Lewis (1990) premise that no tax gain can be captured from changing the proportions of long-term/short-term debt in firms financing structure provided that the decisions about leverage choice and maturity issue are assumed (as they are in this study) to be simultaneous.

The lack of support to signalling/adverse-selection theories reinforces the evidence from the firm-specific analysis suggesting that the level of information asymmetry about the issuers' future prospects is small among Eurobond market participants. Indeed, taking into account that Eurobond markets are clearly open to larger firms

with higher credit quality and subject to strong disclosure regulations for quoted companies, it should not come as a surprise the absence of significant privately held information by Eurobond issuers. Moreover, considering that Eurobond issues target not only domestic but also foreigner investors a particularly close market scrutiny is impose to Eurobond issuers with a significant number of investment analysts continuously assessing firm's performance and credit quality and generating financial forecasts about firm's future earnings and prospects.

The results reported in Table 7.4 – Column A show that, contrary to the adverse selection arguments (see e.g. Lucas and McDonald (1990)), the average firm issues short-term Eurobonds following a stock price runup – proxied by quarterly average stock return over a year prior to the issues announcement dates ($\overline{RET1YB}$). More specifically, the evidence suggests that the average Eurobond issuer does not exploit potential asymmetries of information by offering disadvantageously mispriced long-term contracts following a period of particularly good performance in the stock market. On the other hand, no significance was found for the coefficient of the proxy for unexpected earnings ($\overline{UEXP}$). Hence, the signalling argument that firms use short-term debt to convey information to the market about the favourable future prospects is not supported by the Eurobond issues data set.

The positive and significant sign of the coefficient for the proxy of average firm size ($\overline{SIZE}$) is inconsistent with the liquidity risk theory. Indeed, the liquidity-related argument that predicts smaller firms, typically of lower credit quality (Queen and Roll (1991)) and/or with less collateral assets (Sharpe (1991)), to be more likely to

issue longer-term debt to avoid the costs of financial distress is not validated by the data. Nevertheless, the positive sign of the coefficient for the average firm size ($\overline{SIZE}$) seems to corroborate the empirical evidence (see e.g. Stohs and Mauer (1996)) that large firms tend to prefer long-term debt issues as they benefit from economies of scale due to the fixed transaction costs characterising public debt issues. Relevant collinearity tests suggest, however, that some caution should be drawn to the interpretation of the estimate of the variable average firm size ($\overline{SIZE}$). Indeed, the Condition Index criterion indicates that a high linear dependence between this variable and other regressor(s) might affect the precision of the underlying estimate of $\overline{SIZE}$ [41]. Nevertheless, a close analysis to the cause of the linear dependence reveals that the variable $\overline{SIZE}$ is highly correlated with the regression constant term but not materially associated with any of the other explanatory variables. The particularly low variability of the aggregate proxy for firm size highlighted in section 7.3 can indeed account for the observed high correlation between this time-series variable and a constant term that is included in the regression solely to validate the least square assumption of zero-mean disturbance term. Therefore, although apparently cumbersome the high correlation depicted by the condition index results from a mechanical relationship and should not impose serious problems to the individual interpretation of the explanatory variables' estimates.

[41] The maximum Condition Index value for the average-maturity regression estimation ascends to 184.2 which largely excess the values of 20 or 30 suggested by Greene (2000) and Judge et al. (1985) as thresholds for the presence of potential multicollinearity bias.

Finally, no support is found for the underinvestment hypothesis from Myers (1977). The statistical insignificance of the coefficient for the proxy of the average firm growth opportunities ($\overline{MBOOK}$) is inconsistent with Myers' (1977) argument that high growth firms issue more short-term debt to control shareholders costly incentives to forego profitable projects at the expense of debt holders. The evidence seems indeed to suggest that either the aggregate time-series proxy for growth opportunities is unable to portray the shareholders' discretionary investment policies or other agency problems such us risk-shifting and claims dilution incentives are more pertinent for Eurobond maturity choice than underinvestment incentives.

In summary, although some support is provided to agency costs theory, no evidence is found to suggest that asymmetric information costs, debt tax advantage or liquidity risk arguments have an impact in the optimal maturity choice for the average Eurobond issuer.

7.5.2. Call option

Table 7.4 – Column B reports the binary Probit estimation results for the structural equation (7.3) where the dependent variable proxy for the quarterly average propensity of Eurobond issues to include call provisions. The χ^2 Likelihood ratio statistic is significant at 10% level and indicates that the null hypothesis that all slope coefficients in the regression are equal to zero can be rejected.

The results show that when fitted values are considered both for maturity and firm leverage only maturity remains significantly and positively related to the quarterly

average propensity to issue callable Eurobonds. To this extent, the arguments underlying the interest rate risk hedging, the asymmetric information, and the tax disadvantage theories seem to be ruled out when maturity and firm's leverage are allow to vary simultaneously with the choice between callable or non-callable issues. Interestingly, the proxy for firm growth opportunities ($\overline{INT}$) becomes significant and positively related to the propensity to issue callable Eurobonds. This result together with the evidence that longer-term Eurobonds tend to include call options strongly supports Myers (1977) and Barnea et al. (1980) arguments that both maturity and call provisions play an important and alternative role in mitigating borrowers' underinvestment and risk-shifting incentives, respectively. It is important to notice, however, that average value for the proxy for growth opportunities ($\overline{INT}$) can also portray the level of credit risk of the average Eurobond issuer. In fact, according to the liquidity risk theory (see e.g. Sharpe (1991)) firms with a higher proportion of intangible assets are more likely to incur in inefficient liquidation due to the incapacity of generating an adequate stream of cash-flows for the timely service of debt obligations. Moreover, as Froot et al. (1993) point out even if the extreme outcome of liquidation is not realised, disadvantageous refinancing can lead to a loss of project rents due to the higher interest rates demanded by the new creditors. The loss of favourable credit conditions might also lead to dead-weight costs of financial distress, for instance, loss of customers or diversion of management efforts. As it was pointed out by Pye (1966), the inclusion of call provisions in Eurobonds provide additional managerial flexibility to decrease the amount of borrowings before the maturity date or to remove restrictive covenants. To this extent, call provisions allow the managers of more risky firms to decrease a number of potential hindrances that

might lead to an unfavourable refinancing outcome. In summary, the significant direct relationship between the quarterly average ratio of intangibles to total assets and the average issuance of callable Eurobonds is also consistent with the liquidity risk theory.

However, no further support is found for the liquidity risk hypothesis. Thus, contrary to the result from the firm-specific analysis in Chapter V, the coefficient for the aggregate firm size ($\overline{SIZE}$) is statistically insignificant failing to provide support to the prediction that smaller and typically less credible firms issue callable bonds to reduce the probability of incurring in inefficient liquidation. This contradictory result might be linked with the dilution of explanatory power that arises from averaging the proxy for firm size across Eurobond issuers that, a priori, do not diverge substantially in terms of the size of their business activities. In fact, a comparative analysis of the descriptive statistics in Table 6.3 and Table 7.3 reveals that averaging the original data set across firms reduces the standard deviation of the proxy for firm size in 53%. Moreover, the loss of explanatory power observed for the proxy of the aggregate marginal corporate tax ($\overline{TAXA}$) when compared with firm-specific results might reflect the same limitation of the aggregate data in explaining the variation of the dependent variable. In particular, the dilution of information regarding firm-specific taxable income and individual policies adopted for imputation of costs and revenues might compromise the impact of aggregate marginal corporate tax on the propensity to issue callable Eurobonds by the "typical" firm. In summary, some caution should

be drawn to the analysis of the results for the proxies of average firm size ($\overline{SIZE}$) and average marginal corporate tax ($\overline{TAXA}$).

7.5.3. Convertible option

The results for the estimation of the structural equation (7.4) are reported in Table 7.4 - Column C. In comparison with the analysis performed in Chapter VI, the proxy for the average firm bankruptcy risk is excluded from the right-hand side of the equation (7.4) to respect the rank condition of identification of the simultaneous-equations estimation as it was mentioned previously in section 7.2.1.

The overall explanatory power of this model is high as, at 5% level of significance, the χ^2 Likelihood ratio test rejects the null hypothesis that the slope coefficients for all the explanatory variables are equal to zero.

Similar to the panel data analysis, the average propensity to issue convertible Eurobonds is significantly and negatively related to the fitted value for the average propensity to include protective covenants. Hence, this result provides additional support to the premise that convertible Eurobonds assure a better alignment between creditors and shareholders interests and therefore play an alternative role to the protective covenants in mitigating agency-contracting costs. In particular, this evidence corroborates Jensen and Meckling (1976), Mikkelson (1980), and Smith and Warner (1979) argument about the positive impact of convertibles in reducing costly wealth transfers between firm's claimants. However, as it will be highlighted in the analysis of the results for the Eurobond's protective covenants equation (7.5), the positive impact of convertibles in Eurobond issues might be primarily associated

with the reduction of equity agency costs rather then the reduction of debt agency costs (i.e. asset substitution costs). This inference relies not only on the additional evidence from the model estimation but also on theoretical arguments that relate the issuance of convertibles (and protected debt) with the principal-agent rationale. Firstly, it can be shown that all the other results strongly contradict the predictions from debt agency costs theory. Thus, the negative and significant coefficient of the proxy for the average firm's leverage (fitted $\overline{LEVEQ}$) is inconsistent with Green (1984) and Jensen and Meckling (1976) arguments that high-levered firms issue convertibles in order to mitigate shareholders incentive to replace profitable investments with low-value, high-risk projects. Moreover, the negative and significant relationship between the average propensity of issuing convertibles and the issue average maturity (fitted $\overline{MAT}$) strongly contradicts the prediction that convertibles and short-term issues are alternatively used to reduce shareholders/creditors conflicts of interest. Secondly, Stulz (1988) argues that convertible issues reduce the probability of take-over bids because convertible-holders are less likely to convert and tender than holders of common stock due to the opportunity costs associated with the loss of the convertible put option. In this context, Stulz (1988) contends that managers can use convertibles to deter hostile take-over bids by forcing the conversion of these securities through exercise of an embedded call option. Although Stulz's (1988) argument seems in line with the use of convertibles for increasing manager's discretionary power over firms activities to the determent of the disciplinary control exerted by the market, it is important to consider three major implications from this argument:

(1) Only forced conversion enables managers to decrease the probability of a take-over attempt. Thus, if convertible-holders voluntarily convert their securities there will be no opportunity cost and these investors will be as willing as the owners of common stocks to agree to the take-over bid;

(2) The value of the convertible put option depends on the firm's stock price that ultimately reflects the quality of firm's performance. To this extent, the higher the firm's stock price the more valuable the convertible option for the convertible-holder and the stronger the manager's ability to deter hostile take-overs by calling back the convertibles;

(3) Whenever the stock price decreases the value of the convertible option decreases accordingly, and at the extreme, the forced conversion of securities will no longer act as a defence mechanism protecting manager's control rights against outside bidders.

Overall, Stulz's (1988) argument implies that managers will be able to use outstanding convertibles to retain their control rights over the firm as long as they pursue investment policies that lead to positive market performance and therefore are in line with shareholders interests.[42] Finally, the inference that equity agency costs might play an important role in the issuance of convertibles permit also to reconcile the evidence from the panel data analysis that suggests that convertibles

[42] Hangen and Senbet (1981) provide another argument for the use of convertibles as mechanisms to reduce investors/managers conflicts of interest. These authors argue that, as put options retained by external investors, convertibles allow for the elimination of owner-manager's incentive to consume perks in determent of shareholder's interests, because perk consumption leads to a decrease on firm's total value which ultimately results in an increase of manager's liability to convertible-holders. In other words, the owner-manager's gain obtained by using external funds to pursuit self-interest policies is simply offset by the increase burden of being liable to repay unconvertible debt.

and protective Eurobond seems to resolve financing inefficiencies that are unrelated with the Eurobond maturity choice.

From the results reported Table 7.4 – Column C some support is found for the risk uncertainty hypothesis from Brennan and Schwartz (1988) and Brennan and Kraus (1987). In line with the estimation risk hypothesis that assumes that the information content of highly variable earnings is less that of more stable earnings streams, a positive and significant coefficient is found for the quarterly average firms' earnings variance ($\overline{EVAR}$). More specifically, this evidence suggests that for firms where the inherent risk is more difficult to be estimate by investors are more likely to issue convertible Eurobonds. This result is also consistent with the evidence from Essig (1991) study focused on US convertible bonds. However, contrary to Essig's (1991) and Mayers' (1998) studies no significance is found for other variables proxying for firm's risk uncertainty i.e. for $MBOOK$ and $SIZE$. Although in the panel data analysis of Chapter VI, no significance was also associated with the proxy for firm-specific growth opportunities ($MBOOK$), the coefficient of the proxy for individual firm size ($SIZE$) was highly significant (the t-statistic test rejected the null hypothesis of no correlation at 1% significance). The loss of significance for the variable $\overline{SIZE}$ in the quarterly average simultaneous-equation analysis might be due to the limitation of the aggregate data to fully capture the variation of a dimension (firm size) that it is, a priori, known for not displaying substantial variability.

A plausible explanation for the contradictory result on the negative and significant relationship between the average propensity to include convertible options and the

proxy for the aggregate firm's leverage is provided by Essig (1991). He observes that, across industries, smaller firms with lower leverage tend to use proportionally more convertible securities than high-levered firms. Essig (1991) contents that although this result contradicts the assets substitution hypothesis, it provides strong support to risk uncertainty hypothesis, as it is possible to argue that firms' ability to raise significant amounts of debt conveys a positive sign about their underlying risk. Taking into account the finding that highly levered firms are typically large firms (Table 7.2 reports positive correlation coefficient of 0.11 between the variables $\overline{SIZE}$ and $\overline{LEVEQ}$) the evidence that suggests that, on average, less levered firms tend to issue more convertible Eurobonds is indeed consistent with the risk uncertainty arguments[43].

Finally, no support is found for the signalling hypotheses from Constantinides and Grundy (1989), Stein (1992), Nyborg (1995), and Mayers (1998). Hence, the variable that proxy for the average Eurobond issuer's unobserved "prosperity" ($\overline{UEXP}$) provide no explanatory power for the propensity to issue convertible securities. Moreover, the insignificant results for the control proxies - $\overline{SDR3M}$ and $\overline{DTARG}$ - suggests that either these proxies are not able to capture the average issuer' propensity to issue more equity-or debt-like securities or these factors do not play a significant role in the choice of convertible Eurobonds. In either case, this result fails to provide support to Billingsley et al.'s (1988) evidence that proxies for

[43] Mayers (1998) argues that this evidence also supports the sequential-financing theory as smaller firms tend to face higher issuance costs and therefore should proportionally raise larger amounts of convertible securities. However, none of the other results supports Mayers's (1998) prediction that the convertible Eurobond issues are used to reduce the informational asymmetry costs driven by the uncertainty about the value of future investment options.

firms' risk such us the standard deviation of firm's stock returns ($\overline{SDR3M}$) are positively related to firms' propensity to issue equity-like securities whereas proxies like the firms' deviation from gearing target ratio - $\overline{DTARG}$ - are associated with firms' propensity to issue debt-like securities.

7.5.4. Protective covenants

Table 7.4 - Panel D presents the estimation results for the structural equation (7.5). Overall, substantial explanatory power is found for the model as the null hypothesis that the slope coefficients of all explanatory variables are equal to zero can be rejected at 1% level of significance. The variable $\overline{SIZE}$ was removed from the final estimation following the recommendation by Greene (1993). The Likelihood ratio test that assesses the significance of this omitted variable in explaining the average propensity to include protective covenants has a significantly high p-value of 0.92.

The lack of explanatory power for the variable $\overline{SIZE}$ might be connected with the loss of information resulting from aggregating a data set that is composed by relatively homogeneous size-type firms. Nevertheless, this result is in line with the evidence from the panel data analysis that indicate that, in Eurobond markets, good quality firms do not use protective covenants in bond indentures to convey favourable information about their future projects. Indeed, the argument from Chan and Kanatas (1986) and Chan and Thakor (1987) that better quality firms are more willing to incur in transaction costs (e.g. legal documentation, monitoring, and costs of restricting managerial actions) and use of protective covenants to separate

themselves from lower quality firms is not validated by the data. As it was mentioned previously, the high degree of information disclosure in Eurobond markets and the inherent reduction of the divergences among market participants about the valuation of firm's projects constitute a plausible motive for the lack of support provided to signalling-related theories.

Contrary to the result obtained in Chapter VI for the single-equation analysis, only the fitted value for convertibles seems to play a significant role in explaining the interdependencies among contract features that determine the use of protective covenants in the quarterly average Eurobond issues. Hence, contrary to agency cost theory (see Myers (1977) and Smith and Warner (1979)) protective covenants do not seem to constitute an alternative to short-term debt in mitigating creditor/shareholders conflicts of interest when aggregate-data is used and the simultaneous character of the explained variables is taken into account. The significance of the fitted value for convertibles at 10% level indicates, however, that the inclusion of protective covenants can play a special role in mitigating agency costs that goes beyond the theories postulated by Myers (1977) – reduction of underinvestment incentives – or by Smith and Warner (1979) – reduction of risk-shifting or claims dilution incentives. This evidence is even more noticeable considering that the results for the remaining variables in equation (7.5) i.e. $\overline{MBOOK}$, fitted $\overline{LEVEQ}$, and $\overline{BRISK}$ suggest the presence of other factors rather then the desire to reduce debt agency costs in the decision of whether or not to use protective covenants by the average Eurobond issuer.

One explanation for the alternative use of protective covenants and convertible options might be linked with the desire to reduce agent-principal conflicts of interest. Jensen and Meckling (1976) argue that whenever the managers hold only a fraction of firm's total equity their incentives to undertake activities that are costly from the shareholders point of view are considerably increased. In particular, managers of relatively large and publicly held companies, which would include the Eurobond issuers sample, are more likely to benefit from perks that maximise their own utility but that are borne by a typically large and diffuse base of shareholders. Indeed, the consumption of perks results in the loss of profitable investments, which decreases the value of shareholders wealth while providing gains only to a small fraction of the firm's claimants – managers. On the other hand, authors like Stulz (1988) and Harris and Raviv (1990) contend that the issuance of risky debt reduces manager's discretionary power over firm's investment policies because the managers are bound to lose their control rights whenever debt obligations are not serviced and creditors force bankruptcy. It is plausible to argue that the inclusion of restrictive covenants in debt contracts increases this disciplinary control of creditors and reduces managers desire to pursue policies that deplete the firm's overall value. This is particularly true in the case of Eurobond issues when it is observed that 76% of the original sample of protected issues includes a put option that is triggered by an event risk (e.g. take-over, financial restructuring, loss of operating license) leading to a credit downgrading by a rating agency. To this extent, the definition of a lower boundary for firm credit quality that if breached can lead to a loss of managerial control rights might play an important role in aligning managers interests with those of shareholders and allow for a decrease the equity agency costs.

Unequivocal evidence against underinvestment hypothesis - Myers (1977) - and risk shifting and claims dilution - Smith and Warner (1979) – is provided in Table 7.4 – Panel D. Thus, the proxies for the average issuer's growth opportunity ($\overline{MBOOK}$), the average bankruptcy risk proxy ($\overline{BRISK}$), and the average issuer's gearing proxy ($\overline{LEVEQ}$) are significant but negatively related to the average propensity of the Eurobond issuer to include protective covenants in the contract agreements.

The explanation for these results might be on the need to reduce liquidity risk and to avoid inefficient liquidation that would primarily affect existing shareholders. Sharpe (1991) stresses that the higher the value of the growth opportunities held by the firm the higher the liquidity cost resulting from the incapacity of the firm to extent credit after forced bankruptcy being triggered by bondholders. Moreover, the higher the bankruptcy risk and gearing level the less is the capacity for the firm to refund the original credit at competitive interest rates. Therefore, the evidence suggests that the average issuer choose not to include protective covenants whenever the chances of incurring in excessive liquidity costs are enhanced. That is, whenever the value of the average firm's growth opportunities is high and when the inherent operational and financial risks (measure by $\overline{BRISK}$ and $\overline{LEVEQ}$, respectively) are substantial.

Overall, these results shed light on the relevancy of the liquidity risk rationale on the choice of protective covenants and point out the importance of considering aggregate-data and endogenous character of the variables when analysing the choice

of debt features. This latter aspect is particularly important taking into account that both the panel data analysis in Chapter VI and Citron's (1995) Logit analysis produce an inconclusive result suggesting a significant correlation between protective covenants and debt maturity but failing to provide support to the underlying agency arguments that underpin this correlation.

7.6. Robustness tests

As Greene (2000, p. 278) argues, the distributions of the F, t-, and χ^2 statistics rely on the assumption of normally distributed disturbances underlying OLS and Probit models. In other words, the inference and robustness tests used in this research require that the assumption of residual normal distribution is verified. To test the normally distributed disturbances assumption for the linear model associated with equation (7.2) and for the limited dependent variable equations (7.3) to (7.5) we use the Jarque-Bera χ^2 statistic[44]. For equations (7.3) and (7.5) – call option and convertible option, respectively - the normality test fails to accept the null hypothesis of residual normality at 5% of significance level. In order to test whether the lack of validation of the normality assumption hinders the inferences made previously for these models, another set of parameters estimators were obtained from restricted sample sets where the null hypothesis of residual normality is respected. More specifically, it is shown that by excluding the last two and the last five observations

[44] Jarque and Bera (1980) devise a statistic where the null hypothesis of zero value for the skewness and excess kurtosis for the residual distribution is tested against the alternative hypothesis that these measures are greater than zero.

from the regression estimation of equations (7.3) and (7.4) respectively[45], the null hypothesis of normally distributed residuals is no longer rejected at a level of significance of 5%. The estimation results for the restricted sample set are reported in Table 7.5. An analysis of this table reveals that the restricted sample estimation results are identical to the ones obtained using the full data set. Thus, for the call option model, both estimation sets show that only the variables fitted $\overline{MAT}$ and $\overline{INT}$ are significantly related to the dependent variable $CALL$, although the level of significance for coefficient of the fitted $\overline{MAT}$ proxy changes from 10% to 5% when the restricted sample is considered. Moreover, all relevant explanatory variables in the full sample model for the binary variable convertible option remain significant when the restricted data set is used. Once more, only the level of significance of the coefficients for the variables $\overline{EVAR}$ and fitted $\overline{LEVEQ}$ changes slightly. To this extent, the null hypothesis of zero slope coefficient for the variable $\overline{EVAR}$ can be rejected at 5% and 1% levels for the restricted and full sample estimation, respectively. On the other hand, the slope coefficient of fitted $\overline{LEVEQ}$ is significant at 5% and 10% level, respectively, for the restricted sample and the full sample estimation. Overall, the comparison between the estimation results from Table 7.4 and Table 7.5 for the call option and convertible option models reveal that, the inference based on the standard statistical tests do not change significantly by restricting the sample set in order to obtain normally distributed disturbances.

[45] The observed skewness in the distribution of the dependent variables callable and convertible issues seems to explained the lack of normally distributed residuals for estimation of the equations (7.3) and (7.4) using the full sample of 56 quarter-period observations.

Serial correlation and heteroscedasticity tests were also applied to the sample disturbances for the linear model associated with equation (7.2). The test for serial correlation reported in Table 7.4 corresponds to the Durbin-Watson test for first-order sample residual correlation. The Durbin-Watson statistic of 2.03 rejects the hypothesis of residual autocorrelation at 5% level of significance validating therefore the assumption of independence of the disturbance errors that underlies the least-squares estimation methods. On the other hand, the Autoregressive Conditional Heteroscedasticity (ARCH) test proposed by Engle (1982) fails to reject the null hypothesis of conditional homoscedasticity for the first-order lag residuals.

For the dichotomous models described by equation (7.3) to (7.5), only conditional homoscedasticity tests are available. Indeed, the Durbin-Watson test presupposes linear association between the lagged values of the residual terms, which does not apply to non-linear estimation methods. Table 7.4 shows that the hypotheses of conditional homoscedasticity for all the dichotomous models cannot be reject at 5% level of significance.

7.7. Summary and discussion of findings

The empirical analysis developed in this chapter, tests the theoretical determinants for the optimal choice of Eurobond terms by UK-based firms taking into account the aggregate market factors and simultaneous character of the elements that encompass this decision process. The distinctions between the analysis carried out in this chapter and the analysis of Chapter VI are twofold. Firstly, the potential misspecification bias associated with the adoption of single equation estimation methods to models

where the dependent variables are jointly determined is overcome by using a two-stage simultaneous-equations approach. Secondly, the relative homogeneity of characteristics and credit quality status between the Eurobond issuers and degree of symmetry of information among market investors suggests the appropriateness of using aggregated data. More specifically, taking into account the information requirements and particular characteristics of Eurobond markets the impact of aggregated market forces more than the firm-specific characteristics can explain the optimal choice of Eurobond contract terms. To this extent, we use aggregate data as an alternative framework to examine the behaviour of typically large and medium/high quality issuers in a market that demands high information.

The results from the simultaneous-equations estimation of the model for the quarterly average maturity and propensity to include call provisions in the average Eurobond issue provide support to agency arguments namely underinvestment costs - Myers (1977) and asymmetry information and asset substitution costs - Barnea et al. (1980). Indeed, both the continuous dependent variable model for maturity and the binary model for call provisions predict an alternative use of short-term and callable Eurobonds by the average issuer. This is in line with Myers (1977) and Barnea et al. (1980) arguments on the substitute role of maturity and call provisions in resolving the inefficiencies connected with creditors/shareholders conflicts of interests. Moreover, consistent with Myers (1977) arguments the structural-maturity model results show that more levered firms are more likely to issue, on average, short-term Eurobonds. The evidence from the call provision simultaneous-equations model provide further support to Myers (1977) and Barnea et al. (1980) by suggesting a

significant inverse relationship between the proxy for the average firm's growth opportunities and the propensity to issue callable securities. There are some caveats on the interpretation of this result. As it was discussed previously, the quarterly average of the variable intangibles/total assets across firms might depict more accurately the level of collateral rather then the level of growth opportunities held by the average firm. Therefore, the inverse relation between the average of intangibles/total assets and the average propensity to issue callable Eurobonds might be driven by purposes of controlling excess liquidity risk rather than debt agency costs.

The asymmetric information and signalling theories are strongly contradicted by the results from the structural models for the average Eurobond maturity and the average propensity to issue callable Eurobonds. On the other hand, both call provisions and maturity models provide no support to the theories that predict an impact of debt tax issues on the decision about optimal Eurobond design. To this extent, this evidence is consistent with debt tax irrelevance theorems from Lewis (1990) and Miller (1977).

The results from the binary convertible and protective-covenants models are consistent with agency costs arguments (e.g. Myers (1977), Jensen and Meckling (1980), Smith and Warner (1979), amongst others). However, the evidence suggests that the alternative use between convertible and protective covenants, results from agency costs other than those induced by creditors and shareholders' conflicting interests. This unexpected result might be explained by the particular characteristics and relationships established between Eurobond issuer's claimants. More

specifically, the fact that a relatively high proportion of Eurobond creditors are also shareholders of the issuer company (e.g. insurance companies and mutual funds) together with the premise that the managerial perquisite incentives tend to be particularly important in firms with a typically large and diffuse base of equity-holders, can explain the higher impact of equity rather than debt agency costs on the choice of Eurobond covenants.

Similar to the results obtained for the choice of the Eurobond maturity and call structure, the estimation of the structural-equations for convertible and protective provisions provide no support to the signalling and asymmetric information theories (see Chan and Kanatas (1986), Chan and Thakor (1987), Constantinides and Grundy (1989), and Nyborg (1995), amongst others). Thus, contrary to previous studies (see e.g. Barclay and Smith (1995), Guedes and Opler (1996), and Mitchell (1991)) the evidence from this research unequivocally rejects the arguments stemmed from the aforementioned theories. This result, per se, highlights the importance of using a unique type of debt contract with a specific market informational background - as in the case of Eurobond issues - to more adequately test the information asymmetry-related theories.

Some support is found for the risk uncertainty hypothesis (Brennan and Schwartz (1988) and Brennan and Kraus (1987) that postulate the use of convertibles to overcome mispricing costs driven by creditors/managers divergent opinion about firm's inherent risk. Finally, evidence from protective covenants model provide support to liquidity risk arguments suggesting that firms facing high default risk tend

issue Eurobonds with no protective mechanisms in order to avoid excessive financial distress or inefficient liquidation.

Table 7.1: List of Variables, Coefficients, and Full rank Matrices for Assessing the Identification Conditions of the Simultaneous-Equations Model

Panel A: Variables and coefficients of the structural-equations models for maturity, call option, convertible option, protective covenants and leverage. The definition of the variables is provided at the end of this table.

		$\overline{MAT}$	$\overline{CALL}$	$\overline{COV}$	$\overline{PROTC}$	$\overline{LEVEQ}$
ENDOGENOUS VARIABLES	Maturity ($\overline{MAT}$)	-1	γ_{cm}	γ_{com}	γ_{pm}	0
	Call option ($\overline{CALL}$)	γ_{mc}	-1	0	0	0
	Convertible option ($\overline{COV}$)	0	0	-1	γ_{pco}	0
	Protective covenants ($\overline{PROTC}$)	0	0	γ_{cop}	-1	0
	Leverage ($\overline{LEVEQ}$)	γ_{ml}	γ_{cl}	γ_{col}	γ_{pl}	-1
EXOGENOUS VARIABLES	One	α_0	β_0	χ_0	δ_0	π_0
	Size ($\overline{SIZE}$)	α_9	β_6	χ_4	δ_2	π_1
	Market book value/Intangibles ($\overline{MBOOK/INT}$)	α_1	β_3	χ_1	δ_1	π_2
	Assets maturity ($\overline{ASSMAT}$)	α_2	0	0	0	π_3
	Interest volatility ($\overline{INTVOL}$)	α_6	β_2	0	0	π_4
	Term premium ($\overline{TERMP}$)	α_5	0	0	0	π_5
	Earning variance ($\overline{EVAR}$)	α_4	0	χ_3	0	π_6
	Tax paid ($\overline{TAXA}$)	α_3	β_4	0	0	π_7
	Bankruptcy risk ($\overline{BRISK}$)	0	0	0	δ_3	π_8
	Stock return_1 year before ($\overline{RET1YB}$)	α_7	0	0	0	π_9
	Unexpected earnings ($\overline{UEXP}$)	α_8	β_5	χ_2	0	π_{10}
	Std.dev. return_3 m before ($\overline{SDR3M}$)	0	0	χ_5	0	π_{11}
	Deviation target ($\overline{DTARG}$)	0	0	χ_6	0	π_{12}
	Interest level ($\overline{INTLEV}$)	0	β_1	0	0	π_{13}

Panel B: Computed matrices for assessing the validity of the rank condition for identification

MATURITY

RANK = M -1 = 4

$$\begin{vmatrix} \beta_1 & 0 & 0 & 0 \\ 0 & \chi_6 & -1 & 0 \\ 0 & 0 & \gamma_{pco} & \delta_3 \\ \pi_{13} & \pi_{12} & 0 & \pi_8 \end{vmatrix}$$

CALLABILITY

RANK = M-1 =4

$$\begin{vmatrix} \alpha_2 & 0 & 0 & \alpha_4 \\ 0 & \gamma_{cop} & -1 & \chi_3 \\ 0 & -1 & \gamma_{pco} & 0 \\ \pi_3 & 0 & 0 & \pi_6 \end{vmatrix}$$

CONVERTIBILITY

RANK = M-1 =4

$$\begin{vmatrix} \gamma_{mc} & \alpha_6 & 0 & \alpha_2 \\ -1 & \beta_2 & 0 & 0 \\ 0 & 0 & \delta_3 & 0 \\ 0 & \pi_4 & \pi_8 & \pi_3 \end{vmatrix}$$

PROTECTIVE COVENANTS

RANK = M-1 =4

$$\begin{vmatrix} \alpha_7 & \alpha_3 & 0 & \alpha_4 \\ 0 & \beta_2 & 0 & 0 \\ 0 & 0 & \chi_5 & 0 \\ \pi_{10} & \pi_4 & \pi_{11} & \pi_9 \end{vmatrix}$$

LEVERAGE

RANK = M-1 =4

$$\begin{vmatrix} -1 & \gamma_{mc} & 0 & 0 \\ \gamma_{cm} & -1 & 0 & 0 \\ \gamma_{com} & 0 & \gamma_{cop} & -1 \\ \gamma_{pm} & 0 & -1 & \gamma_{pco} \end{vmatrix}$$

Definitions:

All the following variables correspond to quarterly average values across issues, issuers or market conditions proxies. $\overline{MAT}$ - average years-to-maturity; $\overline{CALL}$ - dummy variable for the average propensity of Eurobonds to include call provisions; $\overline{COV}$ - dummy variable for the average propensity of Eurobonds to include convertible provisions; $\overline{PROTC}$ - dummy variable for the average propensity of Eurobonds to include protective covenants; $\overline{LEVEQ}$ - average ratio of total debt to book value of equity; $\overline{SIZE}$ - average of natural log of 100 times firm market value (total assets plus market value of equity less book value of equity) at constant prices of 1982; $\overline{MBOOK}$ - average market-to-book value, defined as the ratio of market value to total assets; $\overline{INT}$ - average ratio of intangible assets to total assets (in percentage); $\overline{ASSMAT}$ - average asset maturity, defined as the average of natural log of the ratio of net fixed assets to total assets times the ratio of net fixed assets to depreciation; $\overline{INTVOL}$ - average standard deviation of 10-year UK government bond yields over the year prior the Eurobond announcement data (in percentage); $\overline{TERMP}$ - average of one year prior announcement average differential between 10-years UK government bond and 3-months UK Treasury bill yields; $\overline{EVAR}$ - average of the standard deviation of the earnings before interest, tax, and depreciation (EBITD) over 3 financial years-ends prior to the issue announcement scaled by average value of total assets for this period; $\overline{TAXA}$ - average ratio of tax paid to total assets (in percentage); $\overline{BRISK}$ - average of the difference between fixed charges and earnings before interest and taxes (EBIT) divided by the standard deviation of the 3 financial years-ends EBIT prior to the issue announcement. Firm fixed charges are defined as the sum of total employment costs, directors remuneration, auditors remuneration and depreciation; $\overline{RET1YB}$ - average stock return over the year prior the issue announcement date; $\overline{UEXP}$ - average unexpected return defined as the average of the difference between the earnings per share at the financial year-end following the announcement date and the earning per share at financial year-end of the issue announcement scaled by the stock price at the financial year-end of the issue announcement (in percentage); $\overline{SDR3M}$ - average of firm's total risk, defined as the average of the standard deviation of stock returns over the 3 months prior to announcement date (in percentage); $\overline{DTARG}$ - average deviation from the target leverage level, defined as the average across firms of the difference between the ratio of total debt to equity at the financial year-end prior to announcement date and the average of this ratio over the 3 financial years-ends prior to the announcement date; $\overline{INTLEV}$ - average interest rate level of the 3 months UK-Treasury bond at the announcement date (in percentage).

Table 7.2: Pearson Correlation Matrix

This table provides a measure of linear association for each pair of dependent and independent variables included in the structural models for maturity, call option, convertible option, and protective covenants. The correlation coefficients are computed for a sample of 56 quarterly average observations. *,** indicate significance at the 10% and 5% levels (two-tailed test). The definitions for all variables except $\overline{ZSCTadj}$ and $\overline{ZSCTadj}^2$, are provided at the end of Table 6.1. $\overline{ZSCTadj}$ is the quarterly average adjusted value for Altman's Z-score used in Dennis et al. (2000) and defined as 3.3 * EBIT/Sales + 1.0 * Sales/TA + 1.4 * RE/TA + 1.2 * WC/TA where EBIT is earnings before interest, and taxes, RE is retained earnings, and WC is working capital. $\overline{ZSCTadj}$ is censored from below at zero. $\overline{ZSCTadj}^2$ is the squared value for the quarterly average adjusted value of Altman's Z-score.

	Protective Covenants ($\overline{PROTC}$)	Convertible option ($\overline{COV}$)	Call option ($\overline{CALL}$)	Maturity ($\overline{MAT}$)	Size ($\overline{SIZE}$)	Market-to-book value ($\overline{MBOOK}$)	Intangibles (%) ($\overline{INT}$)	Asset Maturity ($\overline{ASSMAT}$)
Convertible option ($\overline{cov}$)	-0.18							
Call option ($\overline{CALL}$)	0.14	0.29*						
Maturity ($\overline{MAT}$)	0.13	-0.02	0.37*					
Size ($\overline{SIZE}$)	-0.09	-0.33*	-0.24	-0.04				
Market-to-book value ($\overline{MBOOK}$)	-0.16	-0.13	-0.02	0.01	0.35*			
Intangibles (%) ($\overline{INT}$)	-0.30*	-0.18	0.23	-0.21	-0.01	-0.05		
Asset Maturity ($\overline{ASSMAT}$)	0.37**	0.15	0.08	0.13	0.20	0.02	-0.42**	
Interest Volatility (%) ($\overline{INTVOL}$)	-0.29*	0.45*	0.05	-0.12	-0.09	0.00	-0.08	-0.05
Term premium (%) ($\overline{TERMP}$)	-0.14	-0.31*	-0.01	-0.05	-0.04	0.05	0.25	-0.29*
Earning variance (%) ($\overline{EVAR}$)	0.11	0.14	0.19	0.16	0.02	0.25	-0.05	-0.08
Tax paid (%) ($\overline{TAXA}$)	-0.06	-0.05	-0.08	-0.12	0.06	0.23	0.08	0.12
Leverage ($\overline{LEVEQ}$)	-0.32*	-0.12	-0.18	0.03	0.11	-0.02	0.20	-0.35**
Bankruptcy risk ($\overline{BRISK}$)	-0.28*	0.01	-0.06	0.18	0.12	-0.07	-0.08	-0.03
Z-score (adj.) ($\overline{ZSCOREadj}$)	0.03	0.20	-0.01	0.10	-0.19	-0.04	-0.36**	-0.01
Z-score squared (adj.) ($\overline{ZSCORE\ adj^2}$)	0.06	0.18	0.06	0.14	-0.21	0.09	-0.38**	0.01
Stock return_1 y before ($\overline{RET1YB}$)	0.02	0.18	0.27*	0.07	-0.20	0.14	-0.06	0.14
Unexpected earnings (%) ($\overline{UEXP}$)	-0.23	0.20	0.03	0.06	-0.24	0.01	-0.10	0.04
Std.dev. return_3 m before ($\overline{SDR3M}$)	-0.14	-0.15	-0.18	-0.17	0.14	0.17	-0.01	-0.32*
Deviation target ($\overline{DTARG}$)	-0.12	0.05	0.14	0.00	-0.12	0.03	-0.01	0.04
Interest level (%)($\overline{INTLEV}$)	0.13	0.44**	-0.02	0.03	-0.34**	-0.53**	-0.29*	0.08

	Interest volatility (%) ($\overline{INTVOL}$)	Term premium (%) ($\overline{TERMP}$)	Earning variance (%) ($\overline{EVAR}$)	Tax paid (%) ($\overline{TAXA}$)	Leverage ($\overline{LEVEQ}$)	Bankruptcy risk ($\overline{BRISK}$)	Z-score (adj.) ($\overline{ZSCOREadj}$)	Z-score squared (adj.) ($\overline{ZSCOREadj^2}$)
Term premium (%) ($\overline{TERMP}$)	-0.17							
Earning variance (%) ($\overline{EVAR}$)	0.00	-0.36**						
Tax paid (%) ($\overline{TAXA}$)	-0.20	0.08	-0.02					
Leverage ($\overline{LEVEQ}$)	-0.02	0.18	0.00	0.07				
Bankruptcy risk ($\overline{BRISK}$)	0.30*	0.30*	-0.38**	-0.19	-0.03			
Z-score (adj.) ($\overline{ZSCOREadj}$)	0.15	-0.17	0.25	0.36**	0.02	-0.14		
Z-score squared (adj.) ($\overline{ZSCORE\ adj^2}$)	0.15	-0.21	0.30*	0.34**	-0.08	-0.18	0.95**	
Stock return_1 y before ($\overline{RET1YB}$)	0.05	-0.14	0.02	0.02	-0.43**	0.01	-0.12	-0.01
Unexpected earnings (%) ($\overline{UEXP}$)	-0.14	0.10	-0.11	0.22	-0.10	0.07	0.17	0.17
Std.dev. return_3 m before ($\overline{SDR3M}$)	0.18	-0.15	0.20	-0.32*	0.15	-0.01	-0.20	-0.15
Deviation target ($\overline{DTARG}$)	-0.16	0.20	-0.11	0.34*	0.37**	-0.09	0.06	0.05
Interest level (%) ($\overline{INTLEV}$)	0.18	-0.39**	0.20	0.03	-0.02	-0.12	0.55**	0.45**

	Stock return_1 year before ($\overline{RET1YB}$)	Unexpected earnings ($\overline{UEXP}$)	Std.dev. return_3 m before ($\overline{SDR3M}$)	Deviation target ($\overline{DTARG}$)
Unexpected earnings (%) ($\overline{UEXP}$)	0.23			
Std.dev. return_3 m before ($\overline{SDR3M}$)	-0.15	-0.13		
Deviation target ($\overline{DTARG}$)	-0.18	0.09	-0.26	
Interest level (%)($\overline{INTLEV}$)	-0.15	0.17	-0.24	-0.05

Table 7.3: Descriptive Statistics

Panel A: Descriptive statistics for the dependent and independent variables included in the simultaneous-equations models for maturity, call option, convertible option, and protective covenants. The variables are defined at the end of table 6.1.

	N	Mean	Median	Std. Deviation	Range	Min	Max	Percentiles		
								25%	50%	75%
Protective covenants ($\overline{PROTC}$)	56	0.30	0	0.46	1	0	1	0	0	1
Convertible option ($\overline{COV}$)	56	0.23	0	0.43	1	0	1	0	0	0
Call option ($\overline{CALL}$)	56	0.43	0	0.50	1	0	1	0	0	1
Maturity ($\overline{MAT}$)	56	11.35	10.89	4.42	23.28	3.10	26.39	9.06	10.89	13.57
Size ($\overline{SIZE}$)	56	14.63	14.71	0.51	2.26	13.28	15.54	14.37	14.71	15.00
Market-to-book value ($\overline{MBOOK}$)	56	1.53	1.42	0.40	1.89	0.93	2.83	1.24	1.42	1.73
Intangibles (%) ($\overline{INT}$)	56	4.87	2.32	6.28	30.15	0.00	30.15	0.00	2.32	7.09
Assets maturity ($\overline{ASSMAT}$)	56	1.94	1.91	0.67	3.71	-0.32	3.39	1.62	1.91	2.37
Interest volatility ($\overline{INTVOL}$)	56	0.46	0.41	0.19	0.66	0.19	0.85	0.29	0.41	0.65
Term premium ($\overline{TERMP}$)	56	-0.06	-0.23	1.85	6.56	-3.71	2.85	-1.13	-0.23	1.77
Earning variance (%) ($\overline{EVAR}$)	56	2.61	2.55	0.98	3.51	1.00	4.51	1.83	2.55	3.40
Tax paid (%) ($\overline{TAXA}$)	56	2.72	2.53	1.05	5.10	0.57	5.66	1.99	2.53	3.46
Leverage ($\overline{LEVEQ}$)	56	1.39	1.29	0.65	4.25	-0.72	3.53	1.01	1.29	1.67
Bankruptcy risk ($\overline{BRISK}$)	56	8.83	6.48	11.34	75.15	-3.62	71.53	4.37	6.48	8.67
Stock return_1 y before ($\overline{RET1YB}$)	56	0.17	0.17	0.16	1.11	-0.37	0.74	0.08	0.17	0.24
Unexpected earnings (%) ($\overline{UEXP}$)	56	0.39	0.55	1.89	12.71	-6.66	6.05	-0.26	0.55	1.49
Std.dev. return_3 m before (%) ($\overline{SDR3M}$)	56	1.67	1.51	0.55	3.23	1.02	4.25	1.26	1.51	1.95
Deviation target ($\overline{DTARG}$)	56	0.02	0.00	0.49	3.18	-0.96	2.22	-0.12	0.00	0.10
Interest level (%) ($\overline{INTLEV}$)	56	8.45	8.78	1.72	6.93	4.44	11.38	7.47	8.78	9.66

Panel B: Frequencies of the dependent binary variables in the protective covenants, convertible option, and call option models.

	Protective covenants		Convertible option		Call option	
	Frequency		Frequency		Frequency	
0	39	70%	43	77%	32	57%
1	17	30%	13	23%	24	43%
Total	56	100%	56	100%	56	100%

Table 7.4: Two-Stage Estimates of Structural Models

Independent Variables	(A)[d] Maturity	(B)[e] Call option	(C)[e] Convertible option	(D)[e] Protective covenants
Intercept	-29.28	5.58	15.87	2.87
	(-1.26)	(0.87)	(2.08)**	(1.23)
Maturity (a)		0.19	-0.39	0.18
		(1.82)*	(-2.02)**	(1.44)
Call option (a)	3.89			
	(3.04)***			
Protective covenants (a)			-0.15	
			(-2.25)**	
Convertible option (a)				- 0.28
				(-1.66)*
Market/Book	2.95		-1.54	-1.49
Intangibles/Assets (%)[c]		0.09		
	(1.50)	(2.36)**	(-1.58)	(-2.05)**
Asset maturity	-2.29			
	(-1.57)			
Interest level (%)		-0.20		
		(-0.16)		
Interest volatility (%)	-5.59	1.06		
	(-1.78)*	(1.00)		
Term premium (%)				
Tax paid/Assets (%)				
Earnings variance (%)[b]	-1.54		1.08	
	(-1.63)		(2.64)***	
Unexpected earnings (%)				
Stock return 1-year-before	-14.41			
	(-2.14)**			
Size	4.32	-0.57	-0.56	
	(2.21)**	(-1.42)	(-1.03)	
Bankruptcy risk				-0.19
				(-2.72)***
Std. Returns 3-months -before			-1.05	
			(-1.42)	
Deviation from leverage target			1.15	
			(1.35)	
Leverage [a]	-5.60	-0.34	-2.55	-1.83
	(-2.04)**	(-0.67)	(-1.95)*	(-2.14)**
Number of observations	56	56	56	56
Adjusted R^2	0.096			
Model chi-square		$\chi^2(6)=11.9$*	$\chi^2(8)=18.06$**	$\chi^2(5)=26.10$***
Zero restrictions [b]	F(3,43)=0.06	$\chi^2(2)=0.03$	$\chi^2(1)=0.00$	$\chi^2(1)=0.01$
	[0.98]	[0.99]	[0.97]	[0.92]

Diagnostic tests				
Heteroscedasticity				
ARCH (1)	0.95	0.20	3.89	0.53
Normality	[0.33]	[0.65]	[0.06]	[0.47]
$\chi^2(2)$	1.18	6.38	6.12	1.96
Autocorrelation	[0.56]	[0.04]	[0.05]	[0.38]
Durbin-Watson	2.03			

This table shows the two-stage regression estimators of the average maturity and three dummy variables that proxy for the average propensity to include a call option, a convertible option or protective covenants (respectively) on a set of explanatory variables for a time-series sample from 1986 to 1999. More specifically, average maturity is regressed on fitted value of average propensity to include a call option, average market-to-book value, average asset maturity, average interest volatility (%), average interest term premium, average earnings variance (%), average tax paid to total assets (%), average unexpected earnings (%), average stock return over one year prior to issue announcement, average firm size and fitted value of average leverage. Average propensity to include a call option is regressed on fitted value of average maturity, average intangibles to total assets (%), average interest level (%), average interest volatility (%), average tax paid to total assets (%), average unexpected earnings (%), average firm size and fitted value of average leverage. Average propensity to include a convertible option is regressed on fitted value of average maturity, fitted value of average propensity to include protective covenants, average market-to-book value, average earnings variance (%), average unexpected earnings (%), average firm size, average standard deviation of returns over 3 months prior to issue announcement, average deviation of debt/equity ratio and fitted value of average leverage. Average propensity to include protective covenants is regressed on fitted value of average maturity, fitted value of average propensity to include a convertible option, average market-to-book value, average bankruptcy risk, average firm size, and fitted value of average leverage. *t*-statistics in parentheses. p-values in square brackets. *,**,*** indicate significance at the 10%, 5%, and 1% levels.

(a) Treated endogenously – using predicted values from reduced form estimates
(b) Tests of zero restrictions for omitted variables: (1) unexpected earnings (%), tax paid/assets (%) and interest term premium in the maturity equation; (2) unexpected earnings (%) and tax paid/assets (%) in the call option regression; (3) unexpected earnings (%) in the convertible option equation; and (4) size in protective covenants equation
(c) Intangibles/assets (%) replaces market/book as a proxy for growth opportunities in the call option regression
(d) Estimated using OLS estimator
(e) Estimated using Probit estimator

Table 7.5: Two-Stage Estimates for Call option and Convertible option Models Consistent with the Normality Condition

Independent Variables	(A) Call option	(B) Convertible option
Intercept	3.96	15.42
	(0.61)	(1.97)*
Maturity (a)	0.23	-0.41
	(2.02)**	(-2.09)**
Call option (a)		
Protective covenants (a)		-0.15
		(-2.23)**
Convertible option (a)		
Market/Book		-1.25
Intangibles/Assets (%))[c]	0.11	
	(2.55)**	(-1.24)
Interest level (%)	-0.08	
	(-0.62)	
Interest volatility (%)	1.34	
	(1.20)	
Earnings variance (%)		1.05
		(2.51)**
Size	-0.46	-0.51
	(-1.13)	(-0.92)
Std. Returns 3-months -before		-0.93
		(-1.23)
Deviation from leverage target		1.19
		(1.36)
Leverage [a]	-0.31	-2.87
	(-0.61)	(-2.07)**
Number of observations	54	50
Model chi-square	$\chi^2(6)=13.25$**	$\chi^2(8)=15.84$**
Zero restrictions [b]	$\chi^2(2)=0.03$	$\chi^2(1)=0.03$
	[0.99]	[0.88]

Diagnostic tests		
	(A)	(B)
Heteroscedasticity		
ARCH (1)	0.31	1.93
	[0.58]	[0.17]
Normality		
$\chi^2(2)$	4.41	5.25
	[0.11]	[0.07]

This table shows the two-stage regression estimators of dummy variables that proxy for the average propensity to include a call option and a convertible option on a restricted sample for which the residual term normality condition is validated. As in Table 6.4 the average propensity to include a call provision is regressed on fitted value of average maturity, average intangibles to total assets (%), average interest level (%), average interest volatility (%), average tax paid to total assets (%), average unexpected earnings (%), average firm size and fitted value of average leverage. Moreover, the average propensity to include a convertible provision is regressed on fitted value of average maturity, fitted value of average propensity to include protective covenants, average market-to-book value, average earnings variance (%), average unexpected earnings (%), average firm size, average standard deviation of returns over 3 months prior to issue announcement, average deviation of debt/equity ratio and fitted value of average leverage. Both regressions are estimated using the Probit estimation model. *t*-statistics in parentheses. p-values in square brackets. *,**,*** indicate significance at the 10%, 5%, and 1% levels.

(a) Treated endogenously – using predicted values from reduced form estimates
(b) Tests of zero restrictions for omitted variables: (1) unexpected earnings (%) and tax paid/assets (%) in the call option regression; (2) unexpected earnings (%) in the convertible option regression.
(c) Intangibles/assets (%) replaces market/book as a proxy for growth opportunities in the call option regression

CHAPTER VIII: SUMMARY, CONCLUSIONS, LIMITATIONS, AND EXTENSIONS

This thesis started with an analysis of the Eurobond market and a detail discussion was provided about its historical background, main characteristics, and advantages of this type of financing instrument for the study of debt contract design. In particular, we emphasised the advantages for the analysis of debt terms choice from using a non-homogeneous, publicly tradable, and unique source of financing that enables companies to raise vast amount of funds and that is likely to have an decisive impact on firm's financial decision process. In addition, it was pointed out that the incremental analysis of new debt issues benefits from taking into account the transient character of some explanatory variables and from overcoming the constraints imposed by the accounting categorisation that affect the balance sheet-based studies.

Subsequently, a review of the theoretical and empirical literature on debt contract design was provided. The focus was set on those studies that assess the determinants of the optimal choice of debt maturity and indenture provisions namely call options, convertible options, and protective covenants. It was stressed that although theoretical predictions postulate the alternative use of these debt features as control devises to reduce debt contracting costs, most of the empirical literature focused on the analysis of a single type of contract term (e.g. Barclay and Smith (1995), Guedes

and Opler (1996), Kish and Livingston (1992), Abhyankar and Dunning (1999)). Generally, the empirical research examined the validity of agency, asymmetric information, and tax-related predictions on the choice of a contract term ignoring other relevant financing decisions namely the inclusion of other contract features and the level of firm leverage. To this extent, it was noted that the individual analysis of maturity and call option choices generally supports the agency arguments but provides inconsistent results for the analysis of convertible and protective provisions. In particular, the study by Citron (1995) provides evidence that supports the alternative use of debt features to control agency costs but fails to validate the agency predictions about the impact of firm's characteristics on the choice of protective covenants. Additionally, the results from the empirical studies provide weak support to asymmetric information hypothesis and generally contradict the arguments from tax-related theory.

In order to provide a comprehensive analysis of the optimal choice of Eurobond terms, a sample set of Eurobond issues made by UK companies during the period of 1986-1999 was introduced and a detailed descriptive analysis of this sample was provided. This data set of Eurobond issues supports the subsequent empirical research where, on the one hand, the impact of cross-sectional and time-series effects is taken into account, and on the other hand, the endogenous character of debt terms and firm leverage decisions is appropriately accommodated into the regression analysis.

The panel data analysis of the firm-specific determinants for debt contract design provides strong support to Hypothesis one of this thesis that predicts an alternative use between short-term and callable debt, convertible and protected debt, and protected and short-term debt. According to agency theory (see e.g. Myers (1977), Barnea et al. (1980), Jensen and Meckling (1976)) short-term, callable, and protected debt, on the one hand, and convertible and protected debt, on the other hand, can be viewed as alternative mechanisms to align the interests of firm's financial claimants and ultimately to reduce contracting costs. Hypothesis two that predicts an impact of firm's characteristics on the choice of contract terms due to agency costs conditionings is, however, only partially validated by the evidence. To this extent, panel data estimation results suggest that borrowers match the maturity of Eurobond issues with the maturity of assets-in-place limiting the potential conflicts of interest between creditors and shareholders. Nevertheless, no further support is found for the agency predictions about the impact of firm's characteristics on the structure of debt contracts. Consistent with Hypothesis three only weak support is found for the signalling arguments. More specifically, in line with the view that the degree of asymmetric information in the Eurobond market is small, only the choice of convertibles seems to be induced, to some extent, by signalling purposes (one of the proxies for the quality of firm's prospects – firm's unexpected earnings – is positively and significantly related with the use of convertibles). Strong support is also found for Hypothesis four regarding the use of callable Eurobonds. To this extent, smaller and typically less credible firms seem to benefit from the managerial flexibility provided by the call option exercise, which allow them to protect against inefficient liquidation processes. On the other hand, contradicting the tax-advantage

arguments in Hypothesis five the evidence rejects the impact of tax-shield purposes on the choice of maturity and call options. Thus, market conditions like term premium structure or interest volatility and firm characteristics like marginal corporate tax rate or earnings volatility seem to be irrelevant for the choice of Eurobonds maturity. In addition, the evidence suggests that firms with a higher degree of corporate tax liability are more likely to issue non-callable rather than callable Eurobonds, which is out of line with the interest tax shield predictions. Finally, Hypotheses six and seven that predict the use of convertible and call options for hedging against the volatility of firm's returns and the interest rate risk (respectively) are partially validated by the evidence. Hence, the firm's returns uncertainty hypothesis is supported by the negative and significant coefficient of firm size but the lack of significance of the other proxies for risk uncertainty (i.e. market-to-book value and earnings variance) mitigates the explanatory power of the underlying theory regarding the choice of convertible Eurobonds. On the other hand, although no significance is found for the coefficient of the proxy for interest rate level, the proxy for interest rate volatility is significant and positively related with the issuance of callable bonds as predicted by the theory.

In order to test whether the unexpected results obtained, in particular, for the agency predictions were due to the ignorance of the endogenous character of concurrent financial decisions, a simultaneous-equations analysis was implemented where the interdependencies among variables determined within the model are taken into account. Strong support is provided to the use of short-term and callable debt and the inclusion of convertible and protective provisions as alternative control devises for

mitigating agency problems. Nevertheless, the alternative role played by protected and short-term debt is no longer validated by the simultaneous-equations analysis. In addition, while the results validate the agency predictions that high-levered firms issue more short-term debt and that high grow firms tend to issue callable bonds, no support is found for the debt agency cost hypothesis about the impact of firms' characteristics on the choice of convertible and protected Eurobonds. On the one hand, this finding highlights the importance of considering the endogenous character of jointly determined variables to appropriately test the agency predictions on the maturity and call option decision processes. On the other hand, it suggests that the decision about the use of alternative mechanisms such as convertible and protective provisions is determined by motives that go beyond the mitigation of debt financing inefficiencies. We provide some evidence that suggests that the use of these features might be related to the reduction of agency costs induced by the agent/principal conflicts of interest. Again, some support is found for the argument that relates the use of convertibles with the desire of hedging against firm's business uncertainty. Moreover, in line with liquidity risk arguments the evidence strongly suggests that managers do not include protective covenants in Eurobond issues whenever the risk of inefficient liquidation is significant. Nevertheless, contrary to the results from the panel data analysis, the evidence from the simultaneous-equation model regarding the use of call options in Eurobonds indentures no longer validates the liquidity risk theory. Finally, no support is found for the impact of signalling and tax-related factors on the simultaneous choice of contract terms.

Important implications can be drawn from the results obtained in this research. First, it is clear that managers consider the choice of debt terms as a way of reducing contracting costs that are not completely resolved by decisions related to capital structure and lender's identity choices. The decision about the optimal composition of terms is particularly relevant for Eurobond offerings, due to not only the significant amount of funds involved but also the advantages provided by the segmentation of this market. In fact, these factors enhance the pressure for assuring that the conditions for a successful placement are fulfilled. Second, the results suggest that institutional intermediaries that are specialised in organising, underwriting and selling Eurobonds with certain type of terms will attract a clientele of firms with a common set of characteristics. The relevant characteristics that condition the type of the clienteles formed are the level of agency costs faced by the firms, degree of uncertainty surrounding issuers' business, and level of liquidity risk. Thus, investment banks that tend to underwrite straight or callable Eurobond offerings are likely to attract firms facing significant debt agency costs while underwriters of convertible or protected Eurobonds are expected to attract firms with cyclical business or facing excessive liquidity costs, respectively. The potential for the existence of clienteles derives not only from the observed advantages from placing well designed Eurobond instruments but also from the possibility of assuring an efficient allocation of resources among the portfolio financial intermediaries. An interesting extension to this study would be to examine whether there is indeed a convergence of issuers with similar characteristics in turn of underwriters that typically place certain types of tailored Eurobonds.

Finally, the evidence that short-term maturity and embedded call options are used to resolve debt agency costs which seem to be unrelated with the inclusion of convertible or protective covenants in Eurobond indentures, calls for a careful examination of the type of conflicts that prevail between firm's claimants at the time when the offering terms are settled.

Some caveats can be, however, pointed out to this research. First, one of the characteristics of the sample set used is that it is made up of typically large size and median/high credit quality firms. The inferences made in the empirical analysis are therefore conditioned by the particularities guiding the behaviour of these firms and any extrapolation of the results to debt structure decisions for smaller firms suffers from clear hindrances. Furthermore, the particular characteristics of the Eurobond market (e.g. high level of information disclosure and close scrutiny by financial analysts and investors in general) restrict the extrapolation of the results to the choice of terms for other forms of public debt financing.

Second, some variables that are used as proxies for firm or market characteristics might depict the impact of other type of effects impairing the interpretation of the results. For instance, the use of the ratio intangibles to total assets as a proxy for firm growth opportunities might be hindered by the fact that this variable could be depicting the degree of collateral available in the firm for servicing debt obligations in case of bankruptcy. Another problem might arise from using the variable Z-score adjusted as a proxy of firm's credit quality. In fact, this variable relies on a measure computed by Altman (1968) using a sample made up exclusively by US firms. The

use of this variable as a proxy of the default probability for a sample of UK Eurobond issuers is, however, supported by the study of Masocha (2000) where the Altman's measure is found to be a good predictor of the probability of default for a sample of UK companies.

Finally, some of the interdependencies between debt features are not taken into account due to the lack of clear theories specifying the effects of the joint impact on the relationship between variables. Thus, both call and convertible provisions can be used to decrease the length of debt contracts, which according to the literature (e.g. Myers (1977) and Barnea et al. (1980)) mitigates potential agency problems. Nevertheless, other authors (e.g. Stein (1992) and Mayers (1995)) sustain that call options are included in the indentures of convertible contracts as complementary devises to guarantee the forced conversion of these contracts. Therefore, no clear direction is specified for the relationship between these features leaving open interesting issues for further developments in the literature about debt contract design.

The empirical study of the debt terms' choice for other forms of publicly traded debt (i.e. domestic and foreign bonds) constitutes an interesting extension to this research. In particular, a study on these debt instruments would allow for a comparative analysis where not only the consistency of agency arguments regarding the interdependencies between debt features could be examined but also the impact of signalling arguments in different asymmetric information environments could be assessed. The study of the terms' structure of private debt placements such as bank

loans would contribute also to a deeper understanding of the factors guiding the design of different type of debt instruments. The empirical study on private placements' structure can be, however, impaired by the lack of information disclosure regarding the specific characteristics of the features embedded in these contracts.

Another extension to this research is the analysis of the impact that sector-related factors might have on the choice of contract features. Some factors like business restructuring or exposure to economic cycles have an impact on the choice of embedded covenants in Eurobond issues. A Seemingly Unrelated Regression Estimation (SURE) model would appropriately accommodate the impact of sector-related effects because this model allows for the estimation of different slope coefficients and/or constant terms for each aggregate industry values across the sample of Eurobond issues [46]. Therefore, the use of this estimation method to the data set of this research represents an interesting extension to this research allowing for the assessment of the significance of sector-driven factors on the design of Eurobonds.

Furthermore, it would interesting to investigate whether the likelihood of issuers to form clienteles around financial intermediaries that have good reputation for underwriting and selling certain types of tailored Eurobond offerings, is indeed corroborated by empirical evidence. This would be undoubtedly a logical extension for this research considering that the level of competition observed among Eurobonds underwriters (in particular, after the increase of the role played by

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[46] For a detailed explanation about the use of SURE models in longitudinal data sets see Greene (2000, Chapter 15).

European investment banks) and the pressure for them to assure the success of the offerings recommend that lead-manager(s) and selling groups become specialists on placing Eurobonds that embed certain type of relevant features.

Finally, the study of the relationship between the proxies for the level of managerial entrenchment (e.g. percentage of insider ownership, firm performance, board structure) and the propensity to include convertible or protective covenants in Eurobond issues would provide a better insight about inferred impact of equity agency costs on the design of debt contracts.

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