“Essays on Corporate Finance, Monetary Policy and Asset Pricing on London Stock Exchange”

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ABSTRACT

The present thesis examines how stock returns in the UK market are related to two specific firms' characteristics that have attracted the interest of policy makers and the academic literature due to their importance during the recent global financial crisis: i) the financial constraints that firms face in their attempt to invest and grow at their desirable pace and ii) the level and structure of the compensation that corporations pay to their executives.

Chapter 2 examines how the financial constraints that firms may face in their attempt to invest and grow at their desirable pace are related to the stock returns earned by their shareholders during the period 1988-2010. To this end, Chapter 2 uses a survivorship bias-free sample of firms listed on LSE and a series of proxies to measure the degree of financial constraints that these firms face. Classifying firms as financially constrained or unconstrained according to each of these proxies, we examine whether the most financially constrained firms yield a higher level of returns to investors relative to the least constrained ones. The main finding of Chapter 2 is that investors in highly constrained firms were not rewarded for being exposed to this aspect of risk, regardless of the utilized proxy. To the contrary, the portfolio containing the most constrained firms underperformed the portfolio containing the least constrained firms in most of the cases we have examined.

Chapter 3 examines the effect of firms' financial constraints on the response of their stock returns to UK monetary policy shocks during the period 1999-2011. These shocks are extracted on the meeting days of Bank of England's Monetary Policy Committee. Using a survivorship bias-free dataset of firms listed on LSE and a number of proxies to measure firms' financial constraints, we find no significant evidence to support the argument that the return response of the most constrained firms is of greater magnitude relative to the corresponding response of the least constrained firms. The opposite is actually true for most of the measures we

use. Moreover, we find that the inverse relationship between monetary policy shocks and stock returns became positive during the 2007-2009 crisis period. Finally, the relationship between stock returns and monetary policy shocks in the UK market exhibits state dependence, especially across tight versus loose credit market conditions.

Chapter 4 examines the relationship between the level and the structure of the compensation that firms listed on LSE pay to their executives and the subsequent returns that their shareholders earn during the period 1998-2010. Total CEO compensation is decomposed into its cash- and incentive-based components. The results in Chapter 4 indicate a strong negative relationship between CEO incentive pay and future shareholder returns. Moreover, the outperformance of firms with low pay is less pronounced but still apparent when longer investment horizons are considered. Finally, we provide evidence that, in contrast to incentive pay, cash pay is not found to be related to future shareholder returns in a statistically significant way.

Chapter 5 concludes this thesis, providing an overview of its contributions and empirical results, outlining their implications and discussing issues for future research.

CHAPTER 1

Introduction

1.1 Motivation and structure of the thesis

The present thesis examines how stock returns in the UK market are related to two specific firms' characteristics that have attracted the interest of the media, regulators, policy makers as well as the academic literature due to their importance during the recent global financial crisis. In particular, we examine the informational content for investors and policy makers of: i) the financial constraints that firms face in their attempt to invest and grow at their desirable pace and ii) the level and structure of the compensation that corporations pay their executives. While these two issues have been at the centre of public debate in the UK, almost no academic research examining firms listed on London Stock Exchange (LSE) has been conducted. The focus of the existing literature and the corresponding empirical results refer, almost exclusively, to US firms. This thesis significantly contributes to the literature and informs the public debate by examining, for the first time in the UK market, the importance of financial constraints and executive compensation for shareholders and policy makers, constructing and utilizing comprehensive datasets of firms listed on LSE.

Chapter 2 examines how the financial constraints that firms may face in their attempt to invest and grow at their desirable pace are related to the stock returns earned by investors. To this end, Chapter 2 uses a comprehensive and survivorship bias-free sample of firms listed on LSE as well as a series of proxies to measure the degree of financial constraints that these firms face during the period 1988-2010, which is the longest period for which reliable data are available for a sufficient number of UK firms. Classifying firms as financially constrained or unconstrained according to each of these proxies, we perform a series of asset pricing tests to examine whether this firm characteristic is priced in the UK market, that is whether the most financially constrained firms yield a higher level of raw or risk-adjusted returns to investors relative to the least constrained ones.

Chapter 3 examines the effect of firms' financial constraints on the response of their stock returns to UK monetary policy shocks during the period 1999-2011. These shocks are extracted on the meeting days of Bank of England's (BoE) Monetary Policy Committee (MPC) and they are calculated relative to expectations regarding short-term interest rates embedded into LIBOR futures prices. Using a comprehensive and survivorship bias-free dataset of firms listed on LSE as well as a number of proxies to measure firms' financial constraints, Chapter 3 examines whether the stock returns of the most constrained firms respond to monetary policy shocks in a differential manner relative to the stock returns of the least constrained firms. Moreover, Chapter 3 examines whether the relationship between stock returns and monetary policy shocks in the UK market exhibits state dependence as well as whether the sign or the magnitude of this relationship has been modified during the financial crisis of 2007-2009.

Chapter 4 examines the relationship between the level and the structure of the compensation that corporations pay to their executives, particularly their Chief Executive Officer (CEO), and the subsequent returns that their shareholders earn. In other words, Chapter 4 explores, for the first time in the UK market, the ex-post consequences of CEO compensation for shareholder value using a large and carefully constructed compensation dataset for firms listed on LSE during the period 1998-2010. Total CEO compensation is decomposed into its cash-based and incentive/ equity-based components to examine the relationship between the structure of CEO compensation and subsequent stock returns. A series of asset pricing tests and alternative portfolio classification schemes are used to examine whether firms that pay their CEOs excess fees relative to their peer firms in the same industry and size group outperform or underperform in terms of raw and risk-adjusted returns.

Chapter 5 concludes this thesis by providing an overview of its contributions and main empirical results, outlining their important implications and discussing issues for future research. The rest of Chapter 1 reviews the theoretical arguments and the corresponding empirical results in the prior related literature and positions the present thesis relative to these studies.

1.2 Financial constraints and asset pricing

The recent global financial crisis has highlighted the importance of capital markets' well-functioning and the availability of credit to firms. The classical result of Modigliani and Miller (1958), that the firm's capital structure decisions are irrelevant under perfect and frictionless markets, may still be theoretically appealing but it crucially fails in the real world of imperfect capital markets. Agency problems, asymmetric information and market incompleteness may cause a prolonged disruption in credit markets, to the extent that external finance may become impossible to acquire. There is a well-established strand of the corporate finance literature that recognizes the existence of constraints/ frictions in firms' financial decision making and examines their impact on corporate investment policy.

Following the definition of Kaplan and Zingales (1997, p. 172), firms are considered to be financially constrained if they face a wedge between the internal and external cost of financing their investment plans. As the difference between the cost of internal and external funds increases, the more constrained a firm becomes. As a result, firms with severe financial constraints may face difficulties to raise funds to finance their investment plans. Along the same lines, Lamont et al. (2001, p. 529), define financial constraints as the frictions that prevent a firm from funding all desired investments.

Accepting that external finance, such as new equity or debt issue, is not a perfect substitute for internal finance, such as retained profits, in the sense that it may be costlier and scarcer, obliges us to take into account firms' capital structure as well as their financial status. To provide explanations why internal finance may be less costly than external finance, one must consider transaction costs, tax advantages, agency problems, cost of financial distress and asymmetric information (see Fazzari et al., 1988). The previously mentioned market "imperfections" hinder the ability of financial intermediaries and creditors to evaluate the quality of firms' investment opportunities. Importantly, Jaffee and Russell (1976) showed that the market interest rate increases and the loans' size may be limited when lenders cannot identify the quality of borrowers. Consequently, the cost of issuing new debt and equity may be significantly higher than the opportunity cost of internal funds generated through cash flows and retained earnings. Therefore, the investment-to-cash flow sensitivity and external financial constraints are expected to be correlated.

The seminal studies of Fazzari et al. (1988), Kashyap et al. (1994) and Hubbard (1998) have demonstrated that firms' financial conditions do affect their financing, investment decisions, and hence their profits. In particular, Fazzari et al. (1988) utilized firms' dividend payout ratios, size and the existence of credit rating (or access to commercial paper) to measure the degree of their financial constraints and found that firms with low dividend payout ratios display a high investment-to-cash flow sensitivity. More recently, Guariglia (2008), utilizing a dataset of unlisted UK firms, found that the investment-to-cash flow sensitivity tends to increase monotonically with the degree of external financial constraints, corroborating the findings of Fazzari et al. (1988) for the UK market.

To the contrary, Kaplan and Zingales (1997), investigating whether high investment-to-cash flow sensitivities can be interpreted as indicators of financial constraints, actually found that the least constrained firms' investments were more sensitive to cash flows. As a result, they argued that higher investment-to-cash flow sensitivities cannot be attributed to the degree of financial constraints. Moreover, Guariglia and Mateut (2006) suggested that this relationship may become weaker due to the presence of another source of financing, namely trade credit. Trade credit is given by short-term loans provided by suppliers to their customers when they purchase their products; a customer can purchase goods on credit, paying the supplier at a later date. Additionally, Guariglia and Mateut (2006) argued that during recessions and periods of tight monetary policy, when the supply of intermediated credit decreases, the trade credit channel offsets the absence of bank loans especially for financially constrained firms.

The concept of financial constraints is rather elusive. A firm may become constrained either due to the size, liquidity and structure of the assets and liabilities of its balance sheet or due to the level and the variability of its cash flows. In our attempt to capture the risk of a firm becoming financially constrained and to provide comprehensive evidence, we use a plethora of financial constraints measures that have been used in the prior literature (see Hahn and Lee, 2009). These proxies utilize information embedded into the assets and the liabilities side of the firm's balance sheet as well as its cash flows. In particular, these measures refer to the firm's total assets, its debt-to-book equity and debt-to-market value ratios, its cash holdings-to-assets ratio, its interest coverage ratio, its debt capacity measured by its tangible assets as well as two composite indices of financial constraints: the KZ-index developed by Kaplan and Zingales (1997) and the WW-index developed by Whited and Wu (2006). Each of these two indices combines linearly the previously mentioned as well as other accounting and market characteristics of a firm into a single measure of the degree of financial constraints that the firm encounters. The higher the value of the index, the more constrained the firm is.

Since financial constraints affect firms' operations and investment decisions, it is worth examining whether they are related to their stock prices too. A series of previous studies have considered financial constraints as a source of risk with contradictory findings. A representative list of previous studies include: Whited (1992), Lamont et al. (2001), Campello and Chen (2005), Gomes et al. (2006), Whited and Wu (2006), Almeida and Campello (2007) as well as Hahn and Lee (2009). In particular, Lamont et al. (2001) employed the composite KZ-index as a measure of financial constraints and found that the group of the most constrained firms actually yielded lower returns relative to the group of the least constrained ones. Similarly, Gomes et al. (2006), relying on an investment-based model, showed that financing frictions play only a negligible role for the pricing of cross-sectional premia. To the contrary, Campello and Chen (2010), using a more recent sample, found that a factor that goes long financially constrained firms and sells short unconstrained ones earns the theoretically predicted premium, especially when one controls for the value effect.

Along the same lines, Whited and Wu (2006), introducing their novel WW-index as a proxy for financial constraints, found that the most constrained firms carry higher returns relative to the least constrained ones, but the premium of the corresponding factor is not statistically significant. Finally, Hahn and Lee (2009) showed that it is the interaction of firms' debt capacity, measured via asset tangibility, with financial constraints risk that is priced in the market; debt capacity is an important determinant of the cross-sectional premia only within the group of financially constrained firms. Overall, most of these studies argue that the variation of the financial constraints factors they construct cannot be fully explained by the commonly used Fama-French asset pricing model. All of the previously mentioned asset pricing studies focus on the US market. To the best of our knowledge, there is no prior study providing comprehensive evidence on the pricing of financial constraints risk on London Stock Exchange. Chapter 2 fills this gap in the literature.

1.3 Monetary policy shocks and financially constrained firms' stock returns

The improved transparency of central banks' decision making has rendered the meetings of their monetary policy committees to be key events for the calendars of market participants during the last two decades. The financial press and professional investors assign a large weight to the role of monetary policy decision to extract information with respect to current and future movements in asset prices. The importance of this issue has triggered a growing literature of studies examining the impact of monetary policy decisions on stock returns. The seminal studies of Jensen and Johnson (1995), Thorbecke (1997) and Bernanke and Kuttner (2005) provide characteristic examples, proposing different methodologies to assess this impact. In short, there is sufficient evidence that an unexpected monetary tightening has a negative impact on stock returns, but this impact can be considerably different across stocks with different characteristics. The study of Kontonikas and Kostakis (2012) provides evidence on the differential impact of monetary policy shocks on the returns of US stocks with different size, value and past performance characteristics.

A number of prior studies, reviewed in Sellin (2001), have shown that monetary policy decisions can influence stock prices. The most obvious way through which monetary policy decisions affect stock prices is through the economy-wide interest rate channel. Tobin (1978) argued that a tightening of monetary policy decreases the present value of future earnings, and hence lowers stock prices. Along the same lines, Smirlock and Yawitz (1985), using a standard dividend discount model, argued that an increase in the interest rate raises the discount rate applied to firm's future cash flows, i.e. the opportunity cost of capital, and hence it considerably reduces its cash flows' present value. Thus, monetary policy can affect the rates that market participants use to discount future cash flows as well as expected cash flows themselves (see Patelis, 1997). Moreover, as Bernanke and Gertler (1995) argue, an increase in the policy rate can hamper real economic activity because it reduces current consumer demand and expenditure by increasing the cost of borrowing for consumption and investment. As a result, firms' current net cash flows and expectations over future ones are diminished, leading again to lower stock price valuations.

Another very important channel through which changes in interest rates can affect stock prices is the credit channel of the monetary policy transmission process, as described by Bernanke and Blinder (1992), which affects the "external finance premium", i.e. the wedge between the cost of internal and external funds. In particular, this channel is consisted of two mechanisms: the bank lending channel and the balance sheet channel (see Bernanke and Gertler, 1989 and Bernanke and Gertler, 1995 for a detailed analysis). According to the balance sheet channel, monetary tightening by increasing interest rates can worsen cash flow net of interest due to lower revenues and higher floating rate interest payments and thus firms' balance sheet position. The balance sheet channel focuses on changes in creditworthiness of firms by weakening the present value of collaterals. In addition, the bank lending channel is of particular importance to companies that have restricted access to intermediated credit; on the advent of an overall reduced supply of bank loans, these companies are typically the first to be cut off their credit lines. Consequently, net cash flows get considerably reduced and profitable projects are abandoned due to lack of funding.

This process eventually pulls the trigger of the so-called "financial accelerator" (Bernanke et al., 1996), leading to an even higher external finance premium, especially in the presence of large information asymmetries between the firm and its lenders. This is because in the presence of information asymmetries, lenders need to monitor closer firms' ability to repay debt. As a result, poorly collateralized firms will face a higher external premium, resulting into lower investment demand and reduced economic activity. Interestingly, Bernanke and Getler (1989) stated that these asymmetries are even larger in recession periods affecting in a more severe way weaker borrowers with limited access to alternative sources of credit.

Even though the previously described mechanisms may affect all of the firms in the economy, it is particularly interesting to examine whether and how the magnitude of these effects differs across firms with different capital structures and cash flow characteristics. In particular, financially constrained firms are expected to experience more severe problems due to monetary tightening because they are typically characterized by lower interest coverage ratios, lower borrowing capacity, worse credit ratings, lower cash holdings, higher leverage, higher agency costs of debt and limited access to capital in comparison to the least constrained firms. Fazzari et al. (1988), Kashyap et al. (1994) and Hubbard (1998) have extensively analyzed the impact of financial constraints on firms' financing, investment decisions and net cash flows. Guariglia and Mateut (2006) and Guariglia (2008) provide similar evidence for UK firms.

There are few studies in the prior literature that have examined the differential impact of monetary policy on stock returns taking into account the effect of financial constraints. For example, Gertler and Gilchrist (1994), Thorbecke (1997), Perez-Quiros and Timmermann (2000) and Guo (2004), inter alia, differentiated between small and big capitalization stocks, arguing that a monetary tightening should affect more severely small companies because these are typically less well immunized against such an adverse economic condition and they face severe financing constraints. This is a reasonable hypothesis since optimal risk management procedures are too costly for small companies to bear. Moreover, they are less well collateralized and, as a result, they are more likely to be harmed due to the "flight to quality lending" by creditors. In addition, they have limited ability to issue commercial paper and face higher agency costs of debt, finding it more difficult to raise capital due to their limited ownership base. Nevertheless, firm size is only a very rough proxy of financial constraints.

To overcome this limitation, a series of studies, reviewed in Section 1.2., have suggested a number of more appropriate proxies of firms' financial constraints. As a by-product of their analysis, some of these studies have also tested whether the differential return between the most and the least constrained firms is related to monetary conditions. In particular, Lamont et al. (2001), using size and the composite Kaplan-Zingales (KZ) index as proxies, did not find a significant relationship between the spread return of the most-least constrained firms and the change in the Fed Funds rate or the growth in real M2. Similar is the evidence provided by Hahn and Lee (2009), who used asset tangibility as a measure of constraints and growth in real M2 as a proxy of monetary conditions.

However, these tests are likely to suffer from endogeneity bias because changes in monetary variables measured at monthly or quarterly frequencies are unlikely to be purely exogenous. Therefore, it is not clear whether the effect attributed to monetary policy in these studies also reflects other factors. Rigobon and Sack (2003) have convincingly shown that monetary policy decisions may have already incorporated stock market movements, and hence causality may run in both directions. As Bredin et al. (2009) analyze, in attempt to resolve the endogeneity problem, a number of recent studies have tried to disentangle the unanticipated component of monetary policy changes from the anticipated component mainly through the following three approaches: (i) using surveys from market participants, (ii) using futures market data and (iii) derive expectations based on forecasts from regression analysis.

Controlling for the endogeneity problem, Ehrmann and Fratzscher (2004), Basistha and Kurov (2008) and Jansen and Tsai (2010) are among the few prior studies to have examined the differential impact of US monetary policy shocks on constrained versus unconstrained firms using a number of appropriate proxies to classify firms. In particular, Ehrmann and Fratzscher (2004) used cash flows, credit ratings, leverage ratios and Tobin's q as proxies for financial constraints. However, they used only S&P 500 companies, which are probably the least constrained firms in the US market and they relied on survey expectations to extract monetary policy shocks. To the contrary, Basistha and Kurov (2008), who also examined only S&P 500 firms and used credit ratings, trade credit, size and payout ratios as constraints proxies, as well as Jansen and Tsai (2010), who use profitability, payout ratios and debt ratings as proxies, extracted unanticipated changes in the Fed Funds rate relative to futures-implied expectations. The latter approach has become the common practice in the literature since the seminal study of Bernanke and Kuttner (2005). Overall, these US studies found that the most constrained firms are more affected by monetary policy shocks relative to the least constrained ones and that the magnitude of this relationship exhibits state dependence.

Relatively limited is the evidence on the impact of monetary policy shocks on stock returns in the UK market. In particular, using the event study methodology of Kuttner (2001), Bredin et al. (2007), Bredin et al. (2009) and Gregoriou et al. (2009) have examined the response of stock market returns to monetary policy shocks on BoE's MPC meeting days. However, they examined only aggregate market and sectoral returns. More recently, Florackis et al. (2011) examined the corresponding response of liquidity-sorted portfolios' returns using the same framework. To the best of our knowledge, Chapter 3 provides the first study in the literature that examines the impact of monetary policy shocks on the stock returns of financially constrained firms listed on LSE, shedding new light on the transmission of UK monetary policy decisions through the stock market. Finally, few studies have examined whether the impact of monetary policy shocks on stock returns is asymmetric across different economic (e.g. expansions versus recessions) and market conditions (e.g. bull versus bear markets). The recent studies of Basistha and Kurov (2008), Jansen and Tsai (2010) and Kontonikas et al. (2012) for the US market are notable exceptions. The study in Chapter 3 is the first to examine this issue for the UK market.

1.4 Executive compensation and future shareholder value

In addition to excessive leverage and financial constraints, executive compensation has also drawn the attention of academics, regulators and the media since the outbreak of the recent financial crisis. An important theoretical perspective on the design of executive compensation is provided by agency theory, outlined by Jensen and Meckling (1976), which focuses on conflicts of interest among different corporate stakeholders, notably between managers and shareholders. Agency theory predicts that the diffuse ownership structure that characterizes the vast majority of listed companies creates an "agency relationship", where a firm's managers act as agents of its shareholders. The interests of managers do not always correspond exactly with those of shareholders. In an attempt to maximize their own welfare, managers may take actions that disadvantage certain types of shareholders (e.g. excessive risk-taking). A well-designed executive compensation scheme can serve as a key mechanism to align managerial incentives with those of shareholders, for example by increasing the sensitivity of pay to performance. On the other hand, flawed compensation schemes may also lead to short-termism, suboptimal investment, earnings manipulation and, as a result, value destruction (see Faulkender et al., 2010 for a detailed analysis).

Recent developments in financial markets, such as the flawed incentives for several players that led to excessive risk taking and a series of corporate failures, are more consistent with the latter view and cast doubt on whether the CEO compensation schemes that corporate boards endorse actually work. As a response, a large number of shareholders in UK companies have recently failed to back pay plans at Barclays, Aviva, Xstrata and others. According to the Financial Times, several large Aviva investors used their vote to highlight concerns about long-term underperformance of their company as well as short-term excess pay.[1] Other investors of Aviva have argued that many board members are more concerned with their remuneration packages rather than developing a strategy to grow the business. Such concerns are mainly driven by the fact that CEOs and other top executives are not always paid for good performance. For instance, according to Manifest/MM&K, the median executive pay in FTSE 100 companies rose by 10% in 2011 and in more than 25 of these companies the increase was greater than 41%, while the total returns for shareholders over that period have been, at best, uninspiring.

The academic literature reveals a balanced debate on whether the level and structure of executive pay in large companies serves the interests of both managers and shareholders. Drawing upon agency theory, a large body of literature suggests that CEO compensation can be appropriately designed to resolve agency problems (see Hall and Liebman, 1998, Himmelberg and Hubbard, 2000, Bizjak et al., 2008, Gabaix and Landier 2008, Kaplan, 2008, and Kaplan and Rauh, 2010). Another line of research draws upon the managerial power approach, which rests on the premise that the CEO has a good deal of control over the board and that this control includes the power to set a large part of his own compensation (see Weisbach, 2007, for a detailed analysis). The findings of this strand of research support the view that CEO pay is a complicating factor rather than a solution to the agency problem (see Yermack, 1997, Bertrand and Mullainathan, 2001, Bebchuk and Fried, 2003, 2004, and Bebchuk and Grinstein, 2005).

A limitation of prior studies is that they examine CEO compensation from an *ex-ante* perspective, assuming that CEO pay should reflect company's current and recent past performance. In Chapter 4, we take an *ex-post* perspective and analyze the relationship between

[1] See: "Excessive CEO pay rarely rewards investors", Financial Times, 13th June 2012.

CEO pay and subsequent shareholder returns for firms listed on LSE. In particular, our main objective is to explore whether companies that pay their CEOs higher fees generate superior future returns. To this end, we adopt Hayes and Schaefer's (2000) view that boards reward CEOs for actions that may benefit the firm in the long-run but are not reflected in currently observable performance, which supports a significant link between current CEO pay and future shareholder performance.

The *managerial overconfidence hypothesis* and the *investor overreaction hypothesis* also provide strong theoretical frameworks for the empirical analysis of Chapter 4, as they both predict a strong relationship between CEO pay and subsequent shareholder returns. According to the managerial overconfidence hypothesis (Cooper et al., 2011), highly paid CEOs may become overconfident and engage in suboptimal managerial behaviour, such as extravagant investment and empire-building (see Malmendier and Tate, 2005, 2008, 2009). Many overconfident CEOs, especially those who are awarded high stock-based compensation schemes, may have incentives to conceal bad news about future growth options, an action which leads to suboptimal investment policies, temporary overvaluation and a subsequent crash in share prices (see Benmelech et al., 2010). According to the investor overreaction hypothesis, CEOs that receive the highest fees are those employed by "glamour" firms with superior past returns and operating performance (Cooper et al., 2011 and Core et al., 1999). These firm characteristics generate intense bidding for the stocks of such firms, mainly by uninformed investors who lack the ability to properly assess their fundamentals, resulting in an overreaction and an appreciation of the current stock price. This mechanism leads to a negative association between CEO pay and future stock returns.

Positioning Chapter 4 with respect to the existing literature, this study draws upon and extends a growing body of literature on the consequences of CEO compensation. Prior research does not lead to a consensus regarding the nature of the relationship between pay and future performance/value. On the one hand, a number of studies have provided evidence consistent with the alignment role of CEO pay. For example, Abowd (1990) used data on more than 16,000 managers in 250 large US corporations and found that increased performable sensitivity in compensation leads to superior economic and market-based performance in the following fiscal year. Using data from the Forbes Executive compensation survey over the period 1974-1995, Hayes and Schaefer (2000) found that CEO pay is informative about subsequent accounting performance. They viewed their results as support for the assertion that boards reward top executives for value-maximizing actions with effects that have not materialized yet, and, therefore, are not observable to outsiders, such as the shareholders. Moreover, using a randomly selected sample of 199 firms from the S&P 500, Carpenter and Sanders (2002) documented a positive link between top management team (TMT) member pay and future firm performance, as proxied by the return on assets and Tobin's q. They also found that CEO pay is related to subsequent performance, but its effect may be indirect through such factors as TMT pay.

In a sample of UK firms, Conyon and Freeman (2004) reported a positive relation between shared compensation plans (profit sharing, profit related pay, save as you earn schemes and company stock option plans) and stock market performance in the 1990s. Hanlon et al. (2003) examined the impact of stock options granted to top executives (ESO) on future operating earnings in a large sample of S&P 1500 firms from 1992 to 2000. Their results support a positive relation between option grants and operating income, which is consistent with the incentive alignment perspective. In a similar spirit, Fich and Shivdasani (2005) analyzed a sample of Fortune 1000 firms from 1997 to 1999 and showed that option plan adoptions generated positive cumulative abnormal returns.

Sun et al. (2009), building upon the work of Hanlon et al. (2003) and Fich and Shivdasani (2005), focused on the role of compensation committees on the relationship between option grants and future firm performance. Using a sample of 474 US firms, they documented a positive relation between stock option grants and subsequent firm performance, which became more pronounced as the quality of compensation committees increased. Moreover, examining a sample of 298 CEO departures, Chang et al. (2010) provided evidence consistent with the view that more capable CEOs are rewarded with higher pay and that their departures are viewed by the market as "bad" news, leading to a significantly negative stock market reaction. Finally, Minnick et al. (2011) analyzed 159 acquisitions made by bank holding companies and showed that pay-for-performance sensitivity in executive compensation leads to higher stock returns around the announcement day as well as better operating performance.

On the other hand, prior research also found evidence consistent with the "managerial power approach" or "skimming view" of executive compensation. DeFusco et al. (1991), utilizing a sample of 987 NYSE firms over the period 1978-1982, found that cumulative abnormal returns and accounting performance declined subsequently to stock-option plan adoption. Furthermore, examining a sample of Fortune 500 companies between 1992 and 1994, Yermack (1997) used an event-study methodology and found that CEO option awards were followed by positive cumulative abnormal returns. However, Yermack's study concluded that this outperformance was not necessarily linked to superior managerial decisions, but rather to the informational advantage of managers and their power to influence their compensation committees to award more performance-based pay at times when they expected impending improvements in performance. Moreover, Core et al. (1999), using a sample of 205 publicly traded US firms over the period 1982-1984, documented a negative relationship between excess compensation and subsequent operating and stock return performance.

In a similar spirit, Brick et al. (2006) constructed measures of excessive compensation and examined its link with subsequent firm performance. In a large sample of US firms, they provided evidence consistent with the cronyism hypothesis, which suggests that excessive compensation is symptomatic of agency conflicts between managers and shareholder, and hence value-destroying. Malmendier and Tate (2009) analyzed a sample of CEOs and other top-executives of S&P 500, MidCap 400 and SmallCap 600 firms over the period 1992-2002 and found that "superstar" CEOs (i.e. those winning prestigious business awards) extract more compensation from their firm. They also found that firms with "superstar" CEOs subsequently underperform, in terms of both stock price and accounting performance. In a sample of US firms from 1993 to 2004, Bebchuk et al. (2011) constructed a measure of CEO pay slice (CPS), defined as the fraction of the aggregate compensation of the top-five executive team members that is captured by the CEO. Their findings showed that CPS was negatively associated with firm value, accounting profitability and stock price performance.

An important contribution of Chapter 4 is that it provides, for the first time in the literature, evidence on the link between CEO compensation and future shareholder returns for firms listed on LSE. The UK market is often used as a model for sound governance when it comes to CEO pay. Given the large increase in CEO pay in recent decades, the introduction of legislation to require nonbinding "say on pay" votes for all publicly listed companies and the spate of the recent shareholders revolts over pay, as previously mentioned, the UK provides an ideal setting to examine whether companies that pay their CEOs excess fees generate superior future stock returns. Finally, our analysis complements the very recent study by Cooper et al. (2011), which provides evidence for US firms and finds that those with the highest-paid CEOs produced subsequent shareholder returns that are substantially lower than their peers.

CHAPTER 2

Financial constraints and asset pricing:

Comprehensive evidence from London Stock Exchange

2.1 Introduction

The recent global financial crisis has highlighted the importance of capital markets' well-functioning and the availability of credit to firms. The classical result of Modigliani and Miller (1958), that a firm's capital structure decisions are irrelevant for its value under perfect and frictionless markets, may still be theoretically appealing but it crucially fails in the real world of imperfect capital markets. Agency problems, asymmetric information and market incompleteness may cause a prolonged disruption in credit markets, to the extent that external finance may become impossible to acquire (see the seminal studies of Jaffee and Russell, 1976, Jensen and Meckling, 1976, Stiglitz and Weiss, 1981 and Myers and Maljuf, 1984). There is a well-established strand of the corporate finance literature that recognizes the existence of frictions in firms' financial decision making and examines their impact on corporate investment policy. The frictions that prevent the firm from funding all desired investments are termed as "financial constraints" (Lamont et al., 2001, p. 529).

The seminal studies of Fazzari et al.(1988), Kashyap et al. (1994) and Hubbard (1998) have demonstrated that firms' financial constraints do affect their financing, investment decisions, and hence their profits. Similar is the evidence provided for UK firms in a series of recent studies by Guariglia and Mateut (2006), Carpenter and Guariglia (2008) and Guariglia (2008). Accepting that external finance (e.g. new equity or debt issue) is not a perfect substitute for internal finance (e.g. retained profits), in the sense that it may be costlier and scarcer, obliges us to take into account firms' capital structure as well as their financial status. Interestingly, theories of capital market imperfections have important implications not only for firms' investment decisions but also for their asset prices (see for example the credit cycle model of Kiyotaki and Moore, 1997). In line with this literature, our study examines the asset pricing implications of firms' financial constraints.

The concept of financial constraints is rather elusive, since a firm may become constrained either due to the size, liquidity and structure of the assets and liabilities of its balance sheet or due to the level and the variability of its cash flows. In our attempt to capture this type of risk and provide comprehensive evidence, we utilize a plethora of financial constraints measures defined by these stock and flow variables as well as their informative combinations. These include, among others, a firm's total assets, its debt-to-book equity and debt-to-market value ratios, its cash holdings-to-assets ratio, its interest coverage ratio, its debt capacity as measured by its tangible assets as well as two composite indices of financial constraints: the KZ-index according to Kaplan and Zingales (1997) and the WW-index according to Whited and Wu (2006). Each of these two indices combines linearly the previously mentioned as well as other accounting and market characteristics of a firm into a single measure of the degree of financial constraints that this firm encounters. The higher the value of the index, the more constrained the firm is.

This issue has important implications for firms' optimal capital structure (see Myers, 2001 for an overview of the topic and Beattie et al., 2006 for a recent survey of UK firms). A crucial feature of all these theories is the relationship between leverage, or more generally external finance, and the required rate of return on the securities issued by the corporation. For example, the trade-off theory predicts an optimal target level of debt-to-equity ratio, assuming that any increase beyond this level would actually increase the cost of both equity and debt, offsetting the benefits from substituting costly equity for cheaper debt (see Myers, 1984). In other words, it implicitly assumes that the risk of becoming financially constrained will be priced by the market. Our study essentially tests this crucial assumption too. It is worth mentioning that if this assumption does not hold, then one of the offsetting mechanisms that prevent corporations from increasing their leverage breaks down, and hence it would be rational for managers to leverage their firms with external finance because they would not be penalized by investors requiring higher premia.

A series of previous studies have tested whether financial constraints constitute a priced source of risk, but their results paint a mixed picture. Lamont et al. (2001) employed the composite KZ-index as a measure of financial constraints and found that the group of the most constrained firms actually yielded lower returns relative to the group of the least constrained firms. Similarly, Gomes et al. (2006), relying on an investment-based model, show that financing frictions play only a negligible role for the pricing of cross-sectional premia. To the contrary, Campello and Chen (2010), using a more recent sample, find that a factor that goes long financially constrained firms and short unconstrained ones earns the theoretically predicted premium, especially when one controls for the value effect.

Along the same lines, Whited and Wu (2006), introducing their novel WW-index as a proxy for financial constraints, found that the most constrained firms carry higher returns relative to the least constrained ones, but the premium of the corresponding factor is not statistically significant. Finally, Hahn and Lee (2009) showed that it is the interaction of firms' debt capacity, measured via asset tangibility, with financial constraints risk that is priced in the market; debt capacity is an important determinant of the cross-sectional premia only within the group of financially constrained firms. Overall, most of these studies argue that the variation of the financial constraints factors they construct cannot be fully explained by the commonly used Fama-French model.[2]

All of the previously mentioned asset pricing studies focus on the US stock market. To the best of our knowledge, there is no prior study providing comprehensive evidence on the pricing of financial constraints risk on London Stock Exchange (LSE).[3] This study attempts to fill this gap in the literature, utilizing a carefully constructed dataset of shares listed on LSE during the period 1988-2010. We sort firms on the basis of a series of alternative financial constraints measures and we construct decile portfolios. The post-ranking returns of these portfolios are calculated to examine the potentially differential behaviour of the most financially constrained firms versus the least constrained ones. Standard asset pricing tests are also conducted to examine whether commonly used risk factors, such as market, size, value and momentum, can help explain the cross-section of these portfolios' returns. The main finding of our study is that financial constraints risk does *not* yield a premium on LSE, regardless of the utilized proxy. To the contrary, with the exception of leverage and cash holdings ratios, it is the most constrained firms that puzzlingly yield lower risk-adjusted returns relative to the least constrained firms. This pattern is highly statistically and economically significant when WW-index is used as a financial constraint proxy. A series of robustness checks confirm the validity of these findings.

The rest of this chapter is structured as follows. Section 2.2 provides the details of the utilized proxies of financial constraints and discusses various data issues. Section 2.3 contains

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[2] Our study is also related to the literature on financial distress and asset pricing, even though the concept of financial distress, which is primarily related to the probability of a firm's bankruptcy, is not identical to the concept of financial constraints, which mainly measures the strength of a firm's restrictions to grow at its desirable pace (see Whited and Wu, 2006, p. 534 for a discussion on their subtle difference).

[3] Arguably, financial constraints may be even more severe for unlisted companies, which are predominantly small and do not have access to credit (Guariglia, 2008). However, the issue we examine relates to the pricing of this aspect of risk in the stock market, and hence we can only examine listed companies, whose shares are tradable and market prices are observable.

the main body of our results, presenting the characteristics of the decile portfolios and their risk-adjusted performance. In Section 2.4 we check the robustness of our results adjusting the financial constraints proxies for industry effects, employing a higher co-moments asset pricing model and examining alternative portfolio classification schemes, while Section 2.5 concludes.

2.2 Financial constraints proxies and data issues

Our initial dataset consists of all common shares listed on LSE that are available in Thomson Datastream from 1988 to 2010. This is the earliest starting period for which all accounting data that are necessary to calculate the utilized financial constraints proxies are available in Worldscope for a sufficient number of UK firms. Following common practice in the literature (see, for example, Florackis et al., 2011), we include both listed and de-listed firms, so our dataset is free of any potential survivorship bias. We then exclude unit trusts, investment trusts and ADRs. We impose several screening criteria to our initial sample, excluding firms for which the necessary accounting and market data are not available for a year. Moreover, financial and insurance companies are excluded, since their capital structure is fundamentally different, and hence they are not comparable with the rest firms. We end up with a final sample of 2,743 firms for the entire period. Monthly total returns inclusive of dividends are calculated using the RI datatype. Particular attention is also paid to a firm's delisting reason. Utilizing the London Share Price Database (LSPD) and following Soares and Stark (2009), we set the return in the delisting month equal to -100% when a share's death code is assigned by LSPD as 7, 14, 16, 20 or 21. The market portfolio returns are proxied by the FTSE All Share Index returns and the risk-free rate by the UK interbank rate. For the benchmark asset pricing tests, we use the size, value and momentum factors constructed for the UK market by Gregory et al. (2009), which are also used in the asset pricing tests of Gregory et al. (2012).[4]

We use a series of proxies to measure the degree of financial constraints for each firm in our sample that have been used in the prior literature. These proxies utilize information embedded into the assets and the liabilities side of the firm's balance sheet as well as its cash flows. In particular, the following measures are used: firm's size proxied by the book value of its assets, its ratio of tangible-to-total assets as a measure of debt capacity, its total debt-to-common equity and total debt-to-market value ratios, its cash holdings-to-total assets ratio, its interest coverage ratio, the composite KZ-index proposed by Kaplan and Zingales (1997) and the composite WW-index proposed by Whited and Wu (2006).[5] Table 2.1 presents the list of these measures along with their definitions and the corresponding Worldscope/ Datastream codes used to calculate them. [6]

It should be also noted that there is great variation in the fiscal year end for firms whose shares are listed on LSE. In other words, contrary to the common practice in US studies, December accounting values by no means correspond to fiscal year end values for all firms in the UK. As a result, calculating financial constraints proxies using December accounting values for the entire following year, we run the risk of relying on far outdated data for the firms that have

[4] Factors are available at http://xfi.exeter.ac.uk/researchandpublications/portfoliosandfactors/.

[5] To calculate firms' KZ and WW-index values, we use the coefficients suggested in the original studies by Kaplan and Zingales (1997) and Whited and Wu (2006) respectively. We acknowledge that for a UK study one would ideally re-estimate these structural models for UK firms and utilize the corresponding coefficients to calculate indices' values. However, we do not have a long enough sample to estimate these coefficients, use them to construct portfolios and evaluate their out-of-sample (i.e. post-ranking) performance. Therefore, we opt for the original US-estimated coefficients in order to have a long enough period for an asset pricing study and we expect that these should also be applicable for UK firms given the similarities in the functioning of these two countries' financial systems and in their legal frameworks.

[6] We have also considered firms' payout ratios but there is not enough cross-sectional variation in this measure to render it an informative sorting criterion. Similarly, bond/ commercial paper ratings exist only for a small number of UK listed firms. Therefore, unlike US studies, credit ratings are not a useful sorting criterion for the UK market. Finally, we also utilized total debt-to-total assets and total debt-to-tangible assets ratios that yielded similar results to the presented leverage measures, and hence they are omitted for the sake of brevity.

fiscal year end in the subsequent months, because December values would correspond to the previous fiscal year in this case. Soares and Stark (2009, p. 326-327) successfully analyze this issue. To avoid this problem and to use the most up-to-date information, we update these proxies on a monthly basis. Finally, following Soares and Stark (2009) to ensure that accounting data are publicly available, and hence they could be used by an investor in real time to construct portfolios, we lag them by 6 months.[7] For example, if the firm's fiscal year end is in April, the accounting variables can be firstly used to calculate the financial constraints proxies and construct portfolios in October.

Having calculated these financial constraints measures for each share *i* and each month *t*, we construct decile portfolios sorting alternatively the available shares on the basis of each of these measures. Portfolio 1 (P1) contains the shares of the least constrained firms, while Portfolio 10 (P10) contains the shares of the most constrained firms in each case. Next, for each portfolio we calculate post-ranking (i.e. next month, *t+1*) returns in excess of the risk-free rate. To provide comprehensive evidence, we calculate both equally-weighted and value-weighted portfolio returns, but as it is standard in the literature, we rely on the latter for the discussion of our results. Portfolios are rebalanced on a monthly basis.[8] For robustness, we have also repeated the analysis with annual rebalancing using December accounting values. Results are qualitatively similar the ones reported here and they are readily available upon request.

[7] For accounting periods beginning before 2007, firms listed on LSE were allowed by the Financial Services Authority (FSA) to make their financial reports public up to 6 months after the end of their fiscal year. For details see http://fsahandbook.info/FSA/html/handbook/DTR/4/1.

[8] The monthly rebalancing of portfolios is necessary because, as previously explained, information on financial constraints proxies should be updated on a monthly basis due to the lack of common fiscal year end in the cross-section of UK firms. Nevertheless, the portfolio classification for most of the firms does not substantially change within a calendar year, exactly because the accounting information for each firm individually is not updated more than once per year.

2.3 Empirical Results

2.3.1 Portfolio characteristics

We begin the discussion of our empirical results by presenting the characteristics of the decile portfolios constructed on the basis of each of the eight alternative proxies of firms' financial constraints. Tables 2.2 to 2.5 contain the average equally-weighted and value-weighted post-ranking excess portfolio returns during the full sample period July 1988- December 2010, the average value of the financial constraint proxy across firms in each portfolio and their corresponding average market value. Moreover, we report the full sample CAPM beta estimate for each portfolio using value-weighted returns. It should be noted that in each case P1 always stands for the portfolio of the least financially constrained firms and P10 for the portfolio of the most financially constrained firms according to each employed measure. The pre-last column in each Table reports the difference between P10 and P1. The last column contains the value of the corresponding t-test under the null hypothesis that the characteristic of portfolio P10 is equal to the characteristic of portfolio P1.

The first sorting criterion we examine is the book value of firms' total assets and the corresponding results are reported in Panel A of Table 2.2. As expected, the least constrained firms according to this criterion have higher market values relative to the most constrained firms that are typically very small capitalization firms. Interestingly, the post-ranking value-weighted excess returns of the portfolios containing the most constrained firms are much lower than the corresponding returns of the portfolios containing the least constrained firms. The annualized spread between the extreme decile portfolios (P10-P1) is significantly negative and equal to -12.47%. Panel B of Table 2.2 contains similar information for portfolios constructed on the basis of the firms' ratio of tangible-to-total assets. This appears to be a meaningful sorting criterion because there is a large variation across the firms' ratios in our sample. The size pattern is less pronounced in this case, but still the most constrained firms according to this measure have much lower market values relative to the least constrained firms. Focussing on value-weighted returns, portfolios containing the most constrained firms tend again to underperform portfolios of the least constrained firms. The spread between the extreme decile portfolios is equal to -8.61% p.a. and it is statistically significant.

In Table 2.3 we utilize leverage ratios as proxies of financial constraints. Panel A uses the ratio of total debt-to-common equity, while Panel B employs the ratio of total debt-to-market value.[9] We assign firms with zero leverage ratios to portfolio P0, separating them from decile portfolios P1 to P10 that contain firms with strictly positive leverage ratios.[10] As expected, there is a large cross-sectional variation in firms' degree of leverage. In general, the firms with the lowest leverage ratios typically have very low market values. However, it should be noted that there is no monotonic size pattern as we move towards portfolios containing firms with high leverage ratios. With respect to the performance of these portfolios, we find that there is no particular relationship between average excess returns and leverage ratios. In the case of total debt-to-common equity ratio, the spread return between P10 (high leverage portfolio) and P1 (low leverage portfolio) is almost zero (-0.69% p.a.). When total debt-to-market value ratios are used to sort firms and construct portfolios, the P10-P1 spread return is only marginally positive (1.67% p.a.) and insignificant, even though the beta estimate of P10 (high leverage portfolio) is much higher than the one of P1 (low leverage portfolio). As a result and contrary to intuition, portfolios of highly leveraged firms according to total debt-to-market value ratios do not yield

[9] It should be noted that we have excluded firms with negative total debt-to-common equity values that derive from negative common equity values.

[10] We do so in order to avoid classifying firms with zero leverage ratios to the portfolio of the least constrained firms, P1. Firms may have zero leverage by choice (in which case they are unconstrained) or because they are unable or untrustworthy to borrow (in which case they are highly constrained). The number of firms with zero leverage ratios in our sample increases dramatically after 2000.

significantly higher average excess returns relative to low leverage firms, even though they appear as more risky according to the CAPM

We repeat the same procedure in Table 2.4, using cash holdings-to-total assets ratios in Panel A and interest coverage ratios in Panel B as sorting criteria to construct decile portfolios. Panel A shows that there is no particular relationship between average size, CAPM beta or excess returns and firms' cash holdings. Even though there is a huge variation across firms' cash holdings ratios in our sample, these differences are not related to the riskiness of these firms' shares or the premia these yield. There is no evidence suggesting that the shares of cash-poor firms that appear as highly constrained yielded higher returns as a reward to investors who would be averse to withholding them. Similar are the results in Panel B, using the interest coverage ratio as a sorting criterion.[11] Again, there is considerable cross-sectional variation in firms' interest coverage ratios, revealing the differential degree of constraints that they face. The most interesting finding in this case is the fact that portfolio P10 containing the most constrained firms (i.e. the portfolio of firms with the lowest interest coverage ratios) significantly underperforms portfolio P1 that contains the least constrained firms (i.e. the portfolio of firms with the highest interest coverage ratios). In particular, a strategy that would go long the most constrained firms and short the least constrained firms (i.e. P10-P1) would yield a statistically negative return of -14.89% p.a. using value weights.

Until now, the measures we have utilized overall show that shares of the most financially constrained firms by no means yield higher returns relative to the shares of the least constrained firms. If anything, the opposite statement is true. Portfolios of the most constrained firms significantly underperform portfolios of the least constrained firms in most of the cases.

[11] It should be noted that in this Table we have excluded firms with negative interest coverage ratios values deriving from negative EBITs. As a robustness check, we have alternatively assigned the firms with negative such values to the portfolio of the most constrained firms (P10); the spread return P10-P1 was even more negative and highly significant.

Arguably, the previously utilized measures reveal only some aspects of the financial constraints a firm may face. To overcome this potential limitation, we also utilize two composite indices that have been suggested and widely used in prior literature in an attempt to simultaneously capture all relevant dimensions of financial constraints: the Kaplan-Zingales (KZ) index and the Whited-Wu (WW) index.

Table 2.5 presents the characteristics of the portfolios constructed by sorting firms according to each of these two indices. Utilizing the KZ-index in Panel A, we find that there is a considerable cross-sectional variation in the values that this index takes across the firms in our sample, rendering it a meaningful sorting criterion. There seems to be a hump-shaped relationship between KZ-index values and firms' capitalizations, with larger firms classified in the middle deciles. Interestingly, though there is no monotonic relationship between average excess returns and KZ-index values, the portfolio containing the most constrained firms, P10, significantly underperforms portfolio P1 with the least constrained firms. The spread return P10-P1 is significantly negative, equal to -9.45% p.a.

Even more interesting are the findings reported in Panel B of Table 2.5 utilizing the WW-index, which turns out to be an informative sorting criterion. We find a stark size pattern as we move from the portfolios of the least constrained firms, which are typically very large capitalization firms, to the portfolio of the most constrained and typically small capitalization firms. Most importantly for our study, we report an almost monotonic decline in average excess returns as we move from P1 to P10. The most constrained firms severely underperform the least constrained firms according to the WW-index too. In particular, a strategy P10-P1 that goes long the most constrained firms in P10 (least negative WW-index values) and goes short the least constrained firms in P1 (most negative WW-index values) would yield a significantly negative average post-ranking return of -19.73% p.a. during the sample period 1988-2010. This sophisticated composite WW-index corroborates the previous findings, highlighting the severe underperformance of the portfolios containing the most constrained firms. In sum, investors on LSE not only they have not been rewarded with higher returns for holding highly constrained firms during the examined period, but they have actually significantly underperformed the market and portfolios of the least constrained firms.

2.3.2 Risk-adjusted time-series performance

The previous subsection analyzed the performance of portfolios constructed using a series of financially constrained proxies in terms of their average excess post-ranking returns without making any adjustment for exposure to commonly used risk factors. In this subsection we perform this risk-adjustment and re-examine the relative performance of these portfolios. In particular, we estimate the abnormal time-series performance of portfolios P1 to P10 according to each financial constraints proxy, using three popular asset pricing models for the sample period July 1988- December 2010. Firstly, we estimate Jensen alpha from the CAPM regression:

$$R_{i,t} - R_t^f = \alpha_i + \beta_{i,MKT}\left(R_{m,t} - R_t^f\right) + \varepsilon_{i,t} \tag{2.1}$$

where $R_{i,t}$ is the return of portfolio *i* in month *t*, R_t^f is the risk-free rate for month *t*, $\left(R_{m,t} - R_t^f\right)$ is the excess market portfolio return in month *t* and $\beta_{i,MKT}$ is the market beta of portfolio *i*. Secondly, we compute Fama-French alpha, i.e. the intercept of the 3-factor Fama-French (1993) model:

$$R_{i,t} - R_t^f = \alpha_i + \beta_{i,MKT}\left(R_{m,t} - R_t^f\right) + \beta_{i,SMB}SMB_t + \beta_{i,HML}HML_t + \varepsilon_{i,t} \tag{2.2}$$

where SMB_t and HML_t stand for the size and value factors respectively, while $\beta_{i,SMB}$ and $\beta_{i,HML}$ denote the corresponding factor loadings of portfolio *i*. Thirdly, we estimate Carhart alpha, i.e. the intercept of the 4-factor Carhart (1997) model:

$$R_{i,t} - R_t^f = \alpha_i + \beta_{i,MKT}\left(R_{m,t} - R_t^f\right)_t + \beta_{i,SMB} SMB_t + \beta_{i,HML} HML_t + \beta_{i,MOM} MOM_t + \varepsilon_{i,t} \tag{2.3}$$

where MOM_t stands for the momentum factor and $\beta_{i,MOM}$ denotes the corresponding factor loading of portfolio *i*.

We report alphas estimated via GMM with Newey-West standard errors corrected for heteroscedasticity and serial correlation. Opting for a system estimation also enables us to test for the joint significance of the ten portfolios' alphas, using a Wald test under the null hypothesis that all alphas are equal to zero. This Wald test has an asymptotic chi-squared distribution, its functional form is proportional to the finite-sample test of Gibbons et al. (1989) and it can help us evaluate the magnitude of each model's pricing errors (see Goyal, 2012, p. 8 for a detailed discussion). We further test and report in each case the significance of the risk-adjusted performance of the return differential (spread) between the extreme portfolio deciles (P10-P1).

Table 2.6 reports the estimated alphas using Total Assets (Panel A) and the ratio of Tangible-to-Total Assets (Panel B) as proxies for financial constraints. With respect to Total Assets, we observe that the portfolios containing the least constrained firms have higher alphas relative to the portfolios containing the most constrained firms. This holds true for all three asset pricing models we use. Most interestingly, the spread strategy P10-P1 that goes long the decile portfolio of the most constrained firms (P10) and short the decile portfolio of the least constrained firms (P1) yields a Jensen alpha of -11.66% p.a., a Fama-French alpha of -10.14% p.a. and a Carhart alpha of -11.12% p.a., with the last two being highly statistically significant. Finally, the Wald test strongly rejects the null hypothesis of all ten alphas being equal to zero regardless of the asset pricing model employed. Similar is the evidence when the ratio of Tangible-to-Total Assets is used as a sorting criterion in Panel B. Again, the decile portfolio containing the most constrained firms (P10) significantly underperforms the decile portfolio containing the least constrained firms (P1) and the corresponding spread strategy (P10-P1) yields highly negative abnormal performance in each case. The main difference with Panel A is that here the null hypothesis of all ten alphas being equal to zero is not rejected because the alphas of the middle decile portfolios are relatively close to zero and statistically insignificant.

The same asset pricing tests are repeated in Table 2.7 using portfolios that have been constructed on the basis of leverage ratios. Panel A reports the results for the portfolios sorted according to total debt-to-common equity ratio. In this case, the estimated alphas are quite low and none is statistically different from zero at the 5% level. All three asset pricing models explain well the performance of these decile portfolios and the Wald tests reported in the last column confirm this argument. Though the performance differential is marginal and statistically insignificant, the portfolio of the most constrained firms (P10) still underperforms the portfolio of the least constrained firms (P1). Investors were by no means rewarded for holding highly leveraged firms. Similar are the results reported in Panel B of Table 2.7, using the total debt-to-market value ratio as a financial constraints proxy. Apart from very few exceptions, alphas across decile portfolios and asset pricing models are statistically insignificant, confirming the ability of these models to explain the time-series performance of leverage-sorted portfolios' returns. Moreover, we do not find any statistically significant differential performance between the most and the least constrained firms' portfolios (P10 and P1 respectively). This evidence is in partial contrast with the negative relationship between leverage and future returns documented for the US market by Penman et al. (2007), but this can be explained by the argument of Caskey et al. (2012) claiming that the deviation from an optimal leverage target affects future returns, not the leverage ratio itself.

Table 2.8 reports the time-series risk-adjusted performance of portfolios sorted on the basis of firms' cash holdings-to-total assets ratios (Panel A) and interest coverage ratios (Panel

B). With respect to cash holdings-sorted portfolios in Panel A, apart from portfolio P10 the rest yielded statistically insignificant alphas regardless of the asset pricing model we have employed. Overall, these models are successful in explaining the performance of these portfolios' returns. Interestingly, the decile portfolio containing the most constrained firms (P10) yielded significantly negative Jensen alpha (-5.61% p.a.), Fama-French alpha (-5.69% p.a.) and Carhart alpha (-5.8% p.a.). Nevertheless, the portfolio P1 containing the least constrained firms according to this proxy also performed quite badly, yielding negative alphas too. As a result, the performance of the spread strategy P10-P1 is not found to be significantly different from zero for any of these three asset pricing models. A potential explanation for this finding can be provided by the argument of Simutin (2010), who claims that it is excess cash relative to a target ratio that matters for asset pricing, rather than the level of cash holdings.

Quite different are the results reported in Panel B of Table 2.8 for the decile portfolios using firms' interest coverage ratios. In this case, there is a clear pattern with portfolios of the most constrained firms (P9 and P10) yielding significantly negative alphas and portfolios of the least constrained firms (P1 to P4) yield significantly positive alphas in most of the cases. In particular, the spread strategy P10-P1 yields a highly significant negative Jensen alpha of -15.41% p.a., Fama-French alpha of -15.73% p.a. and Carhart alpha of -16.35% p.a. In other words, the most financially constrained firms according to their interest coverage ratio severely underperformed their least constrained counterparts and this massive relative underperformance cannot be explained by differential exposure to market, size, value or momentum factors.

Having examined the risk-adjusted performance of portfolios constructed according to unilateral proxies of financial constraints, we now report in Table 2.9 the results of the asset pricing tests for the portfolios sorted on the basis of the composite KZ-index (Panel A) and WW-index (Panel B). With respect to KZ-sorted portfolios in Panel A, we find that the decile portfolio

P10 containing the most constrained firms performs very poorly both in statistical and in economic terms, yielding an annualized Jensen alpha of -15.03%, Fama-French alpha of -14.46% and Carhart alpha of -15.08%. Most interestingly, for the spread strategy P10-P1, on which we focus in this study, we find that it yields negative and statistically significant Jensen, Fama-French and Carhart alphas (-9.8% p.a., -9.63% p.a., -11.33% p.a. respectively). It should be also noted that though there is no particular pattern in the sign and the magnitude of alphas across the various decile KZ-sorted portfolios, Wald tests show that none of these three asset pricing models can sufficiently explain the joint time-series performance of all ten portfolios.

Panel B of Table 2.9 reports the corresponding results using the WW-index. This is a very interesting case because we observe an almost monotonic deterioration in the risk-adjusted performance as we move from the least to the most constrained firms' portfolios (from P1 to P10) regardless of the asset pricing model we use. Actually, portfolios P8, P9 and P10 exhibit highly significantly negative alphas in every case. Along these lines, the spread strategy P10-P1 that goes long the portfolio with the most constrained firms and short the portfolio with the least constrained firms had a negative annualized Jensen alpha of -19.75% (t-value=-2.82), Fama-French alpha of -18.34% (t-value=-3.75) and Carhart alpha of -18.36% (t-value=-3.67). As expected from the reported alphas' estimates, Wald tests confirm that the null hypothesis of jointly zero alphas across the ten WW-sorted portfolios is easily rejected for all three models.

The previous asset pricing results, referring to the most sophisticated proxies of financial constraints suggested in the literature, confirm in risk-adjusted terms the preliminary evidence presented in Table 2.5 using average excess returns. Taken together, these results strongly support the argument that investors in highly constrained UK firms not only did not earn a premium for holding such shares and being exposed to this risk, but to the contrary, they experienced a significant underperformance relative to the rest listed firms and the market as a whole during the sample period 1988-2010. This underperformance in absolute and relative terms is found to be strongly significant in economic and statistical terms and robust to the choice of the asset pricing model since it cannot be attributed to differential exposure to commonly used risk factors.

We have also performed cross-sectional asset pricing tests using the standard two-pass Fama-MacBeth methodology to check whether the market, size, value and momentum factors can explain the cross-section of KZ and WW-sorted portfolios' returns. In the first-pass regression we have alternatively estimated rolling window, expanding window and full sample betas from CAPM, Fama-French and Carhart models respectively, which were then used in the second-pass rolling cross-sectional regressions. Unreported results, which are readily available upon request, show that none of these commonly used factors can sufficiently explain the cross-section of KZ and WW-sorted portfolios' returns. In other words, the differential premia yielded by these decile portfolios did not reflect differential exposure to any of these risk factors. This finding complements and confirms the results we previously reported via time-series regressions.

2.4 Robustness checks

2.4.1 Industry effects

A potential issue arising in our benchmark results is that firms from particular industries may be clustered into the same decile portfolios because they exhibit similar balance sheet or cash flow features. For example, it is reasonable to expect that firms belonging to an industry may be altogether exhibiting a higher degree of leverage or having a lower level of cash holdings, if this is standard practice for firms in this particular industry. In this case, some firms could be erroneously characterized as financially constrained relative to the entire universe of UK firms, even though they are actually unconstrained relative to their industry competitors. To tackle this potential issue, in this section we standardize the values of each financial constraints measure utilized in Section 2.3 relative to the industry each firm belongs to.[12] To this end, we use firms' Level-3 FTSE Industrial Classification (Datastream datatype: FTAG3). Using the industry-adjusted values of financial constraints proxies, we repeat the procedure of sorting firms, assigning them to the corresponding decile portfolios and calculating their post-ranking monthly returns in order to examine the robustness of our benchmark results. To save space, we focus on the time-series risk-adjusted performance (alphas) of decile portfolios constructed on the basis of the KZ and WW industry-adjusted composite indices.[13]

The estimated Jensen, Fama-French and Carhart alphas during the sample period 1988-2010 are reported in Table 2.10. Panel A contains the alphas of the ten industry-adjusted KZ-sorted portfolios. These are qualitatively similar to the benchmark results reported for KZ-sorted portfolios in Panel A of Table 2.9. Along the same lines, the spread strategy P10-P1 still yields economically and statistically significant negative alphas of the same order as in the benchmark results (Jensen alpha: -9.76% p.a., Fama-French alpha: -9.96% p.a. and Carhart alpha: -9.75% p.a.). Panel B of Table 2.10 contains the corresponding alphas for portfolios sorted on the basis of industry-adjusted WW-index values. Comparing these alphas with the benchmark estimates for WW-sorted portfolios reported in Panel B of Table 2.9, they are remarkably robust to the industry-adjustment we perform. The interesting, almost monotonic, deterioration of performance as we move from P1 to P10 also remains largely intact. Moreover, the spread strategy P10-P1 that goes long the most constrained firms and short the least constrained firms is still characterized by severe and highly significant underperformance. Hence, we confirm the main finding of this study that the most constrained firms not only failed to yield a premium as a

[12] In particular, for each month we deduct from the calculated measure the corresponding mean industry value and divide by the corresponding standard deviation of industry values.

[13] The corresponding tables of descriptive statistics and alphas for the rest industry-adjusted financial constraints proxies are readily available upon request.

compensation to investors for withholding them, but they rather severely underperformed the rest listed shares. This result cannot be attributed to an industry effect.

2.4.2 Higher co-moments risk factors

The limited ability of the commonly used models to price the cross-section of KZ and WW-sorted portfolios motivates us to investigate whether other risk factors may be more successful. To this end, we employ the higher co-moments asset pricing model in the spirit of Harvey and Siddique (2000), Dittmar (2002), Hung et al. (2004) and Kostakis et al. (2012). The motivation to employ this model is that the shares of financially constrained firms may exhibit negative coskewness and positive cokurtosis risk, or more generally tail risk, since these firms are typically more likely to go bankrupt and yield extreme negative returns when bankruptcy occurs. These features are undesirable and a typical investor would require a premium for holding such shares (see Dittmar, 2002 and Dichtl and Drobetz, 2011). Hence, we test whether coskewness or cokurtosis risk factors can explain away the KZ and WW-sorted portfolios' alphas. To this end, we augment the CAPM with the coskewness $(S^- - S^+)$ and cokurtosis $(K^+ - K^-)$ factors, leading to the following higher co-moments model:[14]

$$R_{p,t} - R_t^f = \alpha_p + \beta_{MKT}\left(R_{m,t} - R_t^f\right) + \beta_{S^- - S^+}\left(S^- - S^+\right)_t + \beta_{K^+ - K^-}\left(K^+ - K^-\right)_t + e_{p,t} \tag{2.4}$$

We estimate alphas and factor loadings for each set of portfolios via (2.4) and we report them in Table 2.11.

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[14] The coskewness factor $(S^- - S^+)$ has been constructed as a zero-cost spread between the portfolio containing the 20% of the shares exhibiting the most negative coskewness with respect to the market portfolio (S^-) and the portfolio containing the 20% of the shares exhibiting the most positive coskewness (S^+). Similarly, the cokurtosis factor $(K^+ - K^-)$ has been constructed as a zero-cost spread between the portfolio containing the 20% of the shares exhibiting the most positive cokurtosis with respect to the market portfolio (K^+) and the portfolio containing the 20% of the shares exhibiting the most negative cokurtosis (K^-). For more details, see Kostakis et al. (2012).

With respect to KZ-sorted portfolios (Panel A), we get very similar results to the benchmark results reported in Panel A of Table 2.9. The portfolio containing the most constrained firms (P10) yields a highly statistically and economically significant negative abnormal performance (-15.47% p.a.) even after adjusting for coskewness and cokurtosis risk. As with the CAPM, Fama-French and Carhart alphas, the portfolio containing the least constrained firms (P1) also yields a significantly negative abnormal performance, while the portfolios in the middle of the distribution yield alphas close to zero and insignificant. The zero-cost strategy (P10-P1) still yields a highly negative abnormal performance (-8.31% p.a.), though this is not statistically significant. The estimates for market, coskewness and cokurtosis factor loadings do not reveal any particular pattern as we move from the portfolios of the least constrained firms to the portfolios of the most constrained firms. In conclusion, even though the higher co-moments model does a better job in explaining overall the performance of all ten KZ-sorted portfolios and the null hypothesis of jointly zero alphas cannot be rejected at any conventional level, the abnormal performance we have previously documented in the extreme deciles cannot be explained by exposure to coskewness and cokurtosis risk factors.

Even more interesting are the results we derive by applying this model to the WW-sorted portfolios (Panel B of Table 2.11). Overall, the null hypothesis of jointly zero alphas along the decile portfolios can be rejected at any level of statistical significance, showing the inability of coskewness and cokurtosis risk factors to explain the abnormal performance of WW-sorted portfolios. As with the commonly used asset pricing models (see Panel B of Table 2.9), we still observe an interesting negative gradient as we move from P1 to P10 and the spread strategy P10-P1 yields a remarkable alpha of -22.32% p.a., reflecting the highly negative abnormal performance of the portfolio containing the most constrained firms (P10). With respect to factor loadings, we find no particular pattern with respect to market and coskewness risk exposure. On the other hand, the portfolios with highly constrained firms (P8 to P10) tend to be much less exposed to cokurtosis risk, but this differential is by no means enough to explain the differential performance relative to portfolios containing the least constrained firms (P1 to P3). These findings lead to the conclusion that the underperformance of the most constrained firms, sorted on the basis of either KZ or WW-index values, is a genuine finding that cannot be explained by exposure to higher co-moments risk either.

2.4.3 Quintile portfolios

The asset pricing tests we have performed show that the negative spread between the most and the least constrained firms as classified according to the WW-index, is highly statistically and economically significant and it cannot be explained by the commonly used asset pricing models. In this and the following subsections we attempt to investigate further the robustness of this puzzling negative abnormal performance. A potential concern could be that this spread appears only between extreme decile portfolios, and hence it is concentrated only on a small fraction of firms' population. To address this concern, we alternatively construct *quintile* portfolios that naturally contain a much larger number of stocks and calculate their post-ranking value-weighted monthly excess returns. Apart from reporting the characteristics and premia of these quintile portfolios in Table 2.12, we also estimate their Jensen, Fama-French and Carhart alphas from time-series regressions (2.1), (2.2) and (2.3) respectively.

The most striking result is that the spread between the quintile portfolio containing the most constrained firms (Q5) and the quintile portfolio containing the least constrained firms (Q1) is highly negative (-14.44% p.a.) and strongly statistically significant (*t*-value= -2.95). This negative spread mainly derives from the severe underperformance of Q5. Adjusting these returns for their market, size, value and momentum risk exposure, this finding remains intact. Q5 has significantly underperformed Q1 during our sample period and the spread strategy yielded highly significant negative alphas (Jensen alpha: -14.13% p.a., Fama-French alpha: -12.94% p.a. and Carhart alpha: -13.17% p.a.). Finally, it is interesting to note that there is a clear monotonic deterioration of (raw and risk-adjusted) performance as we move from the quintile portfolios of the least constrained firms to the most constrained ones.

2.4.4 Double-sorted portfolios

The characteristics of WW-sorted decile and quintile portfolios reported in Panel B of Table 2.5 and Table 2.12, respectively, revealed a clear negative size gradient with the most constrained firms predominantly having small market values. As a result, a potential concern could be that the spread between the most and the least constrained firms reflects a potential size effect. Even though we have already shown that this abnormal underperformance does not disappear when we account for the SMB factor in the Fama-French and Carhart models, we further examine its robustness by double-sorting the firms on their market values and their WW-index values independently. To ensure that there is a sufficient number of firms in each of the 6 (2x3) double-sorted portfolios we construct, the following classification scheme is used: a firm is categorized as Small in a given month if its market value is below the median market value of all firms in this month and Big if it is above the median. Moreover, a firm is categorized as Least Constrained if its WW value is below the 40th percentile of the firms' WW values' distribution in this month, Neutral if its value is between the 40th and the 70th percentiles and Most Constrained if its value is above the 70th percentile of the distribution.[15] As before, we calculate the post-

[15] We have also experimented with alternative percentiles for firms' classification. Results, which are readily available upon request, are very similar to the ones presented here, and hence they are very robust to the choice of the cutoff percentiles.

ranking monthly value-weighted excess returns of these portfolios and we estimate their Jensen, Fama-French and Carhart alphas. Results are reported in Table 2.13.

The severe underperformance of the most constrained firms relative to the least constrained ones is remarkably robust across the two size categories. The Most-Least spread strategy yields a return of -13.42% p.a. among Small firms and -14.25% p.a. among Big firms. These negative spreads remain intact and highly economically and statistically significant even after adjusting for market, size, value and momentum risk factors. For example, the Carhart alpha of the Most-Least strategy is -13.17% p.a. (*t*-value= -3.79) for Small firms and -12.75% p.a. (*t*-value= -2.53) for Big firms. This abnormal underperformance mainly derives from the severely negative performance of the Most constrained firms. This finding also holds independent of the Size category the firms belong to and confirm that the benchmark results of our study are very robust.

2.5 Conclusions

The present study contributes to the literature by providing for the first time comprehensive evidence on the pricing of the financial constraints risk on London Stock Exchange using a detailed dataset of non-financial firms during the period 1988- 2010. The main finding of our study is that investors in highly constrained firms were not rewarded for being exposed to this aspect of risk. To the contrary, the portfolio containing the most constrained firms underperformed the portfolio containing the least constrained firms in almost every case we have examined. With the exception of leverage ratios and cash holdings that did not yield significant differential performance, the relative underperformance of the most constrained firms was highly significant, both in economic and in statistical terms. The reported underperformance was even more striking using the composite Whited-Wu index that jointly captures various aspects of financial constraints. This remarkable finding was confirmed via a series of asset pricing tests and it was found to be robust to potential industry effects, higher co-moments risk adjustment or alternative portfolio sorting schemes. Regarding the exception of cash holdings and leverage ratios, we conjecture that this may be explained by the arguments of Simutin (2010) and Caskey et al. (2012), respectively, claiming that deviations from firms' optimal leverage and cash holdings targets matter more for future returns than the levels of these variables. We intend to investigate this issue for the UK market in future research.

Apart from the obvious implications for asset pricing and investment management, our results have important implications for firms' optimal capital structure decisions too. Since investors on London Stock Exchange did not penalize financially constrained firms by requiring higher premia for holding their shares, one could argue that managers were acting rationally in leveraging up their firms. The offsetting mechanism of the trade-off theory broke down, the cost of capital did not increase in line with the debt-to-equity capital mixture, and hence managers rationally chose to utilize the cheaper source of external capital. Empirical tests of capital structure theories in the UK should take our findings into account.

Table 2.1
Definitions of Financial Constraints proxies

This Table contains the definitions of eight financial constraints proxies used to classify all of the non-financial firms listed on LSE into quintile portfolios as well as the Datastream and Worldscope data items used to calculate them.

Financial Constraints measure	**Definition**	**Data Items used**
1. Total Assets	Book Value of Total Assets$_t$	Worldscope item: WC02999
2. Tangible-to-Total Assets ratio	$\frac{\text{Tangible Assets}_t}{\text{Total Assets}_t}$	Worldscope item: WC02501
3. Total Debt-to-Common Equity ratio	$\frac{\text{Total Debt}_t}{\text{Book Value of Common Equity}_t}$	Worldscope item: WC08231
4. Total Debt-to-Market Value ratio	$\frac{\text{Total Debt}_t}{\text{Market Value}_t}$	Worldscope item: WC03255 and MV
5. Cash holdings-to-Total Assets ratio	$\frac{\text{Cash Holdings}_t}{\text{Total Assets}_t}$	Worldscope item: WC02001 and WC02999
6. Interest Coverage ratio	$\frac{\text{EBIT}_t}{\text{Total Interest Expense ratio}_t}$	Worldscope item: WC08291
7. Kaplan-Zingales (KZ) index	$\text{KZ}_t = -1.002 \times \frac{\text{Cash Flow}_t}{\text{Prop, Plant and Equip}_{t-1}}$ $+0.283 \times \text{Tobin's Q}_t$ $+3.139 \times \frac{\text{Total Debt}_t}{\text{Total Capital}_t}$ $-39.368 \times \frac{\text{Dividends Paid}_t}{\text{Prop, Plant and Equip}_{t-1}}$ $-1.315 \times \frac{\text{Cash Holdings}_t}{\text{Prop, Plant and Equip}_{t-1}}$	Worldscope item: WC01250, WC01151, WC02501, WC02999, WC03501, WC03451, MV, WC03255, WC03998, WC04551 and WC02001
8. Whited-Wu (WW) index	$\text{WW}_t = -0.091 \times \frac{\text{Cash Flow}_t}{\text{Total Assets}_t}$ $-0.062 \times \text{Dividend dummy}_t$ $+0.021 \times \frac{\text{Long-term Debt}_t}{\text{Total Assets}_t}$ $-0.044 \times \ln(\text{Total Assets}_t)$ $+0.102 \times \text{Industry Sales Growth}_t$ $-0.035 \times \text{Firm Sales Growth}_t$	Worldscope item: WC01250, WC01151, WC02999, WC04551, WC03251, WC01001 and FTAG3 for industry classification

Table 2.2

Characteristics of decile stock portfolios constructed on the basis of Total Assets and Tangible-to-Total Assets ratio

This table reports the characteristics of portfolios constructed on the basis of Total Assets (Panel A) and Tangible-to-Total Assets ratio (Panel B). All stocks listed on the London Stock Exchange from 1988 to 2010 are sorted at month *t* and they are assigned to ten portfolios. **P1** is the decile portfolio containing the stocks of the **least constrained** firms (highest values of Total Assets in Panel A and highest values of Tangible-to-Total Assets ratio in Panel B) and **P10** is the decile portfolio containing the stocks of the **most constrained** firms (lowest values of Total Assets in Panel A and lowest values of Tangible-to-Total Assets ratio in Panel B). The returns of these portfolios in excess of the risk-free rate at month *t+1* are calculated (i.e. post-ranking returns). **P10-P1** stands for the spread return between P10 and P1. Portfolios are rebalanced on a monthly basis. EW returns correspond to the annualized average monthly excess returns of equal weighted portfolios. VW returns refer to the annualized average monthly excess returns of value weighted portfolios. MV is the average market value of the stocks in each portfolio (in £m). The last column reports values for t-tests referring to the null hypothesis of no difference in means between portfolios' P10 and P1 characteristics.

PANEL A: TOTAL ASSETS												
	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	P10-P1	*t*-test
	Least Constrained									Most Constrained		
EW returns (% p.a.)	6.97	5.36	2.67	3.71	3.40	1.51	2.34	-0.62	3.24	5.56	-1.40	-0.28
VW returns (% p.a.)	4.82	3.25	1.30	1.81	3.95	2.82	-1.02	-3.26	-6.07	-7.65	-12.47	-2.40
Total Assets (£m)	6811.38	546.36	197.00	100.89	58.44	35.94	22.68	14.08	7.77	2.94	-6808.45	-30.45
MV (£m)	5546.47	531.02	206.89	116.33	66.76	42.40	27.48	19.43	12.57	7.85	-5538.63	-34.40
CAPM Beta	0.92	1.10	1.02	0.97	0.91	0.94	0.93	0.87	0.73	0.72		

PANEL B: TANGIBLE/ TOTAL ASSETS RATIO (%)												
	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	P10-P1	*t*-test
	Least Constrained									Most Constrained		
EW returns (% p.a.)	3.89	4.78	4.01	2.57	1.59	3.00	1.49	3.19	1.63	7.90	4.01	1.04
VW returns (% p.a.)	7.96	7.44	1.72	2.99	5.70	5.08	3.69	1.83	2.29	-0.65	-8.61	-2.09
Tangible/T. Assets (%)	81.53	58.75	44.45	35.31	27.95	22.07	17.33	13.00	8.67	3.08	-78.45	-287.90
MV (£m)	905.31	1633.56	677.81	858.14	776.56	580.59	369.80	318.25	252.53	201.83	-703.48	-19.09
CAPM Beta	0.87	0.93	1.07	0.85	0.92	0.78	0.91	1.16	1.15	1.06		

Table 2.3

Characteristics of decile stock portfolios constructed on the basis of Debt-to-Common Equity and Debt-to-Market Value ratios

This table reports the characteristics of portfolios constructed on the basis of Debt-to-Common Equity (Panel A) and Debt-to-Market Value ratio (Panel B). All stocks listed on the London Stock Exchange from 1988 to 2010 are utilized. **P0** contains the firms with zero leverage ratios in each month. The rest firms are sorted at month *t* and they are assigned to ten portfolios. **P1** is the decile portfolio containing the stocks of the **least constrained** firms (lowest values of Debt-to-Common Equity ratio in Panel A and lowest values of Debt-to-Market Value ratio in Panel B) and **P10** is the decile portfolio containing the stocks of the **most constrained** firms (highest values of Debt-to-Common Equity ratio in Panel A and highest values of Debt-to-Market Value ratio in Panel B). The returns of these portfolios in excess of the risk-free rate at month *t+1* are calculated. **P10-P1** stands for the spread return between P10 and P1. Portfolios are rebalanced on a monthly basis. EW returns and VW returns correspond to the annualized average monthly excess returns of equally weighted and value weighted portfolios respectively. MV is the average market value of the stocks in each portfolio (in £m). The last column reports values for t-tests referring to the null hypothesis of no difference in means between portfolios' P10 and P1 characteristics.

PANEL A: TOTAL DEBT/ COMMON EQUITY RATIO (%)													
	P0	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	P10-P1	*t*-test
	Zero	Least Constrained								Most Constrained			
EW returns (% p.a.)	8.85	6.07	6.67	4.76	3.91	4.87	3.82	3.24	1.86	-1.19	-2.95	-9.02	-2.91
VW returns (% p.a.)	7.34	5.26	6.44	5.74	4.38	6.41	7.55	4.89	3.82	2.54	4.57	-0.69	-0.18
Debt/ Equity (%)	0.00	1.30	6.48	14.30	23.37	33.46	45.13	59.43	79.88	117.70	691.95	650.45	33.26
MV (£m)	1127.1	151.7	313.6	786.1	736.2	1341.6	822.6	857.4	898.9	1109.4	929.2	777.5	22.06
CAPM Beta	1.09	1.04	0.92	0.92	1.08	0.95	1.00	1.01	0.94	0.83	0.91		

PANEL B: TOTAL DEBT/ MARKET VALUE RATIO (%)													
	P0	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	P10-P1	*t*-test
	Zero	Least Constrained								Most Constrained			
EW returns (% p.a.)	8.86	3.09	2.95	3.82	1.85	2.34	1.95	2.26	-0.63	2.12	6.72	3.63	0.86
VW returns (% p.a.)	7.22	3.46	1.54	6.75	3.20	3.79	5.73	8.42	4.95	6.93	5.13	1.67	0.26
Debt/ MV (%)	0.00	0.58	3.15	7.30	12.54	19.24	27.43	38.47	55.16	87.55	592.28	591.7	10.24
MV (£m)	1118.5	242.1	459.6	758.5	1442.4	1391.1	1132.9	929.1	594.2	454.6	158.9	-83.2	-8.8
CAPM Beta	1.09	0.95	0.78	0.84	0.91	0.91	1.00	0.96	1.04	1.02	1.44		

Table 2.4

Characteristics of decile stock portfolios constructed on the basis of Cash holdings-to-Total Asset and Interest Coverage ratios

This table reports the characteristics of portfolios constructed on the basis of Cash holdings-to-Total Assets ratio (Panel A) and Interest Coverage ratio (Panel B). All stocks listed on the London Stock Exchange from 1988 to 2010 are sorted at month *t* and they are assigned to ten portfolios. **P1** is the decile portfolio containing the stocks of the **least constrained** firms (highest values of Cash holdings-to-Total Assets ratio in Panel A and highest values of Interest Coverage ratio in Panel B) and **P10** is the decile portfolio containing the stocks of the **most constrained** firms (lowest values of Cash holdings-to-Total Assets ratio in Panel A and lowest values of Interest Coverage ratio in Panel B). The returns of these portfolios in excess of the risk-free rate at month *t+1* are calculated (i.e. post-ranking returns). **P10-P1** stands for the spread return between P10 and P1. Portfolios are rebalanced on a monthly basis. EW returns correspond to the annualized average monthly excess returns of equal weighted portfolios. VW returns refer to the annualized average monthly excess returns of value weighted portfolios. MV is the average market value of the stocks in each portfolio (in £m). The last column reports values for t-tests referring to the null hypothesis of no difference in means between portfolios' P10 and P1 characteristics.

PANEL A: CASH HOLDINGS/ TOTAL ASSETS RATIO (%)

	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	P10-P1	*t*-test
	Least Constrained									Most Constrained		
EW returns (% p.a.)	6.01	10.16	7.13	5.58	4.35	1.76	2.13	0.57	-0.84	-2.85	-8.86	-1.97
VW returns (% p.a.)	-1.98	7.91	3.53	3.96	4.84	5.15	4.25	4.27	4.44	-1.83	0.15	0.03
Cash/ T. Assets (%)	57.78	30.08	19.55	13.47	9.50	6.56	4.23	2.37	0.97	0.13	-57.65	-70.56
MV (£m)	169.23	308.29	647.93	866.24	779.79	931.70	1043.55	828.82	792.42	188.66	19.43	0.96
CAPM Beta	1.19	1.08	0.92	0.85	0.91	0.95	0.95	1.00	0.88	0.92		

PANEL B: INTEREST COVERAGE RATIO

	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	P10-P1	*t*-test
	Least Constrained									Most Constrained		
EW returns (% p.a.)	12.87	13.61	10.23	12.53	8.85	7.59	7.64	6.37	0.50	-4.38	-17.26	-7.02
VW returns (% p.a.)	8.02	8.82	6.46	10.33	4.45	6.75	5.85	3.72	-0.35	-6.86	-14.89	-3.84
Interest Coverage	83.06	41.76	18.64	11.54	8.11	6.03	4.59	3.42	2.34	1.05	-82.01	-90.68
MV (£m)	299.18	929.21	1493.09	1156.12	1147.29	1224.78	1060.77	900.09	557.74	453.69	154.51	5.70
CAPM Beta	0.98	0.82	0.89	0.91	0.95	0.86	0.93	0.95	0.93	1.10		

Table 2.5

Characteristics of decile stock portfolios constructed on the basis of composite Kaplan-Zingales and Whited-Wu indices

This table reports the characteristics of portfolios constructed on the basis of Kaplan-Zingales (Panel A) and Whited-Wu (Panel B) composite indices of financial constraints. All stocks listed on the LSE from 1988 to 2010 are sorted at month *t* and they are assigned to ten portfolios. **P1** is the decile portfolio containing the stocks of the **least constrained** firms (lowest values of Kaplan-Zingales (KZ) index in Panel A and lowest values of Whited-Wu (WW) index in Panel B) and **P10** is the decile portfolio containing the stocks of the **most constrained** firms (highest values of KZ index in Panel A and highest values of WW index in Panel B). The returns of these portfolios in excess of the risk-free rate at month *t+1* are calculated (i.e. post-ranking returns). **P10-P1** stands for the spread return between P10 and P1. Portfolios are rebalanced on a monthly basis. EW returns correspond to the annualized average monthly excess returns of equal weighted portfolios. VW returns refer to the annualized average monthly excess returns of value weighted portfolios. MV is the average market value of the stocks in each portfolio (in £m). The last column reports values for t-tests referring to the null hypothesis of no difference in means between portfolios' P10 and P1 characteristics.

PANEL A: KAPLAN-ZINGALES (KZ) INDEX												
	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	P10-P1	*t*-test
	Least Constrained									Most Constrained		
EW returns (% p.a.)	4.31	4.55	4.23	6.22	3.02	7.12	5.23	4.61	-2.04	-8.84	-13.15	-4.69
VW returns (% p.a.)	-1.00	3.80	5.39	2.52	5.28	3.84	5.89	5.73	3.24	-10.45	-9.45	-2.06
KZ Index	-24.58	-15.96	-9.27	-5.61	-3.47	-1.98	-0.87	0.03	1.04	2.87	27.45	86.22
MV (£m)	255.39	595.88	1193.53	690.50	936.63	1267.27	723.08	755.79	406.42	146.83	-108.55	-12.04
CAPM Beta	1.02	0.87	0.78	0.90	0.97	1.04	1.05	0.93	1.09	1.11		

PANEL B: WHITED-WU (WW) INDEX												
	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	P10-P1	*t*-test
	Least Constrained									Most Constrained		
EW returns (% p.a.)	5.61	5.91	4.36	4.75	4.60	3.43	1.39	-0.23	0.51	0.54	-5.07	-1.08
VW returns (% p.a.)	4.90	2.57	3.78	3.32	0.56	0.63	-1.89	-5.23	-7.40	-14.83	-19.73	-3.37
WW index	-0.42	-0.35	-0.31	-0.27	-0.25	-0.22	-0.19	-0.16	-0.12	-0.03	0.39	114.16
MV (£m)	5660.78	658.05	242.76	127.71	75.72	51.47	32.67	21.78	17.65	13.10	-5647.69	-31.65
CAPM Beta	0.91	1.14	0.98	0.94	0.92	1.05	0.99	0.95	0.83	0.92		

Table 2.6

Alphas of value-weighted decile stock portfolios constructed on the basis of Total Assets and Tangible-to-Total Assets ratio

This table reports the abnormal performance of ten value-weighted stock portfolios constructed on the basis of Total Assets (Panel A) and Tangible-to-Total Assets ratio (Panel B). **P1** is the decile portfolio containing the stocks of the **least constrained** firms (highest values of Total Assets in Panel A and highest values of Tangible-to-Total Assets ratio in Panel B) and **P10** is the decile portfolio containing the stocks of the **most constrained** firms (lowest values of Total Assets in Panel A and lowest values of Tangible-to-Total Assets ratio in Panel B). **P10-P1** stands for the zero-cost strategy that goes long the portfolio of the most constrained firms (P10) and sells short the portfolio with the least constrained firms (P1). CAPM alpha is the annualized alpha estimate derived from the Capital Asset Pricing Model. Fama-French alpha is the annualized alpha estimate from the Fama-French 3-factor model. Carhart alpha is the annualized alpha estimate from the Carhart 4-factor model. t-statistics are reported in parentheses. ***, ** and * indicate statistical significance at the 1%, 5% and 10% level, respectively. The last column reports the chi-square (χ^2) statistic of the Wald test for the null hypothesis that the ten portfolios' alphas are jointly equal to zero in each case; p-values are reported below the statistic.

	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	P10-P1	Chi-sq.
PANEL A: TOTAL ASSETS												
	Least Constrained								Most Constrained			
CAPM alpha (% p.a.)	1.07	-1.24	-2.88	-2.15	0.23	-1.03	-4.83	-6.82	-9.07	-10.59	-11.66	37.89
	(1.57)	(-0.57)	(-0.94)	(-0.62)	(0.06)	(-0.23)	(-1.00)	(-1.30)	(-1.62)	(-1.63)	(-1.75)*	(0.00)
Fama-French alpha (% p.a.)	0.99	-0.91	-2.12	-1.34	0.89	-0.06	-3.70	-5.79	-8.13	-9.16	-10.14	30.53
	(1.57)	(-0.66)	(-1.31)	(-0.78)	(0.49)	(-0.02)	(-1.28)	(-1.78)*	(-2.22)**	(-1.96)**	(-2.21)**	(0.00)
Carhart alpha (% p.a.)	0.49	-1.39	-2.36	-2.12	-0.09	-0.07	-4.94	-7.21	-9.37	-10.63	-11.12	37.89
	(0.78)	(-0.97)	(-1.32)	(-1.32)	(-0.05)	(-0.03)	(-1.83)*	(-2.41)**	(-2.59)***	(-2.34)**	(-2.52)**	(0.00)
PANEL B: TANGIBLE/ TOTAL ASSETS RATIO (%)												
	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	P10-P1	Chi-sq.
	Least Constrained								Most Constrained			
CAPM alpha (% p.a.)	4.37	3.62	-2.67	-0.48	1.93	1.88	-0.05	-2.94	-2.43	-4.99	-9.36	11.61
	(1.78)*	(2.00)**	(-1.37)	(-0.28)	(0.93)	(0.96)	(-0.02)	(-1.00)	(-0.61)	(-1.47)	(-2.21)**	(0.31)
Fama-French alpha (% p.a.)	3.77	3.41	-2.89	-0.42	1.73	1.92	0.00	-2.47	-1.47	-4.64	-8.40	13.29
	(1.75)*	(1.90)*	(-1.66)	(-0.24)	(0.83)	(0.99)	(0.00)	(-1.01)	(-0.54)	(-1.54)	(-2.38)**	(0.21)
Carhart alpha (% p.a.)	2.68	1.47	-1.89	0.82	2.27	1.50	0.60	-1.39	-0.42	-3.69	-6.37	6.30
	(1.02)	(0.80)	(-0.98)	(0.45)	(1.02)	(0.70)	(0.22)	(-0.62)	(-0.17)	(-1.41)	(-1.87)*	(0.79)

Table 2.7

Alphas of value-weighted decile stock portfolios constructed on the basis of Debt-to-Common Equity and Debt-to-Market Value ratios

This table reports the abnormal performance of value-weighted portfolios constructed on the basis of Debt-to-Common Equity (Panel A) and Debt-to-Market Value ratios (Panel B). **P0** contains the firms with zero leverage ratios in each month. All the rest firms are assigned to ten portfolios. **P1** is the decile portfolio containing the **least constrained** firms (lowest positive values of Debt-to-Common Equity ratio in Panel A and lowest positive values of Debt-to-Market Value ratio in Panel B) and **P10** is the decile portfolio containing the **most constrained** firms (highest values of Debt-to-Common Equity ratio in Panel A and highest values of Debt-to-Market Value ratio in Panel B). **P10-P1** stands for the zero-cost strategy that goes long the portfolio of the most constrained firms (P10) and sells short the portfolio with the least constrained firms (P1). CAPM, Fama-French and Carhart alphas are the annualized alpha estimates derived from the Capital Asset Pricing Model, the Fama-French 3-factor model and the Carhart 4-factor model respectively. t-statistics are reported in parentheses. ***, ** and * indicate statistical significance at the 1%, 5% and 10% level, respectively. The last column reports the chi-square statistic of the Wald test for the null hypothesis that the ten portfolios' alphas are jointly equal to zero; p-values are reported below the statistic.

PANEL A: TOTAL DEBT/ COMMON EQUITY RATIO (%)

	P0	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	P10-P1	Chi-sq.
	Zero	Least Constrained								Most Constrained			
CAPM alpha (% p.a.)	2.88	1.01	2.68	1.96	-0.06	2.50	3.44	0.75	-0.03	-0.87	0.83	-0.18	10.37
	(0.54)	(0.27)	(0.98)	(0.73)	(-0.03)	(1.14)	(1.76)*	(0.40)	(-0.02)	(-0.47)	(0.41)	(-0.04)	(0.41)
Fama-French alpha (% p.a.)	4.44	2.18	2.96	1.63	-0.08	2.10	3.34	0.55	-0.18	-0.84	1.15	-1.02	10.89
	(1.23)	(0.79)	(1.12)	(0.58)	(-0.03)	(0.98)	(1.69)*	(0.30)	(-0.10)	(-0.45)	(0.58)	(-0.29)	(0.37)
Carhart alpha (% p.a.)	2.50	1.32	2.42	2.03	1.72	0.58	2.82	-0.38	0.33	-0.30	0.53	-0.79	7.15
	(0.77)	(0.54)	(0.84)	(0.70)	(0.91)	(0.25)	(1.32)	(-0.20)	(0.17)	(-0.15)	(0.25)	(-0.22)	(0.71)

PANEL B: TOTAL DEBT/ MARKET VALUE RATIO (%)

	P0	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	P10-P1	Chi-sq.
	Zero	Least Constrained								Most Constrained			
CAPM alpha (% p.a.)	2.75	-0.44	-1.65	3.30	-0.51	0.05	1.64	4.47	0.69	2.76	-0.79	-0.35	8.97
	(0.52)	(-0.12)	(-0.57)	(1.46)	(-0.32)	(0.03)	(1.01)	(1.95)*	(0.24)	(0.97)	(-0.14)	(-0.05)	(0.54)
Fama-French alpha (% p.a.)	4.31	1.01	-1.29	3.78	-0.58	-0.12	1.43	4.23	0.21	2.25	-2.21	-3.22	10.13
	(1.19)	(0.42)	(-0.47)	(1.83)*	(-0.36)	(-0.06)	(0.88)	(1.96)**	(0.08)	(0.88)	(-0.56)	(-0.70)	(0.43)
Carhart alpha (% p.a.)	2.38	-0.38	-1.82	2.13	-0.63	-1.48	0.76	4.26	1.69	5.12	5.05	5.43	9.21
	(0.73)	(-0.15)	(-0.65)	(1.01)	(-0.32)	(-0.65)	(0.46)	(1.78)*	(0.69)	(1.99)**	(1.08)	(1.10)	(0.51)

Table 2.8

Alphas of value-weighted decile stock portfolios constructed on the basis of Cash holdings-to-Total Assets and Interest Coverage ratios

This table reports the abnormal performance of ten value-weighted stock portfolios constructed on the basis of Cash holdings-to-Total Assets (Panel A) and Interest Coverage ratios (Panel B). **P1** is the decile portfolio containing the stocks of the **least constrained** firms (highest values of Cash holdings-to-Total Assets ratio in Panel A and highest values of Interest Coverage ratio in Panel B) and **P10** is the decile portfolio containing the stocks of the **most constrained** firms (lowest values of Cash holdings-to-Total Assets ratio in Panel A and lowest values of Interest Coverage ratio in Panel B). **P10-P1** stands for the zero-cost strategy that goes long the portfolio of the most constrained firms (P10) and sells short the portfolio with the least constrained firms (P1). CAPM alpha is the annualized alpha estimate derived from the Capital Asset Pricing Model. Fama-French alpha is the annualized alpha estimate from the Fama-French 3-factor model. Carhart alpha is the annualized alpha estimate from the Carhart 4-factor model. t-statistics are reported in parentheses. ***, ** and * indicate statistical significance at the 1%, 5% and 10% level, respectively. The last column reports the chi-square (χ^2) statistic of the Wald test for the null hypothesis that the ten portfolios' alphas are jointly equal to zero in each case; p-values are reported below the statistic.

	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	P10-P1	Chi-sq.
PANEL A: CASH HOLDINGS/ TOTAL ASSETS RATIO (%)												
	Least Constrained									Most Constrained		
CAPM alpha (% p.a.)	-6.85	3.47	-0.25	0.48	1.12	1.24	0.34	0.17	0.83	-5.61	1.24	14.11
	(-1.10)	(1.15)	(-0.13)	(0.30)	(0.56)	(0.74)	(0.18)	(0.09)	(0.30)	(-1.92)*	(0.17)	(0.17)
Fama-French alpha (% p.a.)	-5.22	4.16	-0.26	0.76	1.08	1.38	0.04	-0.15	0.63	-5.69	-0.48	17.21
	(-1.12)	(1.71)*	(-0.14)	(0.47)	(0.54)	(0.84)	(0.03)	(-0.08)	(0.25)	(-2.29)**	(-0.08)	(0.07)
Carhart alpha (% p.a.)	-5.43	3.60	0.34	0.72	1.14	0.37	-0.34	-0.57	-0.11	-5.80	-0.37	13.55
	(-1.27)	(1.60)	(0.18)	(0.41)	(0.53)	(0.25)	(-0.18)	(-0.29)	(-0.04)	(-2.40)**	(-0.07)	(0.19)
PANEL B: INTEREST COVERAGE RATIO												
	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	P10-P1	Chi-sq.
	Least Constrained									Most Constrained		
CAPM alpha (% p.a.)	3.71	5.18	2.52	6.29	0.27	2.97	1.75	-0.47	-4.43	-11.71	-15.41	43.97
	(1.30)	(1.88)*	(1.23)	(3.62)***	(0.15)	(1.68)	(0.66)	(-0.23)	(-1.90)	(-3.51)***	(-3.49)***	(0.00)
Fama-French alpha (% p.a.)	4.07	5.95	2.67	6.32	0.48	2.90	1.70	-0.81	-4.77	-11.66	-15.73	48.32
	(1.71)*	(2.26)**	(1.33)	(3.71)***	(0.26)	(1.63)	(0.68)	(-0.42)	(-2.35)**	(-3.56)***	(-3.71)***	(0.00)
Carhart alpha (% p.a.)	4.58	2.70	1.93	4.69	-1.56	2.51	1.88	0.69	-4.58	-11.77	-16.35	29.81
	(1.97)**	(0.96)	(0.86)	(2.43)**	(-0.89)	(1.41)	(0.69)	(0.36)	(-1.92)*	(-3.46)***	(-3.68)***	(0.00)

Table 2.9

Alphas of value-weighted decile stock portfolios constructed on the basis of composite Kaplan-Zingales and Whited-Wu indices

This table reports the abnormal performance of ten value-weighted stock portfolios constructed on the basis of Kaplan-Zingales (Panel A) and Whited-Wu (Panel B) indices of financial constraints. **P1** is the decile portfolio containing the stocks of the **least constrained** firms (lowest values of Kaplan-Zingales (KZ) index in Panel A and lowest values of Whited-Wu (WW) index in Panel B) and **P10** is the decile portfolio containing the stocks of the **most constrained** firms (highest values of KZ index in Panel A and highest values of WW index in Panel B). **P10-P1** stands for the zero-cost strategy that goes long the portfolio of the most constrained firms (P10) and sells short the portfolio with the least constrained firms (P1). CAPM alpha is the annualized alpha estimate derived from the Capital Asset Pricing Model. Fama-French alpha is the annualized alpha estimate from the Fama-French 3-factor model. Carhart alpha is the annualized alpha estimate from the Carhart 4-factor model. t-statistics are reported in parentheses. ***, ** and * indicate statistical significance at the 1%, 5% and 10% level, respectively. The last column reports the chi-square (χ^2) statistic of the Wald test for the null hypothesis that the ten portfolios' alphas are jointly equal to zero in each case; p-values are reported below the statistic.

PANEL A: KAPLAN-ZINGALES (KZ) INDEX												
	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	P10-P1	Chi-sq.
	Least Constrained									Most Constrained		
CAPM alpha (% p.a.)	-5.23	0.19	2.16	-1.19	1.27	-0.47	1.56	1.90	-1.26	-15.03	-9.80	17.12
	(-1.85)*	(0.09)	(1.10)	(-0.55)	(0.60)	(-0.24)	(0.78)	(0.75)	(-0.54)	(-2.66)***	(-1.85)*	(0.07)
Fama-French alpha (% p.a.)	-4.82	0.73	2.75	-1.11	0.76	-0.68	1.51	1.58	-1.34	-14.46	-9.63	22.86
	(-1.90)*	(0.39)	(1.72)*	(-0.51)	(0.38)	(-0.33)	(0.75)	(0.66)	(-0.59)	(-3.11)***	(-1.90)*	(0.01)
Carhart alpha (% p.a.)	-3.74	1.25	2.70	-1.08	1.12	-0.99	0.87	0.16	-1.26	-15.08	-11.33	18.80
	(-1.67)*	(0.61)	(1.59)	(-0.50)	(0.54)	(-0.46)	(0.39)	(0.06)	(-0.51)	(-3.05)***	(-2.11)**	(0.04)
PANEL B: WHITED-WU (WW) INDEX												
	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	P10-P1	Chi-sq.
	Least Constrained									Most Constrained		
CAPM alpha (% p.a.)	1.14	-2.13	-0.28	-0.55	-3.25	-3.70	-5.96	-9.16	-10.84	-18.62	-19.75	22.84
	(1.53)	(-0.96)	(-0.12)	(-0.17)	(-0.87)	(-0.78)	(-1.19)	(-1.77)*	(-1.85)*	(-2.78)***	(-2.82)***	(0.01)
Fama-French alpha (% p.a.)	1.03	-1.87	0.08	0.09	-2.27	-2.43	-5.09	-8.43	-9.86	-17.31	-18.34	27.98
	(1.62)	(-1.37)	(0.05)	(0.05)	(-1.02)	(-0.87)	(-1.60)	(-2.39)**	(-2.32)**	(-3.57)***	(-3.75)***	(0.00)
Carhart alpha (% p.a.)	0.45	-1.11	-0.17	-1.42	-2.90	-3.13	-4.88	-8.21	-10.31	-17.91	-18.36	17.27
	(0.71)	(-0.80)	(-0.11)	(-0.73)	(-1.12)	(-1.19)	(-1.55)	(-2.24)**	(-2.39)**	(-3.57)***	(-3.67)***	(0.07)

Table 2.10

Alphas of value-weighted decile stock portfolios constructed on the basis of *industry-adjusted* Kaplan-Zingales and Whited-Wu indices

This table reports the abnormal performance of ten value-weighted stock portfolios constructed on the basis of *industry-adjusted* Kaplan-Zingales (Panel A) and Whited-Wu (Panel B) indices of financial constraints. **P1** is the decile portfolio containing the stocks of the **least constrained** firms adjusting for industry characteristics (lowest values of *industry-adjusted* Kaplan-Zingales (KZ) index in Panel A and Whited-Wu (WW) index in Panel B) and **P10** is the decile portfolio containing the stocks of the **most constrained** firms adjusting for industry characteristics (highest values of *industry-adjusted* KZ index in Panel A and WW index in Panel B). **P10-P1** stands for the zero-cost strategy that goes long the portfolio of the most constrained firms (P10) and sells short the portfolio with the least constrained firms (P1). CAPM, Fama-French and Carhart alphas are the annualized alpha estimates derived from the corresponding asset pricing models. t-statistics are reported in parentheses. ***, ** and * indicate statistical significance at the 1%, 5% and 10% level, respectively. The last column reports the chi-square (χ^2) statistic of the Wald test for the null hypothesis that the ten portfolios' alphas are jointly equal to zero in each case; p-values are reported below the statistic.

PANEL A: KAPLAN-ZINGALES (KZ) INDEX												
	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	P10-P1	Chi-sq.
	Least Constrained									Most Constrained		
CAPM alpha (% p.a.)	-1.17	4.45	-1.43	3.90	0.95	-0.61	1.60	1.07	-6.43	-10.92	-9.76	27.10
	(-0.51)	(2.36)**	(-0.73)	(2.16)**	(0.46)	(-0.19)	(0.79)	(0.49)	(-1.74)*	(-2.26)**	(-1.91)*	(0.00)
Fama-French alpha (% p.a.)	-0.83	4.75	-1.19	3.70	0.73	-0.55	1.53	0.73	-6.30	-10.78	-9.96	36.87
	(-0.39)	(2.65)***	(-0.64)	(2.00)**	(0.36)	(-0.17)	(0.77)	(0.36)	(-1.98)**	(-2.62)***	(-2.05)**	(0.00)
Carhart alpha (% p.a.)	-1.11	4.90	-1.24	2.95	0.45	-0.97	0.55	1.48	-5.27	-10.87	-9.75	28.63
	(-0.48)	(2.63)***	(-0.62)	(1.40)	(0.20)	(-0.26)	(0.25)	(0.67)	(-1.52)	(-2.46)**	(-1.83)*	(0.00)

PANEL B: WHITED-WU (WW) INDEX												
	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	P10-P1	Chi-sq.
	Least Constrained									Most Constrained		
CAPM alpha (% p.a.)	0.84	2.34	1.00	1.93	-1.00	-1.43	-3.02	-11.08	-7.26	-14.19	-15.02	33.32
	(0.96)	(1.31)	(0.52)	(0.67)	(-0.34)	(-0.44)	(-0.65)	(-2.67)***	(-1.29)	(-1.90)*	(-1.98)**	(0.00)
Fama-French alpha (% p.a.)	0.80	2.62	1.33	2.80	-0.36	-1.21	-2.37	-10.61	-6.53	-12.72	-13.52	30.65
	(0.93)	(1.74)*	(0.87)	(1.44)	(-0.18)	(-0.51)	(-0.78)	(-3.45)***	(-1.47)	(-2.40)**	(-2.62)***	(0.00)
Carhart alpha (% p.a.)	0.40	2.29	0.49	1.27	-2.37	-1.44	-2.68	-10.99	-7.07	-16.79	-17.19	33.42
	(0.48)	(1.42)	(0.32)	(0.66)	(-1.12)	(-0.54)	(-0.77)	(-3.37)***	(-1.55)	(-3.36)***	(-3.54)***	(0.00)

Table 2.11

Higher co-moments alphas and factor loadings of decile portfolios constructed on the basis of Kaplan-Zingales and Whited-Wu indices

This table reports the abnormal performance and the *higher co-moments* factor loadings of ten value-weighted stock portfolios constructed on the basis of Kaplan-Zingales (Panel A) and Whited-Wu (Panel B) indices of financial constraints. **P1** is the decile portfolio containing the stocks of the **least constrained** firms (lowest values of Kaplan-Zingales (KZ) index in Panel A and Whited-Wu (WW) index in Panel B) and **P10** is the decile portfolio containing the stocks of the **most constrained** firms (highest values of KZ index in Panel A and WW index in Panel B). **P10-P1** stands for the zero-cost strategy that goes long the portfolio of the most constrained firms (P10) and sells short the portfolio with the least constrained firms (P1). Higher co-moment alpha stands for the annualized alpha estimate derived from the higher co-moments asset pricing model in (2.4). Market loading, $\left(S^{-}-S^{+}\right)$ loading and $\left(K^{+}-K^{-}\right)$ loading stand for the point estimates of each portfolio returns' exposure to market, coskewness and cokurtosis factor returns, respectively. t-statistics for the alphas are reported in parentheses. ***, ** and * indicate statistical significance at the 1%, 5% and 10% level, respectively. The last column reports the chi-square (χ^2) statistic of the Wald test for the null hypothesis that the ten portfolios' alphas are jointly equal to zero in each case; p-values are reported below the statistic.

PANEL A: KAPLAN-ZINGALES (KZ) INDEX

	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	P10-P1	Chi-sq.
	Least Constrained								Most Constrained			
Higher co-moments alpha (% p.a.)	-7.16 (-2.33)***	-0.03 (-0.01)	2.95 (1.26)	0.04 (0.02)	2.08 (0.79)	-0.81 (-0.44)	1.65 (0.73)	-1.24 (-0.42)	-0.94 (-0.36)	-15.47 (-2.34)***	-8.31 (-1.32)	14.38 (0.16)
Market loading	1.06	0.93	0.82	0.89	0.94	0.98	1.00	0.86	1.09	1.15	0.09	
$\left(S^{-}-S^{+}\right)$ loading	0.38	0.09	-0.50	-0.11	-0.38	2.04	0.77	-0.23	-0.36	0.31	-0.07	
$\left(K^{+}-K^{-}\right)$ loading	0.50	0.27	0.66	-0.88	-0.14	-1.45	-1.00	1.02	-0.34	-0.24	-0.74	

PANEL B: WHITED-WU (WW) INDEX

	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	P10-P1	Chi-sq.
	Least Constrained								Most Constrained			
Higher co-moments alpha (% p.a.)	1.02 (1.19)	-3.17 (-1.28)	-0.03 (-0.01)	-0.30 (-0.08)	-2.98 (-0.65)	-6.18 (-1.21)	-6.73 (-1.22)	-7.44 (-1.25)	-10.67 (-1.60)	-21.29 (-2.87)***	-22.32 (-2.81)***	27.02 (0.00)
Market loading	0.88	1.17	0.98	0.94	0.94	1.17	1.03	1.04	0.94	0.96	0.08	
$\left(S^{-}-S^{+}\right)$ loading	0.11	0.53	0.77	0.64	0.89	1.32	1.17	1.00	0.71	0.65	0.54	
$\left(K^{+}-K^{-}\right)$ loading	-0.28	-0.35	-0.86	-0.45	-1.23	-0.83	-0.86	-1.37	-1.14	-1.03	-0.75	

Table 2.12

Characteristics and alphas of value-weighted *quintile* portfolios constructed on the basis of Whited-Wu index values

This table reports the characteristics and abnormal performance of *quintile* portfolios constructed on the basis of firms' Whited-Wu index of financial constraints. All stocks listed on the LSE from 1988 to 2010 are sorted at month *t* and they are assigned to five portfolios. **Q1** is the quintile portfolio containing the stocks of the **least constrained** firms (lowest values of Whited-Wu (WW) index) and **Q5** is the quintile portfolio containing the stocks of the **most constrained** firms (highest values of Whited-Wu (WW) index). The returns of these portfolios in excess of the risk-free rate at month *t+1* are calculated (i.e. post-ranking returns). **Q5-Q1** stands for the zero-cost strategy that goes long the quintile portfolio of the most constrained firms (Q5) and sells short the quintile portfolio with the least constrained firms (Q1). MV is the average market value of the stocks in each portfolio (in £m). VW returns refer to the annualized average monthly excess returns of value weighted portfolios. For the first three rows, the last column reports values of *t*-tests for the null hypothesis of no difference in means between portfolios' Q5 and Q1 characteristics. CAPM, Fama-French and Carhart alphas are the annualized alpha estimates derived from the corresponding asset pricing models. t-statistics for the alphas are reported in parentheses. ***, ** and * indicate statistical significance at the 1%, 5% and 10% level, respectively. The last column next to alphas reports the chi-square (χ^2) statistic of the Wald test for the null hypothesis that the five portfolios' alphas are jointly equal to zero in each case; p-values are reported below the statistic.

FINANCIAL CONSTRAINTS PROXY: WHITED-WU (WW) INDEX							
	Q1	Q2	Q3	Q4	Q5	Q5-Q1	*t*-test/ Chi-sq.
	Least Constrained				Most Constrained		
WW index	-0.56	-0.29	-0.23	-0.18	-0.06	0.50	25.68***
MV (£m)	3161.87	185.39	63.72	27.28	15.38	-3146.49	-32.49***
VW excess returns (% p.a.)	4.59	3.84	0.87	-3.18	-9.85	-14.44	-2.95***
CAPM alpha (% p.a.)	0.74	-0.16	-3.13	-7.19	-13.38	-14.13	10.68
	(1.20)	(-0.06)	(-0.78)	(-1.45)	(-2.27)**	(-2.34)**	(0.06)
Fama-French alpha (% p.a.)	0.70	0.32	-2.03	-6.36	-12.25	-12.94	10.84
	(1.13)	(0.24)	(-0.94)	(-2.08)**	(-3.03)***	(-3.16)***	(0.05)
Carhart alpha (% p.a.)	0.17	-0.33	-2.77	-6.04	-13.00	-13.17	10.66
	(0.29)	(-0.23)	(-1.22)	(-1.98)**	(-3.15)***	(-3.20)***	(0.06)

Table 2.13

Performance of value-weighted *double-sorted* portfolios constructed on the basis of Size and Whited-Wu index values

This table reports the performance of *double-sorted* Size and Whited-Wu (WW) portfolios. All stocks listed on the LSE from 1988 to 2010 are independently sorted at month *t* according to their Size and their WW-index values. A firm is categorized as Small if its market value is below the median market value of all firms in this month and Big if it is above the median. A firm is categorized as Least Constrained if its WW value is below the 40^{th} percentile of the firms' WW values' distribution in month *t*, Neutral if its value is between the 40^{th} and the 70^{th} percentiles and Most Constrained if its value is above the 70^{th} percentile of the distribution. The interaction of these two classifications yields six portfolios. The returns of these portfolios in excess of the risk-free rate at month *t+1* are calculated (i.e. post-ranking returns). Most-Least stands for the zero-cost strategy that goes long the portfolio of the Most Constrained firms and sells short the portfolio with the Least Constrained firms for each Size category. VW returns refer to the annualized average monthly excess returns of value weighted portfolios and the *t*-test refer to the null hypothesis of zero average returns for the Most-Least spread strategy. CAPM, Fama-French and Carhart alphas are the annualized alpha estimates derived from the corresponding asset pricing models. t-statistics for the alphas are reported in parentheses. ***, ** and * indicate statistical significance at the 1%, 5% and 10% level, respectively. The last column next to alphas reports the chi-square (χ^2) statistic of the Wald test for the null hypothesis that the six portfolios' alphas are jointly equal to zero in each case; p-values are reported below the statistic.

PANEL A: VW excess returns (% p.a.)					
	Least Constrained	Neutral	Most Constrained	Most-Least	*t*-test
Small	6.41	1.92	-7.01	-13.42	-3.72
Big	4.47	0.35	-9.78	-14.25	-2.63
PANEL B: CAPM alphas (% p.a.)					
	Least Constrained	Neutral	Most Constrained	Most-Least	Chi-sq.
Small	2.17	-1.22	-10.20	-12.38	15.97
	(0.43)	(-0.35)	(-2.09)**	(-2.82)***	(0.01)
Big	0.62	-3.89	-14.10	-14.72	
	(1.03)	(-0.87)	(-2.19)**	(-2.26)**	
PANEL C: Fama-French alphas (% p.a.)					
	Least Constrained	Neutral	Most Constrained	Most-Least	Chi-sq.
Small	1.63	-1.34	-9.65	-11.27	15.90
	(0.44)	(-0.67)	(-3.01)***	(-3.03)***	(0.01)
Big	0.61	-2.59	-12.95	-13.56	
	(0.99)	(-1.06)	(-2.67)***	(-2.76)***	
PANEL D: Carhart alphas (% p.a.)					
	Least Constrained	Neutral	Most Constrained	Most-Least	Chi-sq.
Small	2.99	-0.77	-10.18	-13.17	18.04
	(0.81)	(-0.35)	(-3.02)***	(-3.79)***	(0.01)
Big	0.06	-3.26	-12.69	-12.75	
	(0.09)	(-1.34)	(-2.51)**	(-2.53)**	

CHAPTER 3

The impact of monetary policy shocks on financially constrained firms' returns: Comprehensive evidence from the UK market

3.1 Introduction

The improved transparency of central banks' decision making has rendered the meetings of their monetary policy committees to be key events for the calendars of market participants during the last two decades. The financial press and professional investors closely follow monetary policy decisions as well as the statements of central banks' board members in their attempt to extract information with respect to current and future movements in asset prices.[16] The importance of this issue has spurred a growing literature of studies examining the impact of monetary policy decisions on stock market returns (see, inter alia, the seminal studies of Jensen and Johnson, 1995, Thorbecke, 1997, and Bernanke and Kuttner, 2005). The diversity of the literature is reflected in the different methodological approaches and the asset menus that researchers have employed (see Sellin, 2001, Ehrmann and Fratzscher, 2004 and Bredin et al., 2009, for a review of the literature). In short, there is sufficient evidence that an unexpected monetary tightening has a negative impact on stock returns, but this impact can be considerably different across stocks with different characteristics (see Kontonikas and Kostakis, 2012, for recent evidence).

The most obvious way through which monetary policy decisions affect stock price valuations is through the economy-wide interest rate channel. Smirlock and Yawitz (1985), using a standard dividend discount model, argue that an increase in the interest rate raises the discount rate applied to firm's future cash flows, i.e. the opportunity cost of capital, and hence it considerably reduces its cash flows' present value. Moreover, as Bernanke and

[16] For a recent commentary in the financial press, see: "Ben buys, bulls buoyant", The Economist, 22nd September, 2012.

Gertler (1995) argue, an increase in the policy rate can hamper real economic activity because it reduces current consumer demand and expenditure by increasing the cost of borrowing for consumption and investment. As a result, firms' current net cash flows and expectations over future ones are diminished, leading again to lower stock price valuations. Another very important channel through which changes in interest rates can affect stock prices is the credit channel of the monetary policy transmission process, as described by Bernanke and Blinder (1992), which affects the "external finance premium", i.e. the wedge between the cost of funds generated internally and the cost of externally raised funds. In particular, this channel is consisted of two mechanisms: the bank lending channel and the balance sheet channel (see Bernanke and Gertler, 1989 and Bernanke and Gertler, 1995 for a detailed analysis).

According to the bank lending channel, an increase in the interest rate potentially decreases both the demand for and the supply of loanable funds from financial intermediaries, hindering firms from pursuing profitable investment opportunities and having a negative effect on their earnings. According to the balance sheet channel, monetary tightening harms the creditworthiness and financial health of firms because it reduces their net cash flows due to lower revenues and higher floating-rate interest payments as well as the value of the collaterals they can post for loans. The deterioration of creditworthiness leads financial intermediaries and investors to increase the cost and reduce the supply of credit to firms with weak balance sheets. This process eventually pulls the trigger of "financial accelerator" (Bernanke et al., 1996), leading to an even higher external finance premium, especially in the presence of large information asymmetries between the firm and its lenders.

Even though the previously described mechanisms may affect all of the firms in the economy, it is particularly interesting to examine whether and how the magnitude of these effects differs across firms with different capital structure and cash flow characteristics. In particular, the aim of this chapter is primarily to examine the impact of monetary policy shocks, as extracted from interest rate futures prices on Bank of England's (BoE) Monetary Policy Committee (MPC) meetings, across firms listed on London Stock Exchange (LSE) that face different degrees of "financial constraints", i.e. frictions that prevent firms from funding all desired investments (Lamont et al., 2001) and pose to them restrictions to grow at their desirable pace (Whited and Wu, 2006).

Following the discussion regarding the interest rate and credit channels of the monetary policy transmission mechanism, financially constrained firms are expected to experience more severe problems due to monetary tightening because they are typically characterized by lower interest coverage ratios, lower borrowing capacity, worse credit ratings, lower cash holdings, higher leverage, higher agency costs of debt and they are less able to raise capital due to their limited ownership base in comparison to the least constrained firms. Fazzari et al. (1988), Kashyap et al. (1994) and Hubbard (1998) have extensively analyzed the impact of financial constraints on firms' financing, investment decisions and net cash flows (see also Guariglia and Mateut, 2006 and Guariglia, 2008, for evidence on UK firms).

There are few studies in prior literature that have examined the impact of monetary policy on stock returns taking into account the effect of financial constraints. For example, Gertler and Gilchrist (1994), Thorbecke (1997), Perez-Quiros and Timmermann (2000) and Guo (2004), inter alia, differentiate between small and big capitalization stocks, arguing that a monetary tightening should affect more severely small companies because these are typically less well immunized against such an adverse economic condition and they face severe financing constraints. Nevertheless, firm size is only a very rough proxy of these constraints.

To overcome this limitation, some recent studies have suggested a number of more appropriate proxies of firms' financial constraints, examining their relationship with risk-adjusted returns (see Chapter 2 for a literature review). As a by-product of their analysis, some of these studies have tested whether the differential return between the most and the least constrained firms is related to monetary conditions among other macroeconomic factors. In particular, Lamont et al. (2001), using size and the composite Kaplan-Zingales (KZ) index as measures, did not find a significant relationship between the spread return of the most-least constrained firms and the change in the Fed Funds rate or the growth in real M2. Similar is the evidence provided by Hahn and Lee (2009), who used asset tangibility as a measure of constraints and growth in real M2 as a proxy of monetary conditions. However, such tests are likely to suffer from endogeneity bias because changes in monetary variables measured at monthly or quarterly frequencies are unlikely to be purely exogenous. As Rigobon and Sack (2003) have convincingly shown, monetary policy decisions may have already incorporated stock market movements, and hence causality may run in both directions.

As a solution to the endogeneity problem, recent studies use the event study approach suggested by Kuttner (2001), relying on daily data to extract the unexpected component of monetary policy decisions. Following this approach, Ehrmann and Fratzscher (2004), Basistha and Kurov (2008) and Jansen and Tsai (2010) have examined the differential impact of US monetary policy shocks on constrained versus unconstrained firms using a number of proxies to classify firms. In particular, Ehrmann and Fratzscher (2004) use cash flows, credit ratings, leverage ratios and Tobin's q as proxies for financial constraints. However, they use only S&P 500 companies, which are probably the least constrained firms in the US market and they rely on survey expectations to extract monetary policy shocks. To the contrary, Basistha and Kurov (2008), who also examine only S&P 500 firms and use credit ratings, trade credit, size and payout ratios as constraints proxies, as well as Jansen and Tsai (2010), who use profitability, payout ratios and debt ratings as proxies, extract unanticipated changes in the Fed Funds rate relative to futures-implied expectations; this is the common practice in the literature since the seminal study of Bernanke and Kuttner (2005). Overall, these US studies find that the most constrained firms are more affected by monetary policy shocks relative to the least constrained ones and that the magnitude of this relationship exhibits state dependence.

This study contributes to the literature by examining, for the first time, the return response of portfolios constructed on the basis of UK firms' financial constraints proxies to monetary policy shocks on BoE's MPC meetings from June 1999 to December 2011.[17] We provide comprehensive evidence on this issue using an exhaustive and survivorship bias-free dataset of firms listed on LSE and utilizing a large number of financial constraints measures that have been suggested in prior literature. We also empirically test whether the most constrained firms respond to monetary policy shocks in a differential manner relative to the least constrained ones. In doing so, we shed light on the transmission of UK monetary policy decisions through the stock market and we provide evidence on whether investors react to these decisions in accordance to the conjectures made on the basis of the credit channel mechanism. Moreover, we test for the first time in the UK market, whether the relationship between stock returns and interest rate shocks is state dependent by investigating how this relationship is modified across different market phases, credit, market volatility and liquidity conditions. Finally, we also examine whether this relationship was affected by the unprecedented global financial crisis of 2007-2009.

Previewing our results, we find that there is a large degree of heterogeneity in the response of the constrained portfolios' returns to monetary policy shocks across the various proxies we use, indicating that these measures capture different dimensions of this elusive concept. Most importantly, with the exception of tangible-to-total assets ratio and KZ-index

[17] Bredin et al. (2007), Bredin et al. (2009) and Gregoriou et al. (2009) have also examined the response of stock market returns to monetary policy shocks on BoE's MPC meeting days; however, they examine only aggregate market and sectoral returns. More recently, Florackis et al. (2011) examined the corresponding response of liquidity-sorted portfolios' returns using the same framework.

in some cases, for the rest proxies there is no evidence supporting the argument that the most constrained portfolios' returns are more responsive to unanticipated interest rate changes on MPC meeting days relative to the returns of the least constrained portfolios. Moreover, we find that there has been a reversal in the relationship between UK stock returns and monetary policy shocks during the financial crisis of 2007-2009; the well documented inverse relationship became significantly positive during the crisis period. Finally, our results reveal that this relationship, excluding the crisis period, exhibits state dependence. Most significantly, returns' response to interest rate shocks is of much larger magnitude on MPC meetings that took place during periods of tight credit conditions.

The rest of the chapter is structured as follows. Section 3.2 provides the details for the calculation of monetary policy shocks from interest rate futures prices, the proxies of financial constraints and the construction of the corresponding portfolios. Section 3.3 contains the main body of the empirical results on the relationship between monetary policy shocks and portfolios' returns, also using various model specifications to reveal potential state dependence of the relationship. Section 3.4 presents a series of robustness checks, while Section 3.5 concludes.

3.2 Data and Methodology

3.2.1 Monetary policy shocks

Following the methodology of Kuttner (2001), we extract monetary policy shocks on BoE's MPC meeting days with respect to expectations regarding interest rates that are embedded in futures prices. Nevertheless, there is no futures market instrument that tracks BoE's policy rate, the 2-week repo rate. Therefore, we follow Bredin et al. (2007), Bredin et al. (2009) and Gregoriou et al. (2009) in utilizing the sterling futures contract that settles on the 3-month British Bankers' Association (BBA) London Interbank Offer Rate (LIBOR) prevailing at 11:00 on the last trading day (third Wednesday of the delivery month). This contract is traded on the London International Financial Futures and Options Exchange (LIFFE) and its settlement price is 100 minus the BBA LIBOR rounded to three decimal places. The price of this futures contract is widely considered to accurately embed market expectations regarding future short-term interest rates and, as Brook et al. (2000) note, it is also used by BoE's MPC for policy purposes.[18] Data on futures prices are obtained from Thomson Datastream.

The *unanticipated* (unexpected) interest rate change, Δi_d^u, is defined as the change in the futures-implied 3-month LIBOR rate on MPC meeting day, *d*, relative to the previous day, *d-1*:

$$\Delta i_d^u = f_{m,d} - f_{m,d-1} \tag{3.1}$$

where $f_{m,d}$ is the implied interest rate, i.e. 100 minus the LIFFE futures contract price, extracted by the corresponding contract with delivery month *m* nearest to the MPC meeting day *d*.[19] On the other hand, the *anticipated* (expected) interest rate change, Δi_d^e, is defined as the difference between the actual change in the 3-month LIBOR on MPC meeting day *d*, Δi_d, and the corresponding *unanticipated* change, Δi_d^u:

$$\Delta i_d^e = \Delta i_d - \Delta i_d^u \tag{3.2}$$

[18] To be accurate, we actually calculate unexpected short-term LIBOR changes on MPC meeting days and, following Bredin et al. (2007), we consider them to be the best proxy for "monetary policy shocks", given the absence of a futures contract tracking BoE's policy rate. Therefore, we use these two terms interchangeably though, in principle, they are not necessarily identical. As Lildholdt and Wetherilt (2004) and Joyce et al. (2008) have shown, these LIBOR futures prices reflect market participants' expectations over future interest rates and UK monetary policy quite accurately.

[19] Piazzesi and Swanson (2008) have shown that extracting interest rate shocks using a one-day window is a robust approach because any low-frequency premia embedded in futures prices are effectively "differenced out". Actually, some recent studies have employed even shorter time windows, extracting shocks from futures prices in the interval of 30-minutes around the announcement of the Fed Funds rate (e.g., Wongswan, 2009). Unfortunately, intraday data for interest rate futures and stock prices, which are necessary to calculate portfolios' returns, are not available to us for the UK market.

In contrast to Bredin et al. (2007), who start their sample period from 1994, we examine only meetings that have been publicly announced to take place in advance to ensure that interest rate futures prices actually reflected market participants' expectations regarding monetary policy decisions. In particular, following the practice of Federal Reserve to increase transparency, the schedule of MPC meetings have been publicly announced since June 1997.[20] Nevertheless, our empirical analysis begins from June 1999, since only then 3-month LIBOR futures started settling on a monthly basis. Prior to this date, contracts were settling on a quarterly basis and this lack of correspondence between the frequency of the contract's settlement and MPC meetings could potentially lead to a biased estimate of the unexpected interest rate change. Avoiding this potential problem, we examine a total of 152 MPC meetings, from June 1999 to December 2011. Figure 3.1 illustrates the extracted unexpected interest rate changes along with actual LIBOR changes on MPC meetings.

3.2.2 Financial constraints-sorted portfolios

The concept of financial constraints is rather elusive because a firm may become constrained either due to the size and structure of the assets and liabilities of its balance sheet or due to the level and the variability of its cash flows. Since the aim of this study is to provide comprehensive evidence regarding the return response to monetary policy shocks of stock portfolios constructed on the basis of the degree of financial constraints that firms face, we utilize a number of proxies that have been suggested in prior literature (see also Chapter 2 for a review of the literature). In particular, the following measures are used: a firm's size proxied by the book value of its assets, its ratio of tangible-to-total assets as a measure of debt capacity, its total debt-to-common equity and total debt-to-market value ratios as measures of leverage, its cash holdings-to-total assets ratio, its interest coverage ratio, the composite KZ-

[20] The list of meetings and decisions is available at http://www.bankofengland.co.uk/monetarypolicy.

index proposed by Kaplan and Zingales (1997) and the composite WW-index proposed by Whited and Wu (2006).[21] Table 3.1 presents the list of these measures along with their definitions and the corresponding Worldscope/ Datastream codes used to calculate them.[22]

For the construction of financial constraints-sorted portfolios, we utilize all common stocks listed on LSE from 1998 to 2011. We include both active and de-listed shares, avoiding any survivorship bias. Moreover, we exclude financial and insurance companies, unit trusts and investment trusts because their capital structure and cash flows definition is fundamentally different and by no means comparable with the rest firms. During the examined period, we have used a total of 2,316 firms. To ensure that accounting data were publicly available prior to each MPC meeting, and hence they could have been used by an investor in real time to measure firms' financial constraints and construct the corresponding portfolios, we follow Soares and Stark (2009) and lag these data by 6 months.[23]

For every MPC meeting that takes place in month *m*, we calculate each of the financial constraints measures for each firm using market and accounting data that were available to investors at the end of month *m-1*. In this way, we ensure that we use up-to-date information for firms' degree of financial constraints and that this information was publicly available prior to the MPC meeting day. Having calculated these measures, we sort all firms that were listed on LSE on MPC meeting day *d* and assign them to quintile portfolios. The MPC meeting day return of each quintile portfolio *p* is the value-weighted average of the

[21] As the definition of KZ and WW indices presented in Table 1 indicates, these indices combine in a linear fashion a firm's accounting and market characteristics to measure the strength of its financial constraints.

[22] It should be noted that when we construct portfolios on the basis of interest coverage ratios, we exclude firms with negative values. We also exclude firms with negative debt-to-common equity ratios, arising from negative values of common equity. Finally, when we construct portfolios using debt-to-common equity and debt-to-market value ratios, the firms with zero leverage are assigned to a separate portfolio, because we cannot identify whether this capital structure is a strategic decision for unconstrained firms or an inevitable situation for highly constrained firms who cannot access external finance.

[23] For accounting periods beginning before 2007, firms listed on LSE were allowed by the Financial Services Authority (FSA) to publish their financial reports up to 6 months after the end of their fiscal year. For details see http://fsahandbook.info/FSA/html/handbook/DTR/4/1.

constituent stocks' returns relative to the previous trading day *d-1*. Stock prices inclusive of dividends (datatype RI) are used for the calculation of returns and they are sourced from Datastream.

Table 3.2 reports the descriptive statistics for the most constrained (Panel A) and the least constrained (Panel B) quintile portfolio returns on these 152 MPC meeting days for each of the measures we use as well as the corresponding statistics for FTSE All Share and zero leverage portfolios' returns. Table 3.3 presents the pairwise correlation coefficients for the returns of the most constrained (Panel A) and the least constrained (Panel B) quintile portfolios along with FTSE All Share returns on MPC meetings. The pairwise correlations among the most constrained quintile portfolio and FTSE All Share returns are quite low, confirming that each of these measures captures a different dimension of the financial constraints concept. These low correlations also indicate that these portfolios' return response to interest rate changes is expected to be considerably different from the commonly studied market return response as well as to widely vary across the proxies we utilize. The corresponding correlations among the least constrained quintile portfolio and market returns are somewhat higher, but still low if one takes into account that these are daily returns and that the market index mainly consists of big capitalization firms, which are expected to be among the least constrained ones. These low correlations indicate again a potentially large degree of heterogeneity in these portfolios' return response to interest rate changes.

3.2.3 Proxies for state dependence and other control variables

In our attempt to examine whether the relationship between portfolios' returns and interest rate shocks depends on market and other economic conditions, we use a series of variables to proxy the state of these conditions. In particular, we firstly use the level of FTSE All Share Index to determine whether there is a bull or a bear market phase. To characterize a recession, we follow the technical definition of two consecutive negative real GDP growth rates, using the 2012Q1 vintage of real GDP data compiled by BoE. As a proxy for credit conditions, we use the default yield spread defined as the difference between the long-term corporate redemption yield, extracted from the Bank of America-Merill Lynch UK Corporate Bond Index, and the 10-year UK Government Zero-Coupon Bond yield provided by BoE. As a proxy for financial turmoil and stress, we use FTSE 100 Volatility Index, which is extracted from options on FTSE 100 and it is the UK market equivalent to VIX that is widely used as gauge of market uncertainty (see Whaley, 2000).[24] To measure stock market liquidity, we use the Return-to-Volume (RtoV) price impact ratio proposed by Amihud (2002). To this end, we calculate for a window of 90 trading days the average ratio of FTSE All Share daily returns (in absolute value) to the total trading volume of the same day.

In our attempt to estimate the effect of interest rate shocks on daily portfolio returns, we also control for other factors that could affect UK stock returns. More specifically, following Bredin et al. (2007), we control for Sterling/ Dollar and Sterling/ Euro daily exchange rate changes as well as for the US market return, proxied by the S&P 500 return.[25] Finally, as a measure of adverse funding conditions and stress in the interbank market, we use in Section 3.4.4 the spread between LIBOR and BoE's policy rate; this spread is equivalent to the LIBOR-OIS spread that is commonly used in US studies (see Thornton, 2009 and Nyborg and Ostberg, 2010). All of these variables are sourced from Datastream unless otherwise stated. Figure 3.2 illustrates the values of default yield spread, LIBOR-BoE base rate spread and FTSE Implied Volatility index on the 152 MPC meeting days we examine in our analysis.

[24] FTSE 100 Volatility Index is available on a daily basis from January 2000 onwards.
[25] We use lagged S&P 500 daily returns to account for the lag between UK and US stock market closing times.

3.3 Empirical Results

3.3.1 Portfolio returns and monetary policy shocks: The crisis effect

The benchmark model specification to examine the relationship between anticipated and unanticipated interest rate changes and stock returns, as suggested by Bernanke and Kuttner (2005), is given by the following regression model:

$$r_{p,m,d} = \alpha + \beta^{u}\Delta i_{d}^{u} + \beta^{e}\Delta i_{d}^{e} + \varepsilon_{d} \tag{3.3}$$

where $r_{p,m,d}$ is the value-weighted return of portfolio *p* on MPC meeting day *d* in month *m*, Δi_{d}^{u} is the corresponding unanticipated interest rate change and Δi_{d}^{e} is the anticipated interest rate change. In our attempt to determine the relationship between interest rate shocks and stock returns, we also control for other variables that could potentially affect UK stock returns in a systematic way. To this end, following Bredin et al. (2007), we also control for the Sterling/ Euro and Sterling/ Dollar bilateral exchange rates as well as the lagged S&P 500 return in the following augmented regression model:

$$r_{p,m,d} = \alpha + \beta^{u}\Delta i_{d}^{u} + \beta^{e}\Delta i_{d}^{e} + \gamma' X_{d} + \varepsilon_{d} \tag{3.4}$$

where the vector X_d contains the additional control variables.

We estimate this model for each quintile portfolio constructed by sorting all available firms on the basis of each of the eight alternative financial constraints measures that we employ in this study. For ease of exposition, in Table 3.4 and the rest Tables we report the estimated coefficients only for the extreme quintiles, i.e. the portfolios containing the most and the least constrained firms, respectively. Results for the rest portfolios are available upon request. As a benchmark for comparison, we also report the corresponding estimated coefficients using FTSE All Share Index returns, a proxy for UK market returns. We find that, although negative in most of the cases we examine, the relationship between anticipated or unanticipated interest rate changes and portfolio returns is statistically insignificant. The only exceptions are the most constrained quintile portfolios according to the tangible-to-total assets ratio and WW-index, the zero leverage portfolios and the least constrained quintile portfolio according to the total debt-to-market value ratio, where the inverse relationship between unexpected interest rate changes and returns is significant at the 5% level. The reported lack of statistical significance using portfolios sorted on the basis of financial constraints proxies complements the findings of Gregoriou et al. (2009) and Florackis et al. (2011) for the UK market, showing that this model specification is inadequate to capture the relationship between stock returns and monetary policy shocks when the 2007-2009 crisis period is included in the sample.

The evidence provided in Gregoriou et al. (2009) and Florackis et al. (2011) for the UK market and Kontonikas et al. (2012) for the US market motivates us to examine whether the relationship between the returns of constraints-sorted portfolios and interest rate changes reversed its sign during the recent financial crisis. As a characteristic example, the unexpected interest rate decrease of 0.4% on the MPC meeting of 6th November 2008, which is by far the greatest in our sample and took place when BoE cut its base rate from 4.5% to 3%, was associated with a dramatic drop in FTSE All Share Index of -5.38%, casting doubt on the conventional wisdom that such a massive interest rate cut would instantaneously boost the stock market. Inspecting the returns of the constraints-sorted portfolios, we find that the quintile portfolio consisted of firms with the lowest interest coverage ratio suffered a loss of -5.61% on that day, while the corresponding portfolio containing the firms with lowest cash holdings experienced a return of -7.8%.

Similarly, BoE's policy rate cut from 5% to 4.5% on the MPC meeting of 8th October 2008 and the corresponding unexpected LIBOR rate decrease by 0.1%, relative to futures-implied expectations, was accompanied by another dramatic fall in stock prices. In particular, FTSE All Share Index suffered a loss of -4.81% on that day, while the corresponding quintile portfolio containing the firms with the lowest interest coverage ratio (cash holdings) experienced a fall of -4.37% (-5.3%). A first indication of the potential reversal in the relationship's sign is provided by scatterplots of FTSE All Share returns versus unexpected rate changes distinguishing between MPC meetings that took place outside and during the crisis period. These two scatterplots are presented in Figure 3.3, confirming that the negative relationship between unexpected rate changes and market returns has turned positive during the recent crisis period.

The negative response of the stock market to interest rate cuts during the crisis period also attracted the interest of the financial press.[26] A potential explanation of this paradox is that unexpected interest rate cuts when the global financial system was melting down were actually perceived as a signal from the central bank that even worse economic conditions lie ahead, forcing market participants to dramatically revise downwards their expectations for cash flows and asset prices and sell off risky assets in their attempt to "fly to safety", mainly by purchasing government bonds. To formally examine whether this relationship was modified during the crisis period for the sample of portfolios we have constructed, we utilize the following regression model, in the spirit of Gregoriou et al. (2009) and Florackis et al. (2011):

$$r_{p,m,d} = \alpha + \beta_1^u (1 - D^{Crisis}) \Delta i_d^u + \beta_2^u D^{Crisis} \Delta i_d^u + \beta_1^e (1 - D^{Crisis}) \Delta i_d^e + \beta_2^e D^{Crisis} \Delta i_d^e + \gamma' X_d + \varepsilon_d \quad (3.5)$$

where D^{Crisis} takes the value 1 during the period from August 2007 to December 2009.[27] The choice of the starting period for the financial crisis is motivated by the analysis of Brunnermeier (2009) and it coincides with the bank run of Northern Rock which brought the UK financial system to a near collapse (see Shin, 2009, for a detailed analysis of this episode).

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[26] See: "Another paradox of thrift", The Economist, 18th September 2010.

[27] This and the subsequent model specifications involving dummy variables are chosen to allow the presentation of the dummy coefficients in a direct rather than an additive way, following the practice of Basistha and Kurov (2008) and Kontonikas et al. (2012).

The estimated coefficients for the unexpected rate changes from regression model (3.5) are reported in Table 3.5. We find that the inverse relationship between monetary policy shocks and portfolio returns becomes statistically significant when we exclude the 2007-2009 crisis period. Interpreting the reported coefficients, an unexpected interest rate cut of 25 basis points on an MPC meeting would be associated, for example, with a positive FTSE All Share return of 2.31% on the same day and returns of 1.65% and 2.15% for the most and the least constrained quintile portfolios, respectively, constructed according to interest coverage ratio. Examining the responses of the most and the least constrained portfolios' returns, we find that across the various proxies we use, there is no particular pattern to indicate that portfolios of the most constrained firms are more responsive to unexpected rate changes. This is only true when the tangible-to-total assets ratio and KZ-index are used as constraints proxies, while the differential response is statistically significant only in the first case. To the contrary, for all of the rest proxies, this inverse relationship is of higher magnitude for the portfolios containing the least constrained firms. The large degree of heterogeneity in the estimated return responses among the least as well as among the most constrained portfolios also reflects the fact that each of these measures captures a different aspect of financial constraints. This feature was also indicated by the low pairwise correlations among daily portfolio returns that were reported in Table 3.3.

The evidence provided in Table 3.5 is at odds with the hypothesis that the most constrained firms would be more sensitive to monetary conditions, and hence affected by monetary policy shocks to a larger degree relative to the least constrained firms. It also partially contradicts the limited prior evidence for the US market by Basistha and Kurov (2008) and Jansen and Tsai (2010). There are two potential explanations we put forward for this finding. Firstly, investors on LSE may not consider the interaction between financial constraints and monetary conditions to be an important source of risk, especially at very short horizons, and as a result, it does not affect their decision making even when unexpected interest rate changes occur. In other words, according to this line of reasoning, investors do not differentiate across listed firms on the basis of their financial constraints or they even altogether ignore this information when reacting to monetary policy news.

Secondly, the most constrained firms are predominantly small capitalization firms, especially according to total assets and WW-index proxies that are by definition related to firms' size. The shares of these firms are usually thinly traded, and hence their prices may not respond to incorporate interest rate shocks as quickly as it would happen with the more liquid stocks of the least constrained and bigger capitalization firms. This argument seems to be valid particularly when total assets and WW-index are used as proxies also because the explanatory power of the regression model for the daily returns of the most constrained portfolios is extremely low, implying that these returns do not respond either to interest rate news or to the other control variables we include in model (3.5).

With respect to the response of returns to unexpected interest rate changes during the crisis period, we find that this relationship has indeed reversed its sign and it has become positive for the market index as well as the majority of the portfolios constructed on the basis of the constraints proxies. Actually, the estimated coefficients are very large and significant in some cases, e.g. when cash holdings-to-total assets ratio is used, highlighting the economic importance of the direct impact that these unexpected shocks had on stock returns during the crisis. Formally testing, via a Wald test, whether a shift in the relationship occurred, we can significantly reject, for almost all of the extreme quintile portfolios, the null hypothesis that the estimated coefficients of the unexpected interest rate changes are equal excluding and during the crisis period. Nevertheless, we do not find again any pattern across the various proxies with respect to the relative magnitude of the most versus the least constrained portfolios' return sensitivity to unexpected interest rate changes. The most constrained portfolio returns are significantly more positively reacting to unexpected rate changes during the crisis period only when the total debt-to-market value, cash holdings-to-total assets and interest coverage ratios are used as proxies.

For Table 3.5 and the rest Tables to be legible, we report only the coefficients of the unanticipated interest rate changes. However, it should be mentioned that in most of the cases, the coefficients of the expected interest rate changes are economically and/ or statistically significant, confirming the recent findings of Florackis et al. (2011) and Gregoriou et al. (2009) and contradicting the evidence provided in Bredin et al. (2007) for an earlier sample period. This highly important finding, which was also reported in the seminal study of Bernanke and Kuttner (2005) for the US market, is at odds with the conjecture that a fully efficient market would have already incorporated expected interest rate changes into stock prices. Moreover, it is important to note that for most of the portfolios, the coefficients of the Sterling/ Dollar exchange rate change and the lagged S&P 500 return are also significant, confirming the importance of adding them to the regression models as control variables, while this is not true for the Sterling/ Euro exchange rate change.[28]

Having reduced its base rate to a record low of 0.5% by March 2009, BoE decided to engage in a series of rounds of asset purchases financed with its reserves, an operation termed as Quantitative Easing (QE), in a further attempt to stabilize the UK economy (see Joyce et al., 2010, for an overview and Martin and Milas, 2012, for a critical analysis). While a detailed examination of the impact of QE on stock returns is beyond the aim of this study, we test here whether the announcements made with respect to QE policies had any effect on the portfolio returns we examine. In particular, we introduce in regression model (3.5) a dummy

[28] The estimated coefficients for expected interest rate changes and the control variables are readily available upon request.

variable which takes the value of 1 on the MPC meeting days that an increase in asset purchases was decided.[29]

Unreported results that are available upon request show that there is no significant effect of these QE decisions on the returns of the market index or the constraints-sorted portfolios. The explanation we put forward is that the implementation or extension of QE policies was fully anticipated by market participants each time, and hence this information was already incorporated into stock prices. This is a plausible explanation because even the actual amounts had been communicated and published in the financial press earlier than the corresponding MPC meeting, probably because BoE did not intend to take markets by surprise with this policy. Finally, we have also estimated regression model (3.5) adding a dummy variable that takes the value 1 on 18th September 2001, which is the only unscheduled MPC meeting in our sample period. The estimated coefficients are very similar to the ones reported in Table 3.5 and they are available upon request.

3.3.2 Portfolio returns and monetary policy shocks: State dependence

This section examines whether the relationship between interest rate shocks and portfolio returns exhibits state dependence, i.e. whether its sign and magnitude depends on the market phase, credit, volatility and liquidity conditions. We follow the dummy variable approach of Basistha and Kurov (2008) and Kontonikas et al. (2012) to determine each state and estimate the corresponding coefficients of the relationship. We firstly examine whether the portfolios' return response differs across bull and bear markets. Following the definition of Jansen and Tsai (2010, p. 985), a bull market is said to occur when the stock market index is located between the trough and the peak point, including the peak, and a bear market occurs otherwise. We use daily data on FTSE All Share Index to characterize bull and bear

[29] In particular, these are the MPC meetings on 5th March, 7th May, 6th August and 5th November 2009 as well as on 6th October 2011.

market phases.[30] The regression model we use to examine whether the relationship is modified across these two phases is given by:

$$r_{p,m,d} = \alpha + \beta_1^u (1 - D^{Crisis})(1 - D^{Bull})\Delta i_d^u + \beta_2^u (1 - D^{Crisis}) D^{Bull} \Delta i_d^u + \beta_3^u D^{Crisis} \Delta i_d^u + \beta_1^e (1 - D^{Crisis})(1 - D^{Bull})\Delta i_d^e + \beta_2^e (1 - D^{Crisis}) D^{Bull} \Delta i_d^e + \beta_3^e D^{Crisis} \Delta i_d^e + \gamma' X_d + \varepsilon_d \quad (3.6)$$

where D^{Bull} takes the value 1 when the market is in a bull phase on MPC meeting day d and zero otherwise. This model specification does not differentiate between bull and bear market phases during the 2007-2009 crisis period, because this period was characterized by a prolonged bear market, and hence such a differentiation would be meaningless. The same approach is followed in the subsequent models with dummy variables, since the crisis period was predominantly characterized by very high default yield spreads, high volatility and low market liquidity (see also Figure 3.2).

The estimated coefficients with respect to unexpected rate changes for the market and the constraints-sorted portfolios are presented in Table 3.6. We also perform a Wald test for the null hypothesis that the coefficients of the relationship are equal across bull and bear market phases. Overall, the null hypothesis of equality in the coefficients cannot be rejected at the 5% level, apart from the case of KZ-index, where the returns' response is significantly negative only during bull markets. Setting statistical significance aside, however, we find that the inverse relationship between returns and unexpected rate changes in the UK market existed only during bull market phases. This is true both for market returns and the returns of portfolios constructed on the basis of financial constraints proxies. Actually, our results show that during the bear market of September 2000- March 2003, which was the only one in our sample apart from the recent crisis period, there was no particular relationship between portfolio returns and unexpected rate changes for most of the cases we examine. Moreover,

[30] Obviously, this is an ex post characterization of bull and bear market phases because one needs to know the subsequent trough and peak points. For robustness, we use an alternative definition in Section 4.3, where a moving average of index values is used and the characterization of bull and bear market phases can be made in real time.

there is no evidence suggesting that interest rate shocks had a greater impact on the most constrained portfolios' returns relative to the least constrained ones in either market phase, except when the tangible-to-total assets ratio is used, but still the differential magnitude is not statistically significant.

To examine whether the relationship between stock returns and interest rate changes differs across tight and loose credit conditions, we estimate the following regression model:

$$\begin{aligned} r_{p,m,d} = {} & \alpha + \beta_1^u (1-D^{Crisis})(1-D^{Credit})\Delta i_d^u + \beta_2^u (1-D^{Crisis})D^{Credit}\Delta i_d^u + \beta_3^u D^{Crisis}\Delta i_d^u + \\ & \beta_1^e (1-D^{Crisis})(1-D^{Credit})\Delta i_d^e + \beta_2^e (1-D^{Crisis})D^{Credit}\Delta i_d^e + \beta_3^e D^{Crisis}\Delta i_d^e + \gamma' X_d + \varepsilon_d \end{aligned} \quad (3.7)$$

where D^{Credit} takes the value 1 when the default yield spread on MPC meeting day d is higher than its sample average value, indicating tight credit conditions, and zero otherwise. The estimated coefficients for the returns' response to unexpected interest rate changes are reported in Table 3.7. We also report the p-value of a Wald test for the null hypothesis that the coefficients of the relationship are equal across tight and loose credit market conditions.

Overall, the magnitude of portfolio returns' response to interest rate shocks was much greater during tight credit conditions and, according to the Wald test, this differential is significant at the 10% level for half of the cases we have examined. For example, the negative response of FTSE All Share returns was almost four times greater on MPC meetings taking place during tight credit conditions (-27.12) relative to the rest meetings (-7.55). This differential magnitude is even more pronounced for portfolios containing the most constrained firms according to KZ-index, tangible-to-total assets, total debt-to-market value and cash holdings-to-total assets ratios. Nevertheless, the response of the most constrained portfolios' returns during tight credit conditions is significantly greater relative to the least constrained portfolios' returns only in the first two cases. According to the rest proxies, we find that either the opposite is true, as in the case of total debt-to-common equity, total debt-to-market value and interest coverage ratios or that the differential response is not significant.

Finally, the return response to interest rate shocks during the crisis is very similar to the one reported in the benchmark results of Table 3.5.

The next step is to examine the differential return response according to market volatility conditions, as proxied by the FTSE 100 Implied Volatility Index. The estimated model is given by:

$$r_{p,m,d} = \alpha + \beta_1^u (1 - D^{Crisis})(1 - D^{Vol})\Delta i_d^u + \beta_2^u (1 - D^{Crisis}) D^{Vol} \Delta i_d^u + \beta_3^u D^{Crisis} \Delta i_d^u + \beta_1^e (1 - D^{Crisis})(1 - D^{Vol})\Delta i_d^e + \beta_2^e (1 - D^{Crisis}) D^{Vol} \Delta i_d^e + \beta_3^e D^{Crisis} \Delta i_d^e + \gamma' X_d + \varepsilon_d \quad (3.8)$$

where D^{Vol} takes the value 1 when the implied volatility index on MPC meeting day d is higher than its sample average value, indicating high market volatility, and zero otherwise. The estimated coefficients for interest rate shocks from model (3.8) are reported in Table 3.8.

In general, we find that the inverse relationship between returns and shocks, except for the crisis period, is of greater magnitude on MPC meetings that took place during periods of high market volatility. However, the standard errors of these coefficients are large, rendering them statistically insignificant at the 5% level for most of the portfolios we examined as well as for FTSE All Share. Moreover, the differential magnitude of the return response across low and high volatility conditions is by no means statistically significant, as the p-values for the corresponding Wald test show. Finally, we do not find any evidence supporting the argument that the response of the most constrained portfolios' returns is significantly greater than the response of the least constrained ones, except when the tangible-to-total assets ratio is used as a proxy in low market volatility conditions.

The last potential state dependence we examine refers to market liquidity conditions, as proxied by the RtoV price impact ratio of FTSE All Share Index. In particular, we estimate the following model:

$$r_{p,m,d} = \alpha + \beta_1^u (1 - D^{Crisis})(1 - D^{Illiq})\Delta i_d^u + \beta_2^u (1 - D^{Crisis}) D^{Illiq} \Delta i_d^u + \beta_3^u D^{Crisis} \Delta i_d^u + \beta_1^e (1 - D^{Crisis})(1 - D^{Illiq})\Delta i_d^e + \beta_2^e (1 - D^{Crisis}) D^{Illiq} \Delta i_d^e + \beta_3^e D^{Crisis} \Delta i_d^e + \gamma' X_d + \varepsilon_d \quad (3.9)$$

where D^{Illiq} takes the value 1 when the 90-day moving average of RtoV calculated on MPC meeting day d is higher than its sample average value, indicating that the market is in an illiquid state, and zero otherwise. Table 3.9 reports the estimated coefficients from regression model (3.9). Overall, we find that, except for the crisis period, the inverse relationship between interest rate shocks and the returns of constraints-sorted portfolios is relatively more pronounced on MPC meetings that took place during illiquid market conditions; this is not true, however, for market index returns. Nevertheless, the p-values of the corresponding Wald tests indicate that the estimated differential magnitude is by no means statistically significant. Moreover, there is no evidence suggesting that the most constrained portfolios' returns are significantly more responsive to unexpected rate changes as compared to the least constrained ones either in liquid or in illiquid market conditions; the opposite is actually true for most of the constraints proxies we examine.

In summary, we find that the inverse relationship between stock returns and interest rate shocks, which was documented outside the crisis period, exhibits state dependence indeed. In particular, the negative response of portfolio returns is more pronounced during bull market phases, tight credit conditions, high volatility and market illiquidity, but this difference is statistically significant only across credit conditions.[31] Furthermore, the results reported in Tables 3.6 to 3.9 confirm the main finding of our study, i.e. that the return response of portfolios containing the most constrained firms is not of greater magnitude relative to the response of portfolios containing the least constrained firms, apart from some cases where tangible-to-total assets ratio and KZ-index are used as proxies. In other words, investors on LSE did not seem to differentiate between the most and the least constrained

[31] It should be noted that, unlike the 2007-2009 crisis period, the bear market phase of September 2000- March 2003 also included periods of low default yield spreads, low market volatility and low RtoV values. Similarly, during the 2010-2011 bull market there were still periods characterized high default yield spreads, high market volatility and illiquidity. Therefore, the estimated coefficients considerably differ across the various regression models used to examine state dependence.

firms when reacting to monetary policy shocks during our sample period and this finding holds true across different market phases and credit, volatility and liquidity conditions.

3.4 Robustness checks

3.4.1 Alternative definition of crisis period and robust regression estimates

For the benchmark results reported in Table 3.5, the crisis period was defined to extend from August 2007 to December 2009, using the bank run on Northern Rock as a starting point. In this section, we examine how robust these results are when a narrower definition of the crisis period is used. In particular, the crisis period is now defined to extend from September 2008 to August 2009, i.e. the period during which the UK economy was officially in recession, using the technical definition of two consecutive quarters with negative real GDP growth. Actually, this is the only UK recession period from 1992 to 2011. Therefore, this narrower crisis dummy variable also serves as a recession dummy variable, enabling us to document at the same time how the interest rate shocks- portfolio returns relationship was modified during this recession period, in light of the US evidence provided by Basistha and Kurov (2008) and Kontonikas et al. (2012).

We re-estimate model (3.5), but now the dummy variable D^{Crisis} takes the value 1 during the period from September 2008 to August 2009 and zero otherwise. The estimated coefficients with respect to the unexpected interest rate changes excluding and during this narrower crisis period are reported in Table 3.10, along with the p-values of a Wald test for the null hypothesis that the estimated coefficients are equal across the two periods. These results confirm the validity of the benchmark results reported in Table 3.5. The relationship between portfolio returns and interest rate shocks was negative and statistically significant for most of the cases examined outside the crisis period, while during the crisis period the sign of this relationship became positive and the null hypothesis of equal coefficients across the two periods is rejected. Finally, in line with the benchmark results, there is no evidence that the most constrained portfolios' returns were more responsive to unexpected rate changes relative the least constrained ones, except when the tangible-to-total assets ratio and KZ-index are used as proxies.

Another potential issue for the documented relationships is the impact of outliers, because as Figure 3.1 shows, large unexpected shocks were extracted on various MPC meetings. To address this issue, we follow Basistha and Kurov (2008), Kurov (2010) and Kontonikas et al. (2012), employing the MM weighted least squares procedure introduced by Yohai (1987), which yields estimates that are robust to the presence of outliers. Using this procedure, we re-estimate regression model (3.5). Unreported results, which are readily available upon request, confirm the reversal of the relationship between returns and interest rate shocks during the crisis period, in accordance to the benchmark results reported in Table 3.5. Actually, using this procedure the coefficients of the relationship during the crisis period are now larger and more significant relative to the benchmark results.

3.4.2 Interaction terms to examine state dependence

Section 3.3.2 examined whether the interest rate shocks- portfolio returns relationship exhibits state dependence using a dummy variable approach. For robustness, in this Section we use the state proxy variables as interaction terms and, following Jansen and Tsai (2010), we examine how the coefficient of the relationship changes with different values of the state proxy. In particular, we interact the anticipated and unanticipated interest rate change with each of the credit, volatility and market liquidity state variables alternatively, leading to the following general model specification:

$$\begin{aligned} r_{p,m,d} = {} & \alpha + \beta_1^u (1 - D^{Crisis}) \Delta i_d^u + \beta_2^u (1 - D^{Crisis}) S_d \Delta i_d^u + \beta_3^u D^{Crisis} \Delta i_d^u + \\ & \beta_1^e (1 - D^{Crisis}) \Delta i_d^e + \beta_2^e (1 - D^{Crisis}) S_d \Delta i_d^e + \beta_3^e D^{Crisis} \Delta i_d^e + \gamma' X_d + \varepsilon_d \end{aligned} \tag{3.10}$$

where S_d denotes the value of the default yield spread, FTSE 100 implied volatility index and RtoV price impact ratio of FTSE All Share, respectively, on MPC meeting day d. It should be noted that for the state variables to be used as interaction terms and to have a meaningful interpretation, each of them has been standardized using the average and standard deviation of its full sample daily values.

Since our benchmark results showed that credit conditions significantly affect the interest rate shocks- portfolio returns relationship, we report in Table 3.11 the estimated coefficients for the unanticipated interest rates changes from regression model (3.10), using the standardized default yield spread as an interaction term. The coefficient of the interaction term is estimated to be negative for almost all of the cases we examine, confirming our conjecture that the higher the default yield spread is, and hence the tighter the credit conditions are, the more negative the relationship between returns and interest rate shocks becomes outside the crisis period. However, despite the magnitude of the estimated coefficients, the corresponding standard errors are very large, preventing them from being statistically significant at any conventional level.

With respect to the rest state variables, we find that adding implied volatility as an interaction term in model (3.10) does not have any particular economic or statistical significance. On the other hand, using our standardized liquidity measure as an interaction term, we find that in line with our benchmark results, the magnitude of the inverse relationship between interest rate shocks and portfolio returns increases considerably as the market becomes more illiquid. However, in most of the cases this effect is too noisy, failing to yield statistical significance. These unreported results are available upon request.

3.4.3 Alternative proxies for state dependence

In this section, we examine the robustness of our benchmark results in Section 3.3.2 with respect to the dependence of the shocks- returns relationship on the market phase and market liquidity conditions by using a different approach to determine a bull market phase and a modified price impact ratio to proxy liquidity. In particular, we re-estimate model (3.6), but now the bull market dummy takes the value 1 if the level of FTSE All Share index is higher than its past 500-day moving average and zero otherwise. Moreover, we use the Return-to-Turnover Rate (RtoTR) price impact ratio for FTSE All Share, which is a modification of the RtoV price impact ratio and it is calculated as the 90-day average ratio of absolute FTSE All Shares daily returns to the corresponding turnover rate of the same day (see Florackis, Gregoriou and Kostakis, 2011, for the merits of this liquidity proxy). Using this alternative proxy, we re-estimate model (3.9) where now the liquidity dummy takes the value 1 when RtoTR on MPC meeting day *d* is higher than its sample average value, indicating an illiquid market state, and zero otherwise. Overall, the results from these robustness checks are qualitatively very similar to the benchmark results reported in Tables 3.6 and 3.9, respectively, and they are readily available upon request.

3.4.4 LIBOR-BoE base rate spread changes

The last issue we examine in this study is how the returns of the financial constraints-sorted portfolios respond to an alternative shock on MPC meeting days, namely the change in the spread between LIBOR and BoE base rate. This spread is equivalent to the LIBOR-OIS spread that is commonly used in US studies (see Thornton, 2009, for an introduction) and proxies for funding conditions in the interbank market. Increases in LIBOR-BoE rate spread indicate an increase in the relative cost of funding for financial intermediaries, which eventually leads to an increase in firms' cost of financing through the bank lending transmission mechanism. To examine the response of portfolio returns to changes in this spread on MPC meeting days, we estimate the following regression model:

$$r_{p,m,d} = \alpha + \beta^{spread} \Delta(LIBOR - BoE\ rate)_d + \gamma' X_d + \varepsilon_d \tag{3.11}$$

where $\Delta(LIBOR - BoE\ rate)_d$ denotes the change in this spread on MPC meeting day *d*. This model does not include a dummy variable for the crisis period, exactly because this spread was large and exhibited considerable fluctuations mainly during the 2007-2009 crisis period, as Figure 3.2 shows. Therefore, the crisis effect is inherently taken into account by the behaviour of the spread. The estimated coefficients are reported in Table 3.12.

We find that for almost all of the portfolios we examined, there is an inverse relationship between returns and changes in the LIBOR-BoE rate spread. This negative relationship is statistically significant at the 5% level for half of the cases we report. Regarding the economic significance of the relationship, we find that an increase of 25 basis points in the spread on an MPC meeting day would be associated, for example, with a -0.38% drop in FTSE All Share Index as well as a negative return of -0.80% and -0.47% for the most constrained quintile portfolios according to cash holdings-to-total assets and interest coverage ratios, respectively. These results show that the deterioration of funding conditions for financial intermediaries has a considerable impact on UK stock returns. We also find that this negative impact is stronger for the most financially constrained firms relative to the least constrained ones only when total debt-to-market value, cash holdings-to-total assets and interest coverage ratios are used as proxies, but this differential is significant only for the first two cases. Finally, these results also reveal the large degree of heterogeneity in the response of portfolio returns to changes in the LIBOR-BoE rate spread across the various constraints proxies.

3.5 Conclusions

This study examines, for the first time in the literature, the return response of the most and the least constrained firms listed on LSE according to a series of financial constraints proxies, to UK monetary policy shocks during the period June 1999- December 2011. Following Bredin et al. (2007) and Bredin et al. (2009), these shocks are extracted on BoE MPC meeting days, relative to expectations embedded in LIBOR futures prices. Using a large number of constraints proxies to provide comprehensive evidence, we derive a series of interesting conclusions.

Firstly, we find no significant evidence to support the argument that the return response of the most constrained firms is of greater magnitude relative to corresponding response of the least constrained firms, apart from some cases where the tangible-to-total assets ratio and KZ-index are used as proxies. The opposite is actually true for most of the measures we use. This evidence is at odds with the intuition provided by the credit channel of the monetary policy transmission mechanism and the limited existing evidence for the US market (see Ehrmann and Fratzscher, 2004, Basistha and Kurov, 2008 and Jansen and Tsai, 2010). The primary explanation we put forward for this finding is that investors on LSE do not regard the interaction between financial constraints and monetary conditions to be an important source of risk, especially at very short horizons, and hence they do not differentiate across listed firms on the basis of their constraints when reacting to monetary policy shocks.

Secondly, these results also highlight the large degree of heterogeneity in the return response across the proxies we use, revealing that they capture different aspects of the elusive concept of financial constraints. Therefore, relying only on a subset of these measures to derive strong conclusions regarding the effect of financial constraints on the interest rate shocks- stock returns relationship would be rather misleading. Thirdly, in line with recent studies (Gregoriou et al., 2009 and Florackis et al., 2011), our results show that the inverse relationship between monetary policy shocks and stock returns that is documented excluding the 2007-2009 crisis period became positive during the crisis. This is true both for the market index and for the majority of the portfolios containing the most and the least constrained firms listed on LSE. This finding remains intact when we use the UK recession period of September 2008- August 2009 to define an alternative, narrower crisis period.

Finally, the reported results reveal that the relationship between stock returns and monetary policy shocks in the UK market exhibits state dependence. In particular, we find that excluding the crisis period, this inverse relationship is of greater magnitude during bull market phases, tight credit conditions, high market volatility and illiquidity periods. However, this differential magnitude is statistically significant only in the case of tight credit conditions. Concluding, as Blinder (2012) recently noted, the reduction of policy rates to levels close to the zero lower bound and the introduction of QE calls for a detailed investigation of the impact of unconventional monetary policies on the returns of financially constrained firms; this topic is left for future research.

Table 3.1
Definitions of financial constraints proxies

This Table contains the definitions of eight financial constraints proxies used to classify all of the non-financial firms listed on LSE into quintile portfolios as well as the Datastream and Worldscope data items used to calculate them.

Financial constraints measure	Definition	Data Items used
1. Total Assets	$\text{Book Value of Total Assets}_t$	Worldscope item: WC02999
2. Tangible-to-Total Assets ratio	$\dfrac{\text{Tangible Assets}_t}{\text{Total Assets}_t}$	Worldscope item: WC02501
3. Total Debt-to-Common Equity ratio	$\dfrac{\text{Total Debt}_t}{\text{Book Value of Common Equity}_t}$	Worldscope item: WC08231
4. Total Debt-to-Market Value ratio	$\dfrac{\text{Total Debt}_t}{\text{Market Value}_t}$	Worldscope item: WC03255 and MV
5. Cash holdings-to-Total Assets ratio	$\dfrac{\text{Cash Holdings}_t}{\text{Total Assets}_t}$	Worldscope item: WC02001 and WC02999
6. Interest Coverage ratio	$\dfrac{\text{EBIT}_t}{\text{Total Interest Expense ratio}_t}$	Worldscope item: WC08291
7. Kaplan-Zingales (KZ) index	$\text{KZ}_t = -1.002 \times \dfrac{\text{Cash Flow}_t}{\text{Prop, Plant and Equip}_{t-1}} +0.283 \times \text{Tobin's Q}_t +3.139 \times \dfrac{\text{Total Debt}_t}{\text{Total Capital}_t} -39.368 \times \dfrac{\text{Dividends Paid}_t}{\text{Prop, Plant and Equip}_{t-1}} -1.315 \times \dfrac{\text{Cash Holdings}_t}{\text{Prop, Plant and Equip}_{t-1}}$	Worldscope item: WC01250, WC01151, WC02501, WC02999, WC03501, WC03451, MV, WC03255, WC03998, WC04551 and WC02001
8. Whited-Wu (WW) index	$\text{WW}_t = -0.091 \times \dfrac{\text{Cash Flow}_t}{\text{Total Assets}_t} -0.062 \times \text{Dividend dummy}_t +0.021 \times \dfrac{\text{Long-term Debt}_t}{\text{Total Assets}_t} -0.044 \times \ln(\text{Total Assets}_t) +0.102 \times \text{Industry Sales Growth}_t -0.035 \times \text{Firm Sales Growth}_t$	Worldscope item: WC01250, WC01151, WC02999, WC04551, WC03251, WC01001 and FTAG3 for industry classification

Table 3.2
Descriptive statistics

Panel A reports the descriptive statistics for the value-weighted daily returns of quintile portfolios with the most constrained firms on BoE MPC meeting days during the period June 1999- December 2011 (152 meetings). Panel B reports the corresponding descriptive statistics for the value-weighted daily returns of the quintile portfolios with the least constrained firms, zero leverage firms and FTSE All Share Index. All of the non-financial firms listed on LSE have been classified into quintile portfolios prior to the MPC meeting day using each of the eight financial constraints proxies defined in Table 3.1. Panel C contains the corresponding descriptive statistics for expected and unexpected interest rate changes and the values of default yield spread, LIBOR-BoE base rate spread, FTSE 100 Implied Volatility Index and Return-to-Volume (RtoV) price impact ratio for FTSE All Share Index on MPC meetings.

Panel A: Most constrained quintile portfolios

Financial constraints proxy	Mean	Median	Max	Min	St. Dev.
1. Total Assets	0.03%	0.02%	9.51%	-6.27%	1.16%
2. Tangible-to-Total Assets ratio	0.06%	-0.02%	7.20%	-5.39%	1.64%
3. Total Debt-to-Common Equity ratio	-0.17%	0.01%	3.69%	-5.30%	1.19%
4. Total Debt-to-Market Value ratio	-0.08%	0.05%	4.88%	-5.88%	1.37%
5. Cash holdings-to-Total Assets ratio	0.10%	0.05%	6.91%	-7.80%	1.82%
6. Interest Coverage ratio	-0.26%	-0.04%	4.87%	-5.61%	1.39%
7. Kaplan-Zingales (KZ) index	-0.12%	-0.03%	6.74%	-5.69%	1.68%
8. Whited-Wu (WW) index	0.03%	0.01%	10.92%	-5.37%	1.37%

Panel B: Least constrained quintile portfolios, zero leverage portfolios and FTSE All Share

Financial constraints proxy	Mean	Median	Max	Min	St. Dev.
1. Total Assets	-0.10%	-0.09%	4.47%	-5.61%	1.27%
2. Tangible-to-Total Assets ratio	-0.11%	-0.09%	4.45%	-6.77%	1.46%
3. Total Debt-to-Common Equity ratio	0.09%	0.07%	7.45%	-6.88%	1.66%
4. Total Debt-to-Market Value ratio	-0.06%	-0.04%	9.19%	-5.37%	1.64%
5. Cash holdings-to-Total Assets ratio	0.04%	-0.02%	7.93%	-6.64%	1.88%
6. Interest Coverage ratio	-0.12%	-0.08%	5.77%	-6.58%	1.57%
7. Kaplan-Zingales (KZ) index	-0.21%	-0.15%	4.52%	-4.47%	1.28%
8. Whited-Wu (WW) index	-0.10%	-0.09%	4.46%	-5.61%	1.27%
Zero Debt-to-Common Equity ratio	-0.07%	0.01%	9.15%	-5.53%	1.82%
Zero Debt-to-Market Value ratio	-0.06%	0.01%	9.15%	-5.53%	1.81%
FTSE All Share	-0.12%	-0.10%	5.15%	-5.38%	1.31%

Panel C: Interest rate changes and variables for state dependence

	Mean	Median	Max	Min	St. Dev.
Unexpected rate changes	-0.005%	0%	0.26%	-0.40%	0.07%
Expected rate changes	-0.001%	0%	0.23%	-0.39%	0.07%
Default yield spread	1.72%	1.40%	6.11%	0.83%	1.02%
LIBOR-BoE base rate	0.26%	0.17%	2.40%	-0.50%	0.39%
FTSE 100 Implied Volatility	21.61	19.41	56.81	9.50	9.19
RtoV Price impact ratio	1.84	1.76	4.98	0.49	1.02

Table 3.3
Correlation coefficients

Panel A reports the pairwise correlation coefficients between the value-weighted daily returns of quintile portfolios of the most constrained firms as well as of FTSE All Share Index on BoE MPC meeting days during the period June 1999- December 2011 (152 meetings). Panel B contains the corresponding correlation coefficients between the value-weighted daily returns of quintile portfolios of the least constrained firms as well as of FTSE All Share Index. All of the non-financial firms listed on LSE have been classified into quintile portfolios prior to the MPC meeting day using each of the eight financial constraints proxies defined in Table 3.1.

Panel A: Correlation coefficients for the most constrained quintile portfolios and FTSE All Share

Financial constraints proxy	1	2	3	4	5	6	7	8	FTSE
1. Total Assets	1								
2. Tangible-to-Total Assets ratio	0.67	1							
3. Total Debt-to-Common Equity ratio	0.34	0.60	1						
4. Total Debt-to-Market Value ratio	0.43	0.63	0.81	1					
5. Cash holdings-to-Total Assets ratio	0.46	0.70	0.72	0.72	1				
6. Interest Coverage ratio	0.42	0.60	0.83	0.84	0.61	1			
7. Kaplan-Zingales (KZ) index	0.47	0.70	0.80	0.77	0.66	0.78	1		
8. Whited-Wu (WW) index	0.89	0.70	0.42	0.48	0.51	0.47	0.54	1	
FTSE All Share	0.44	0.76	0.86	0.83	0.83	0.80	0.83	0.50	1

Panel B: Correlation coefficients for the least constrained quintile portfolios and FTSE All Share

Financial constraints proxy	1	2	3	4	5	6	7	8	FTSE
1. Total Assets	1								
2. Tangible-to-Total Assets ratio	0.92	1							
3. Total Debt-to-Common Equity ratio	0.78	0.69	1						
4. Total Debt-to-Market Value ratio	0.74	0.60	0.81	1					
5. Cash holdings-to-Total Assets ratio	0.82	0.72	0.83	0.91	1				
6. Interest Coverage ratio	0.85	0.77	0.76	0.73	0.79	1			
7. Kaplan-Zingales (KZ) index	0.82	0.66	0.71	0.76	0.76	0.80	1		
8. Whited-Wu (WW) index	1.00	0.92	0.78	0.75	0.83	0.86	0.83	1	
FTSE All Share	0.97	0.89	0.77	0.75	0.82	0.82	0.81	0.97	1

Table 3.4
Returns response to interest rate changes without accounting for crisis effect

This table presents the estimated coefficients from least squares regressions of daily value-weighted returns of quintile portfolios with the most and the least constrained firms on expected and unexpected interest rate changes on BoE MPC meeting days during the period June 1999- December 2011, according to model (3.4): $r_{p,m,d} = \alpha + \beta^u \Delta i_d^u + \beta^e \Delta i_d^e + \gamma' X_d + \varepsilon_d$. Firms listed on LSE have been classified into quintile portfolios prior to the MPC meeting day using each of the eight financial constraints proxies defined in Table 3.1. The corresponding estimates for the spread return between the most and the least constrained portfolios, zero leverage portfolio returns and FTSE All Share returns are also reported. ***, **, * indicate statistical significance at the 1%, 5% and 10% level, respectively, for the estimated coefficients using Newey-West standard errors.

Financial constraints proxy	Portfolio	β^u	β^e	R^2 adj.
1. Total Assets	Most constrained	-2.42	-0.35	1.17%
	Least constrained	-1.98	-2.24	18.05%
	Most-Least spread	-0.44	1.89	8.59%
2. Tangible-to-Total Assets	Most constrained	-9.09**	-5.38	7.13%
	Least constrained	0.75	-1.26	18.06%
	Most-Least spread	-9.83***	-4.12	9.90%
3. Total Debt-to- Common Equity	Most constrained	-2.05	-1.17	18.87%
	Least constrained	-4.88	-3.35	11.85%
	Zero Leverage	-8.71**	-6.07	14.59%
	Most-Least spread	2.83	2.19	-2.22%
4. Total Debt-to-Market Value	Most constrained	0.57	2.23	16.44%
	Least constrained	-6.40**	-4.81**	12.51%
	Zero Leverage	-8.88**	-6.16	15.03%
	Most-Least spread	6.97**	7.04	4.36%
5. Cash holdings-to-Total Assets	Most constrained	-0.03	0.36	7.09%
	Least constrained	-6.92	-4.11	18.16%
	Most-Least spread	6.89**	4.47*	2.95%
6. Interest Coverage ratio	Most constrained	-0.21	0.61	18.73%
	Least constrained	-2.87	-2.22	16.41%
	Most-Least spread	2.65	2.83	-1.58%
7. Kaplan-Zingales index	Most constrained	-5.72	-3.41	12.59%
	Least constrained	-4.24	-2.57	13.59%
	Most-Least spread	-1.48	-0.84	-0.25%
8. Whited-Wu index	Most constrained	-4.20**	-1.70	2.13%
	Least constrained	-1.93	-2.16	17.73%
	Most-Least spread	-2.27	0.46	4.53%
	FTSE All Share	-2.33	-2.14	16.19%

Table 3.5

Returns response to unexpected interest rate changes accounting for crisis effect

This table presents the estimated coefficients from least squares regressions of daily value-weighted returns of quintile portfolios with the most and the least constrained firms on expected and unexpected interest rate changes on BoE MPC meeting days during the period June 1999- December 2011, according to model (3.5): $r_{p,m,d} = \alpha + \beta_1^u (1 - D^{Crisis}) \Delta i_d^u + \beta_2^u D^{Crisis} \Delta i_d^u + \beta_1^e (1 - D^{Crisis}) \Delta i_d^e + \beta_2^e D^{Crisis} \Delta i_d^e + \gamma' X_d + \varepsilon_d$, where D^{Crisis} takes the value 1 on MPC meetings from August 2007 to December 2009. p-values for the Wald test of the null hypothesis that the coefficients of unexpected rate changes outside and during the crisis period are equal, $\beta_1^u = \beta_2^u$, are presented in square brackets. The corresponding estimates for the spread return between the most and the least constrained portfolios, zero leverage portfolio returns and FTSE All Share returns are also reported. ***, **, * indicate statistical significance at the 1%, 5% and 10% level, respectively, for the estimated coefficients using Newey-West standard errors.

Financial constraints proxy	Portfolio	β_1^u	β_2^u	$\beta_1^u = \beta_2^u$	R^2 adj.
1. Total Assets	Most constrained	-3.17	-1.48	[0.67]	0.14%
	Least constrained	-8.52***	11.35***	[0.00]	24.20%
	Most-Least spread	5.35*	-12.83***		13.19%
2. Tangible-to-Total Assets	Most constrained	-14.72***	3.82	[0.00]	9.82%
	Least constrained	-6.67**	15.75***	[0.00]	23.94%
	Most-Least spread	-8.05**	-11.93***		10.12%
3. Total Debt-to- Common Equity	Most constrained	-7.22**	8.36**	[0.00]	22.88%
	Least constrained	-14.41***	14.84***	[0.00]	19.67%
	Zero Leverage	-14.45***	4.68	[0.00]	17.00%
	Most-Least spread	7.20**	-6.48		-0.43%
4. Total Debt-to-Market Value	Most constrained	-6.31**	14.97***	[0.00]	22.90%
	Least constrained	-10.06***	-0.88	[0.11]	14.36%
	Zero Leverage	-14.63***	4.54	[0.00]	17.48%
	Most-Least spread	3.75	15.86***		8.27%
5. Cash holdings-to-Total Assets	Most constrained	-11.12***	23.31***	[0.00]	16.17%
	Least constrained	-16.18***	12.39***	[0.00]	23.70%
	Most-Least spread	5.07	10.92***		2.13%
6. Interest Coverage ratio	Most constrained	-6.59**	12.73***	[0.00]	23.38%
	Least constrained	-8.59**	7.22	[0.00]	19.71%
	Most-Least spread	2.00	5.51*		-1.61%
7. Kaplan-Zingales index	Most constrained	-10.28**	3.83	[0.01]	13.43%
	Least constrained	-7.59**	2.82	[0.02]	14.30%
	Most-Least spread	-2.69	1.01		-1.24%
8. Whited-Wu index	Most constrained	-4.71	-3.88*	[0.86]	1.05%
	Least constrained	-8.53***	11.43***	[0.00]	23.93%
	Most-Least spread	3.81	-15.31***		9.53%
	FTSE All Share	-9.25***	12.13***	[0.00]	22.78%

Table 3.6
Returns response to unexpected interest rate changes in bull and bear markets

This table presents the estimated coefficients from least squares regressions of daily value-weighted returns of quintile portfolios with the most and the least constrained firms on expected and unexpected interest rate changes on BoE MPC meeting days during the period June 1999- December 2011, according to model (3.6): $r_{p,m,d} = \alpha + \beta_1^u (1 - D^{Crisis})(1 - D^{Bull})\Delta i_d^u + \beta_2^u (1 - D^{Crisis}) D^{Bull} \Delta i_d^u + \beta_3^u D^{Crisis} \Delta i_d^u + \ldots + \varepsilon_d$ where D^{Crisis} takes the value 1 on MPC meetings from August 2007 to December 2009 and D^{Bull} takes the value 1 when FTSE All Share Index is in a bull phase and zero otherwise, using the bull market definition of Jansen and Tsai (2010). p-values for the Wald test of the null hypothesis that the coefficients of unexpected rate changes in bear and bull markets are equal, $\beta_1^u = \beta_2^u$, are presented in square brackets. The corresponding estimates for the spread return between the most and the least constrained portfolios, zero leverage portfolio returns and FTSE All Share returns are also reported. ***, **, * indicate statistical significance at the 1%, 5% and 10% level, respectively, for the estimated coefficients using Newey-West standard errors.

Financial constraints proxy	Portfolio	β_1^u	β_2^u	β_3^u	$\beta_1^u = \beta_2^u$	R^2 adj.
1. Total Assets	Most constrained	1.37	-3.95	-1.47	[0.19]	-0.18%
	Least constrained	-1.87	-8.56**	11.28***	[0.22]	26.43%
	Most-Least spread	3.23	4.61	-12.75***		12.77%
2. Tangible-to-Total Assets	Most constrained	-12.46*	-12.51***	3.61	[0.99]	10.14%
	Least constrained	1.76	-8.26**	15.79***	[0.09]	25.12%
	Most-Least spread	-14.22	-4.25	-12.18***		9.82%
3. Total Debt-to-Common Equity	Most constrained	-0.59	-7.78**	8.33**	[0.23]	24.70%
	Least constrained	-13.05*	-11.64**	14.59***	[0.86]	20.20%
	Zero Leverage	-12.46***	-13.47**	4.58	[0.89]	16.30%
	Most-Least spread	12.47	3.86	-6.26		-0.98%
4. Total Debt-to-Market Value	Most constrained	-2.51	-6.17**	14.92***	[0.59]	22.94%
	Least constrained	-0.99	-11.09**	-0.90	[0.08]	16.29%
	Zero Leverage	-12.43***	-13.79**	4.45	[0.85]	16.78%
	Most-Least spread	-1.52	4.92*	15.82***		8.11%
5. Cash holdings-to-Total Assets	Most constrained	-0.13	-11.33***	23.21***	[0.10]	19.17%
	Least constrained	-15.21**	-13.17**	12.13***	[0.80]	23.96%
	Most-Least spread	15.08*	1.84	11.08***		3.21%
6. Interest Coverage ratio	Most constrained	1.62	-8.06**	12.76***	[0.22]	24.75%
	Least constrained	1.69	-9.75*	7.21	[0.06]	22.27%
	Most-Least spread	-0.07	1.69	5.56*		-2.55%
7. Kaplan-Zingales index	Most constrained	7.04	-14.80***	4.01	[0.00]	18.07%
	Least constrained	3.84	-10.19**	2.91	[0.00]	17.89%
	Most-Least spread	3.21	-4.61	1.10		-1.05%
8. Whited-Wu index	Most constrained	1.93	-6.64	-3.79*	[0.14]	0.85%
	Least constrained	-1.95	-8.39**	11.35***	[0.23]	26.31%
	Most-Least spread	3.87	1.76	-15.14***		9.22%
	FTSE All Share	-3.54	-8.63**	12.02***	[0.35]	24.82%

Table 3.7

Returns response to unexpected interest rate changes in tight and loose credit conditions

This table presents the estimated coefficients from least squares regressions of daily value-weighted returns of quintile portfolios with the most and the least constrained firms on expected and unexpected interest rate changes on BoE MPC meeting days during the period June 1999- December 2011, according to model (3.7): $r_{p,m,d} = \alpha + \beta_1^u(1-D^{Crisis})(1-D^{Credit})\Delta i_d^u + \beta_2^u(1-D^{Crisis})D^{Credit}\Delta i_d^u + \beta_3^u D^{Crisis}\Delta i_d^u + ... + \varepsilon_d$, where D^{Crisis} takes the value 1 on MPC meetings from August 2007 to December 2009 and D^{Credit} takes the value 1 when the default yield spread is higher than its full sample average daily value and zero otherwise. p-values for the Wald test of the null hypothesis that the coefficients of unexpected rate changes in loose and tight credit market conditions are equal, $\beta_1^u = \beta_2^u$, are presented in square brackets. The corresponding estimates for the spread return between the most and the least constrained portfolios, zero leverage portfolio returns and FTSE All Share returns are also reported. ***, **, * indicate statistical significance at the 1%, 5% and 10% level, respectively, for the estimated coefficients using Newey-West standard errors.

Financial constraints proxy	Portfolio	β_1^u	β_2^u	β_3^u	$\beta_1^u = \beta_2^u$	R^2 adj.
1. Total Assets	Most constrained	-1.49	-22.99	-1.51	[0.26]	1.27%
	Least constrained	-7.11**	-24.24**	11.33***	[0.12]	24.69%
	Most-Least spread	5.62*	1.25	-12.85***		12.03%
2. Tangible-to-Total Assets	Most constrained	-10.71***	-69.68***	3.67	[0.00]	15.93%
	Least constrained	-6.47**	-9.64	15.74***	[0.82]	22.89%
	Most-Least spread	-4.24	-60.03***	-12.07***		17.85%
3. Total Debt-to-Common Equity	Most constrained	-6.53**	-12.50	8.37**	[0.50]	22.41%
	Least constrained	-10.16***	-75.16***	14.66***	[0.00]	27.00%
	Zero Leverage	-12.00***	-54.13*	4.54	[0.14]	18.74%
	Most-Least spread	3.63	62.65***	-6.29		9.30%
4. Total Debt-to-Market Value	Most constrained	-4.50	-25.74**	14.96***	[0.04]	24.25%
	Least constrained	-7.54**	-43.46***	-0.96	[0.02]	16.58%
	Zero Leverage	-12.28***	-53.70***	4.39	[0.14]	19.17%
	Most-Least spread	3.03	17.72**	15.92***		7.88%
5. Cash holdings-to-Total Assets	Most constrained	-8.49**	-41.18**	23.28***	[0.07]	17.56%
	Least constrained	-14.26***	-42.35*	12.32***	[0.23]	23.91%
	Most-Least spread	5.77	1.17	10.96***		1.44%
6. Interest Coverage ratio	Most constrained	-6.33**	-2.29	12.80***	[0.78]	23.22%
	Least constrained	-5.53	-46.41***	7.15	[0.00]	23.12%
	Most-Least spread	-0.79	44.12***	5.64**		3.66%
7. Kaplan-Zingales index	Most constrained	-7.14**	-48.63**	3.76	[0.06]	16.41%
	Least constrained	-5.49*	-29.06**	2.81	[0.11]	16.73%
	Most-Least spread	-1.65	-19.57**	0.95		-0.94%
8. Whited-Wu index	Most constrained	-2.80	-26.30	-3.90*	[0.27]	2.07%
	Least constrained	-7.03**	-25.08**	11.42***	[0.11]	24.59%
	Most-Least spread	4.23	-1.22	-15.32***		8.39%
	FTSE All Share	-7.55***	-27.12**	12.12***	[0.10]	23.92%

Table 3.8

Returns response to unexpected interest rate changes in high and low volatility conditions

This table presents the estimated coefficients from least squares regressions of daily value-weighted returns of quintile portfolios with the most and the least constrained firms on expected and unexpected interest rate changes on BoE MPC meeting days during the period June 1999- December 2011, according to model (3.8): $r_{p,m,d} = \alpha + \beta_1^u (1 - D^{Crisis})(1 - D^{Vol})\Delta i_d^u + \beta_2^u (1 - D^{Crisis}) D^{Vol} \Delta i_d^u + \beta_3^u D^{Crisis} \Delta i_d^u + ... + \varepsilon_d$, where D^{Crisis} takes the value 1 on MPC meetings from August 2007 to December 2009 and D^{Vol} takes the value 1 when the FTSE 100 Implied Volatility Index is higher than its full sample average daily value and zero otherwise. p-values for the Wald test of the null hypothesis that the coefficients of unexpected rate changes in low and high market volatility conditions are equal, $\beta_1^u = \beta_2^u$, are presented in square brackets. The corresponding estimates for the spread return between the most and the least constrained portfolios, zero leverage portfolio returns and FTSE All Share returns are also reported. ***, **, * indicate statistical significance at the 1%, 5% and 10% level, respectively, for the estimated coefficients using Newey-West standard errors.

Financial constraints proxy	Portfolio	β_1^u	β_2^u	β_3^u	$\beta_1^u = \beta_2^u$	R^2 adj.
1. Total Assets	Most constrained	-4.05***	-5.88	-1.76	[0.87]	-0.91%
	Least constrained	-6.35*	-12.63	11.36***	[0.48]	23.67%
	Most-Least spread	2.30	6.75	-13.12***		12.38%
2. Tangible-to-Total Assets	Most constrained	-11.99***	-25.02*	3.58	[0.38]	9.78%
	Least constrained	-5.86	-5.94	15.94***	[0.99]	23.76%
	Most-Least spread	-6.14**	-19.08	-12.35***		11.28%
3. Total Debt-to-Common Equity	Most constrained	-3.86	-11.35	8.68**	[0.33]	22.44%
	Least constrained	-10.35***	-28.39**	14.62***	[0.12]	20.78%
	Zero Leverage	-10.33**	-23.64*	4.63	[0.23]	16.76%
	Most-Least spread	6.48*	17.04**	-5.94		0.69%
4. Total Debt-to-Market Value	Most constrained	-3.88	-14.48*	14.93***	[0.20]	23.72%
	Least constrained	-6.39*	-16.45	-0.62	[0.37]	13.66%
	Zero Leverage	-10.74**	-23.40*	4.50	[0.40]	17.10%
	Most-Least spread	2.52	1.97	15.55***		8.97%
5. Cash holdings-to-Total Assets	Most constrained	-5.70	-16.57	23.78***	[0.37]	15.35%
	Least constrained	-10.49**	-31.68**	12.03***	[0.10]	25.04%
	Most-Least spread	4.79	15.11**	11.76***		4.18%
6. Interest Coverage ratio	Most constrained	-3.13	-13.55	12.69***	[0.27]	22.70%
	Least constrained	-6.59	-15.27	6.94	[0.42]	20.15%
	Most-Least spread	3.46	1.72	5.75*		0.10%
7. Kaplan-Zingales index	Most constrained	-9.70***	-10.81	4.18	[0.95]	11.87%
	Least constrained	-5.46	-12.48	2.80	[0.52]	13.60%
	Most-Least spread	-4.23	1.67	1.38		-1.32%
8. Whited-Wu index	Most constrained	-4.75**	-11.10	-4.14**	[0.66]	1.24%
	Least constrained	-6.32*	-13.05	11.40***	[0.46]	23.52%
	Most-Least spread	1.56	1.95	-15.54***		9.23%
	FTSE All Share	-8.01**	-13.21	12.14***	[0.60]	22.41%

Table 3.9

Returns response to unexpected interest rate changes in liquid and illiquid market conditions

This table presents the estimated coefficients from least squares regressions of daily value-weighted returns of quintile portfolios with the most and the least constrained firms on expected and unexpected interest rate changes on BoE MPC meeting days during the period June 1999- December 2011, according to model (3.9): $r_{p,m,d} = \alpha + \beta_1^u (1-D^{Crisis})(1-D^{Illiq})\Delta i_d^u + \beta_2^u (1-D^{Crisis}) D^{Illiq} \Delta i_d^u + \beta_3^u D^{Crisis} \Delta i_d^u + ... + \varepsilon_d$, where D^{Crisis} takes the value 1 on MPC meetings from August 2007 to December 2009 and D^{Illiq} takes the value 1 when the 90-day moving average of RtoV price impact ratio for FTSE All Share is higher than its full sample average daily value and zero otherwise. p-values for the Wald test of the null hypothesis that the coefficients of unexpected rate changes in liquid and illiquid market conditions are equal, $\beta_1^u = \beta_2^u$, are presented in square brackets. The corresponding estimates for the spread return between the most and the least constrained portfolios, zero leverage portfolio returns and FTSE All Share returns are also reported. ***, **, * indicate statistical significance at the 1%, 5% and 10% level, respectively, for the estimated coefficients using Newey-West standard errors.

Financial constraints proxy	Portfolio	β_1^u	β_2^u	β_3^u	$\beta_1^u = \beta_2^u$	R^2 adj.
1. Total Assets	Most constrained	-2.87	-3.99	-1.64	[0.89]	-0.70%
	Least constrained	-7.91**	-9.46**	11.41***	[0.78]	23.21%
	Most-Least spread	5.04	5.47	-13.05***		12.78%
2. Tangible-to-Total Assets	Most constrained	-13.36**	-16.65**	4.02	[0.73]	9.04%
	Least constrained	-6.58	-6.75	15.79***	[0.98]	22.89%
	Most-Least spread	-6.78	-9.91	-11.77***		9.31%
3. Total Debt-to-Common Equity	Most constrained	-4.90	-10.99***	8.46**	[0.22]	22.46%
	Least constrained	-12.56**	-17.61**	14.82***	[0.61]	18.73%
	Zero Leverage	-9.60**	-23.27***	4.41	[0.12]	17.76%
	Most-Least spread	7.66	6.62	-6.36		-1.62%
4. Total Debt-to-Market Value	Most constrained	-5.43	-7.35*	15.21***	[0.70]	22.78%
	Least constrained	-7.11	-15.43**	-1.06	[0.25]	14.25%
	Zero Leverage	-9.86**	-23.34***	4.26	[0.12]	18.25%
	Most-Least spread	1.69	8.08*	16.27***		11.04%
5. Cash holdings-to-Total Assets	Most constrained	-8.70*	-15.26**	23.31***	[0.39]	15.25%
	Least constrained	-10.41**	-26.17***	12.34***	[0.13]	24.08%
	Most-Least spread	1.71	10.91	10.97***		1.71%
6. Interest Coverage ratio	Most constrained	-4.02	-10.32***	13.08***	[0.24]	24.38%
	Least constrained	-8.45*	-9.14*	7.05	[0.92]	18.93%
	Most-Least spread	4.44	-1.18	6.03**		1.85%
7. Kaplan-Zingales index	Most constrained	-7.44	-14.81**	4.00	[0.33]	12.84%
	Least constrained	-5.70	-10.75**	2.86	[0.40]	13.41%
	Most-Least spread	-1.75	-4.06	1.15		-2.09%
8. Whited-Wu index	Most constrained	-2.97	-8.30	-4.19**	[0.61]	1.54%
	Least constrained	-7.88**	-9.53**	11.48***	[0.76]	22.93%
	Most-Least spread	4.92	1.23	-15.67***		10.74%
	FTSE All Share	-9.45**	-8.67**	12.24***	[0.89]	21.92%

Table 3.10

Returns response to unexpected interest rate changes using an alternative crisis period

This table presents the estimated coefficients from least squares regressions of daily value-weighted returns of quintile portfolios with the most and the least constrained firms on expected and unexpected interest rate changes on BoE MPC meeting days during the period June 1999- December 2011, according to model (3.5): $r_{p,m,d} = \alpha + \beta_1^u(1-D^{Crisis})\Delta i_d^u + \beta_2^u D^{Crisis}\Delta i_d^u + \beta_1^e(1-D^{Crisis})\Delta i_d^e + \beta_2^e D^{Crisis}\Delta i_d^e + \gamma' X_d + \varepsilon_d$, where D^{Crisis} takes now the value 1 on MPC meetings from September 2008 to August 2009. p-values for the Wald test of the null hypothesis that the coefficients of unexpected rate changes outside and during the crisis period are equal, $\beta_1^u = \beta_2^u$, are presented in square brackets. The corresponding estimates for the spread return between the most and the least constrained portfolios, zero leverage portfolio returns and FTSE All Share returns are also reported. ***, **, * indicate statistical significance at the 1%, 5% and 10% level, respectively, for the estimated coefficients using Newey-West standard errors.

Financial constraints proxy	Portfolio	β_1^u	β_2^u	$\beta_1^u = \beta_2^u$	R^2 adj.
1. Total Assets	Most constrained	-2.76	-2.29	[0.91]	0.04%
	Least constrained	-7.20**	10.49***	[0.00]	22.55%
	Most-Least spread	4.45	-12.78***		12.18%
2. Tangible-to-Total Assets	Most constrained	-13.43***	2.07	[0.01]	8.20%
	Least constrained	-5.49	15.39***	[0.00]	23.02%
	Most-Least spread	-7.94**	-13.31***		9.67%
3. Total Debt-to- Common Equity	Most constrained	-5.83**	6.95**	[0.00]	21.09%
	Least constrained	-13.79***	17.45***	[0.00]	20.11%
	Zero Leverage	-13.09***	3.85	[0.00]	15.91%
	Most-Least spread	7.96**	-10.50***		1.69%
4. Total Debt-to-Market Value	Most constrained	-5.00	14.99***	[0.00]	21.39%
	Least constrained	-8.99**	-3.02	[0.22]	14.72%
	Zero Leverage	-13.29***	3.73	[0.00]	16.39%
	Most-Least spread	4.00	18.01***		10.58%
5. Cash holdings-to-Total Assets	Most constrained	-9.90**	24.96***	[0.00]	15.59%
	Least constrained	-15.48***	14.46***	[0.00]	23.82%
	Most-Least spread	5.57	10.50***		1.94%
6. Interest Coverage ratio	Most constrained	-5.06	11.78***	[0.00]	21.62%
	Least constrained	-7.36*	5.45	[0.02]	19.79%
	Most-Least spread	2.30	6.33**		-0.01%
7. Kaplan-Zingales index	Most constrained	-9.02**	2.77	[0.02]	12.68%
	Least constrained	-6.40*	0.98	[0.07]	13.33%
	Most-Least spread	-2.62	1.78		-1.08%
8. Whited-Wu index	Most constrained	-4.43	-4.16*	[0.95]	0.87%
	Least constrained	-7.20**	10.56***	[0.00]	22.30%
	Most-Least spread	2.76	-14.72***		8.18%
	FTSE All Share	-7.88**	11.38***	[0.00]	20.96%

Table 3.11

Returns response to unexpected interest rate changes with default spread as interaction term

This table presents the estimated coefficients from least squares regressions of daily value-weighted returns of quintile portfolios with the most and the least constrained firms on expected and unexpected interest rate changes on BoE MPC meeting days during the period June 1999- December 2011, according to model (3.10): $r_{p,m,d} = \alpha + \beta_1^u (1 - D^{Crisis}) \Delta i_d^u + \beta_2^u (1 - D^{Crisis}) S_d \Delta i_d^u + \beta_3^u D^{Crisis} \Delta i_d^u + ... + \varepsilon_d$ where D^{Crisis} takes the value 1 on MPC meetings from August 2007 to December 2009 and S_d is the value of the default yield spread on MPC meeting day *d*, standardized with respect to its full sample daily values. The corresponding estimates for the spread return between the most and the least constrained portfolios, zero leverage portfolio returns and FTSE All Share returns are also reported. ***, **, * indicate statistical significance at the 1%, 5% and 10% level, respectively, for the estimated coefficients using Newey-West standard errors.

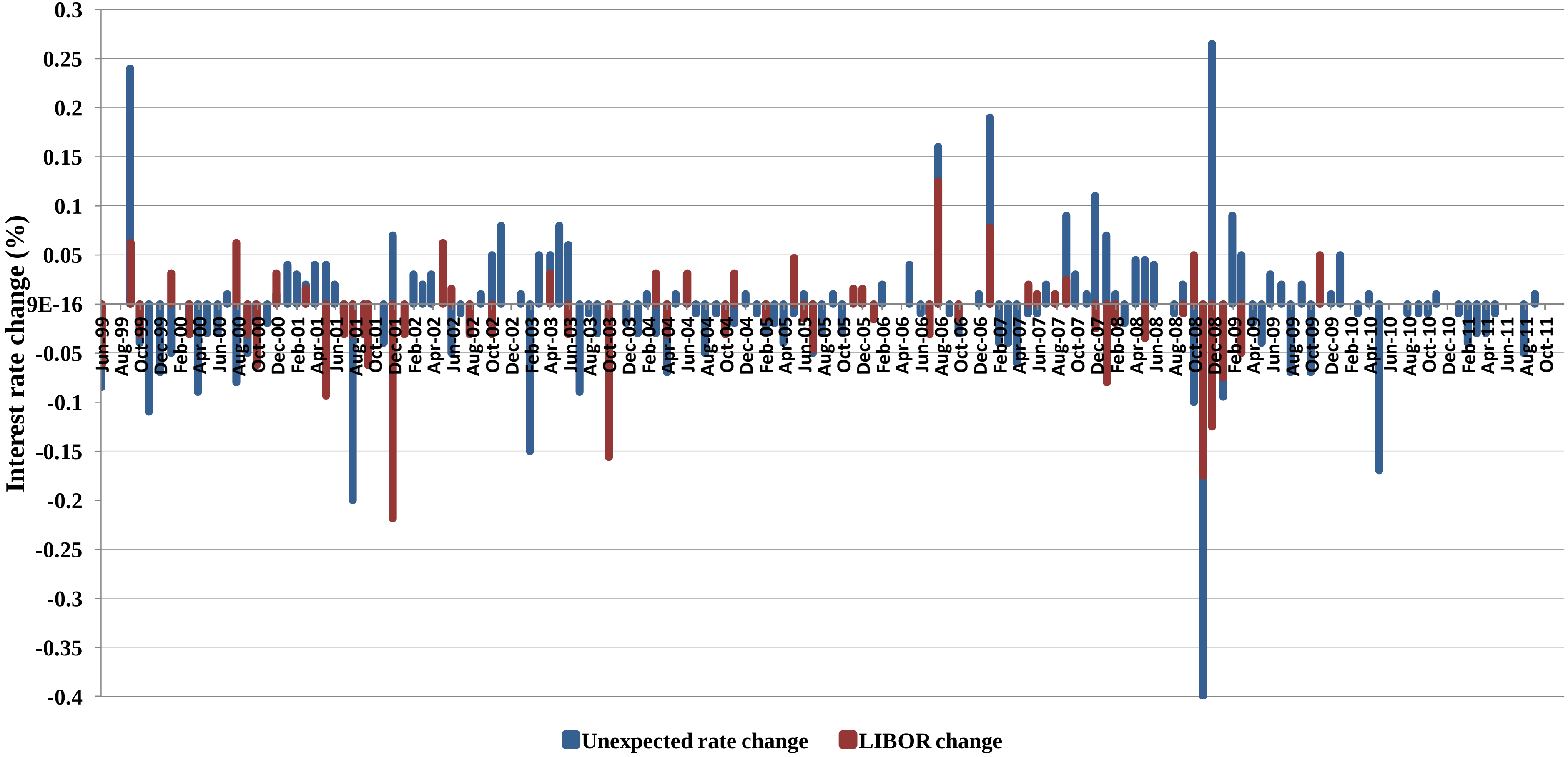
Financial constraints proxy	Portfolio	β_1^u	β_2^u	β_3^u	R^2 adj.
1. Total Assets	Most constrained	-4.84	-3.56	-1.49	-1.12%
	Least constrained	-15.82**	-14.96	11.24***	24.19%
	Most-Least spread	10.97	11.40	-12.73***	12.55%
2. Tangible-to-Total Assets	Most constrained	-27.11**	-25.21	3.61	10.27%
	Least constrained	-8.74	-3.80	15.67***	23.20%
	Most-Least spread	-18.37	-21.40	-12.05***	10.87%
3. Total Debt-to-Common Equity	Most constrained	-13.38**	-12.82	8.29**	22.86%
	Least constrained	-31.09**	-33.75*	14.54***	21.58%
	Zero Leverage	-32.50***	-36.27*	4.33	18.94%
	Most-Least spread	17.71	20.93	-6.24	0.51%
4. Total Debt-to-Market Value	Most constrained	-12.76*	-13.33	14.89***	22.66%
	Least constrained	-20.90**	-22.05	-1.07	14.73%
	Zero Leverage	-32.09***	-34.99*	4.19	19.30%
	Most-Least spread	8.14	8.72	15.96***	7.46%
5. Cash holdings-to-Total Assets	Most constrained	-23.26**	-24.92	23.14***	16.42%
	Least constrained	-27.57**	-23.08	12.19***	23.73%
	Most-Least spread	4.32	-1.84	10.95***	0.95%
6. Interest Coverage ratio	Most constrained	-6.19	0.52	12.77***	22.47%
	Least constrained	-16.94*	-17.33	7.13	19.66%
	Most-Least spread	10.75	17.85	5.65**	-1.60%
7. Kaplan-Zingales index	Most constrained	-21.49*	-22.80	3.64	13.55%
	Least constrained	-12.30	-9.92	2.78	13.81%
	Most-Least spread	-9.20	-12.88	0.86	-1.03%
8. Whited-Wu index	Most constrained	-8.07	-7.10	-3.90*	0.01%
	Least constrained	-16.03**	-15.41	11.32***	23.98%
	Most-Least spread	7.96	8.31	-15.23***	8.60%
	FTSE All Share	-16.27**	-14.53	12.04***	22.73%

Table 3.12
Returns response to changes in the LIBOR-BoE base rate spread

This table presents the estimated coefficients from least squares regressions of daily value-weighted returns of quintile portfolios with the most and the least constrained firms on changes in the LIBOR- BoE base rate spread on MPC meeting days during the period June 1999- December 2011, according to model (3.11): $r_{p,m,d} = \alpha + \beta^{spread}\Delta(LIBOR - BoE\ rate)_d + \gamma' X_d + \varepsilon_d$. The corresponding estimates for the spread return between the most and the least constrained portfolios, zero leverage portfolio returns and FTSE All Share returns are also reported. ***, **, * indicate statistical significance at the 1%, 5% and 10% level, respectively, for the estimated coefficients using Newey-West standard errors.

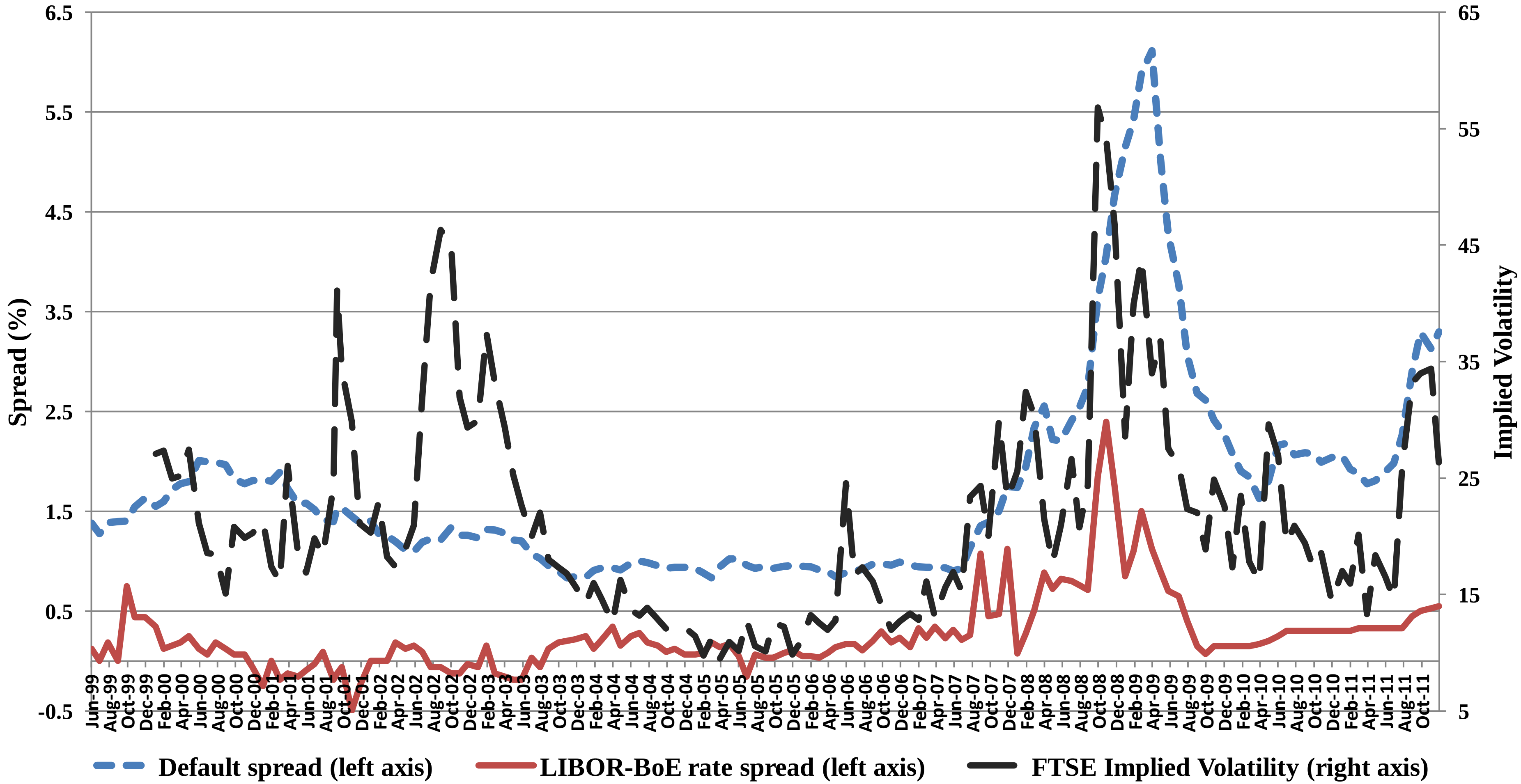
Financial constraints proxy	Portfolio	β^{spread}	R^2 adj.
1. Total Assets	Most constrained	-0.19	0.65%
	Least constrained	-1.51***	22.45%
	Most-Least spread	1.32**	11.03%
2. Tangible-to-Total Assets	Most constrained	-0.63	4.17%
	Least constrained	-1.91***	22.99%
	Most-Least spread	1.28**	4.58%
3. Total Debt-to- Common Equity	Most constrained	-1.35***	22.87%
	Least constrained	-1.77**	14.82%
	Zero Leverage	-0.43	12.58%
	Most-Least spread	0.42	-1.77%
4. Total Debt-to-Market Value	Most constrained	-1.89***	22.38%
	Least constrained	0.27	11.06%
	Zero Leverage	-0.42	12.90%
	Most-Least spread	-2.17***	9.73%
5. Cash holdings-to-Total Assets	Most constrained	-3.21***	19.24%
	Least constrained	-1.35*	20.64%
	Most-Least spread	-1.86***	8.45%
6. Interest Coverage ratio	Most constrained	-1.42***	22.30%
	Least constrained	-0.87	17.52%
	Most-Least spread	-0.55	-1.02%
7. Kaplan-Zingales index	Most constrained	-0.52	11.95%
	Least constrained	-0.82**	13.98%
	Most-Least spread	0.29	0.40%
8. Whited-Wu index	Most constrained	-0.14	22.16%
	Least constrained	-1.52***	1.17%
	Most-Least spread	1.37**	6.89%
	FTSE All Share	-1.52***	20.41%

Figure 3.1
Changes in LIBOR and unexpected interest rate changes



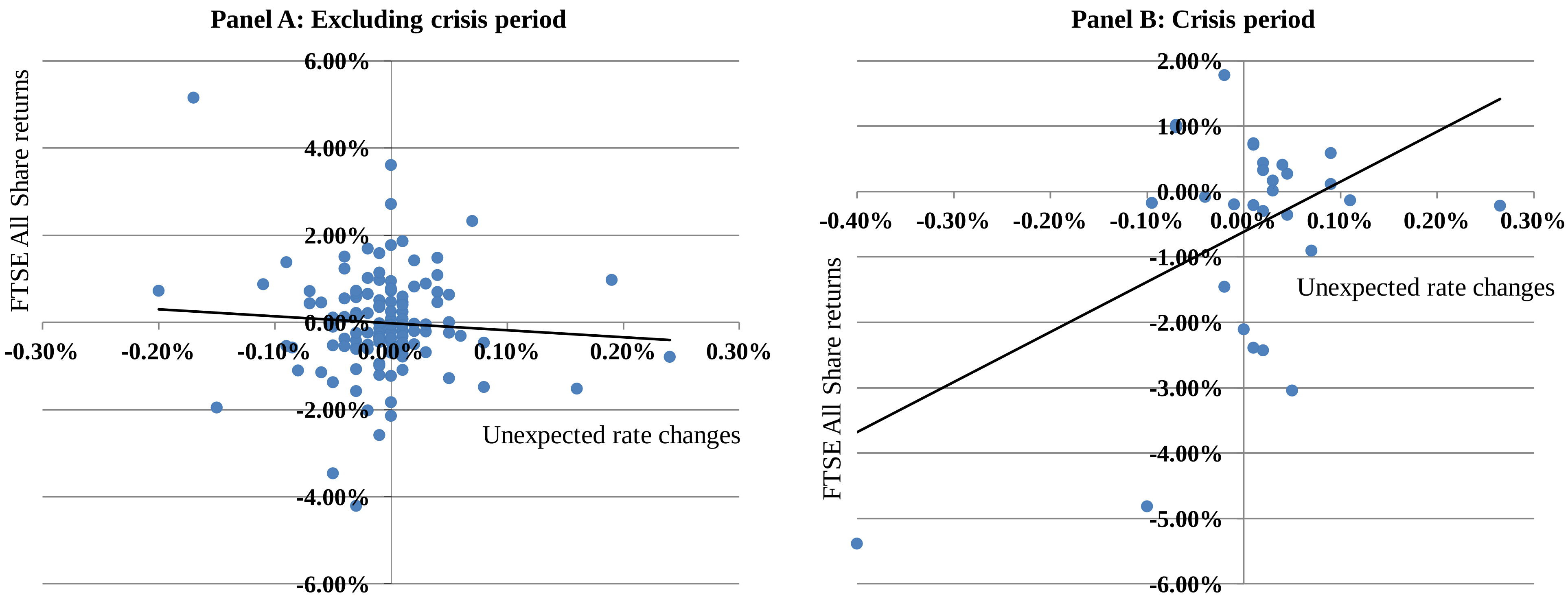
Notes: This Figure presents the daily changes in 3-month LIBOR as well as the corresponding unexpected interest rate changes, relative to expectations embedded in 3-month LIBOR futures prices, on BoE MPC meeting days during the period June 1999- December 2011 (152 meetings).

Figure 3.2
Default yield spread, LIBOR-BoE base rate spread and FTSE 100 Implied Volatility Index



Notes: This Figure presents the values of the default yield spread and LIBOR-BoE base rate spread (left axis) as well as the values of the FTSE 100 Implied Volatility Index on BoE MPC meeting days during the period June 1999- December 2011 (152 meetings).

Figure 3.3
Unexpected interest rate changes and FTSE All Share returns



Notes: This Figure presents the combinations of daily unexpected interest rate changes, relative to expectations embedded in 3-month LIBOR futures prices, and daily FTSE All Share Index returns on BoE MPC meetings. Panel A presents these combinations for MPC meetings that took place during the periods June 1999- July 2007 and January 2010- December 2011, i.e. excluding the crisis period. Panel B presents the corresponding combinations for MPC meetings that took place during the crisis period, i.e. August 2007- December 2009. In both panels, a linear fit extracted from a univariate regression of FTSE All Share returns on unexpected interest rate changes is also drawn.

CHAPTER 4

CEO compensation and future shareholder returns: Evidence from London Stock Exchange

4.1 Introduction

Chief executive officer (CEO) compensation has long attracted a large amount of scrutiny and public controversy. Following the recent financial crisis, which revealed severe flaws in corporate compensation practices, such as the weak link between pay and corporate performance, a subject of intense debate is whether the cross-sectional variation in CEO pay can be fully justified by firms' fundamentals (Faulkender and Yang, 2010, Bizjak et al., 2011). Prior empirical research that attempts to address this issue provides contradictory results.

On the one hand, a large strand of literature documents evidence consistent with the view that compensation serves as a broadly effective means of aligning the interests of both managers and shareholders (Hall and Liebman, 1998, Himmelberg and Hubbard, 2000, Bizjak et al., 2008, Gabaix and Landier 2008, Kaplan, 2008, Kaplan and Rauh, 2010). Accordingly, it is argued that any increase in CEO pay reflects significant changes in the market for CEOs (e.g. shortage of skills and talent) and can be explained by the nature of the CEO job itself (e.g. tight corporate governance). On the other hand, another line of research, which draws upon the managerial power approach, treats CEO pay as a complicating factor rather than a solution to the agency problem (Yermack, 1997, Bertrand and Mullainathan, 2001, Bebchuk and Fried, 2003, 2004, Bebchuk and Grinstein, 2005). The proponents of this so-called “skimming view” of CEO compensation explain the rise of CEO pay by an increase in managerial ability to expropriate wealth from shareholders.[32]

A common feature of most studies in prior literature is that it examines CEO compensation arrangements from an *ex-ante* perspective, based on the view that CEO pay should be positively related to past corporate performance. The positive association between CEO salary and past performance can be attributed to the fact that past performance signals a CEO’s ability to manage the firm (Danker et al., 2012). Another perspective is that boards of directors use information, which is non-observable to outsiders, to reward CEOs for actions that may benefit the firm in the long-run but are not reflected in currently observable performance (Hayes and Schaefer, 2000). Such actions may include acquisitions or R&D expenditures, whose costs are usually incurred immediately while the benefits are unlikely to be observed for several years (Lerner et al., 2011). To the extent that effective compensation policies, particularly incentive compensation, induce managers to exert costly effort to increase their firms’ future growth opportunities, and hence eliminate agency conflicts between top-managers and shareholders, CEO compensation is expected to be informative about future shareholder returns (Cooper et al., 2011).

This study adopts the latter perspective and examines the *ex-post* consequences of different CEO pay arrangements for shareholder value in the UK market. Drawing upon and extending a growing body of literature on the consequences of CEO compensation (e.g., Abowd, 1990, DeFusco et al., 1991, Yermack, 1997, Core et al., 1999, Hayes and Schaefer, 2000, Carpenter and Sanders, 2002, Hanlon et al., 2003, Conyon and Freeman, 2004, Brick et al., 2006, Malmendier and Tate, 2009, Sun et al., 2009, Cooper et al., 2011, Bebchuk et al., 2011, Minnick et al., 2011), our objective is to explore whether companies that pay their CEOs higher fees generate superior subsequent stock returns. Given the lack of consensus as

[32] Goergen and Renneboog (2011) provide a comprehensive review of the literature on managerial compensation.

to whether CEO compensation is linked to future shareholder wealth or not (see e.g. Cooper et al., 2011), our study provides useful insights into this question by *i)* utilizing a unique sample of firms listed on London Stock Exchange (LSE), *ii)* implementing a multi-factor asset pricing framework for risk-adjusting return differentials between firms with different pay arrangements, and *iii)* examining the impact of CEO pay on stock returns for a range of investment horizons (1-month, 3-months, 6-months, 1-year, 2-years and 3-years).

Using a sample of 1,787 companies listed on LSE over the period from 1998 to 2010, we sort firms on the basis of their raw as well as industry- and size-adjusted measures of CEO compensation and assign them to the corresponding decile, quintile and percentile portfolios. Post-ranking equally-weighted portfolio returns are then calculated. Firms that pay their CEOs above the median level of their industry- and size-matched peers are deemed to be "over-paying" or "excess" pay firms. To classify firms, we use total CEO pay as well as measures of the cash-based and equity-based components of compensation. This enables us to test the conjecture that different components of compensation are associated with different outcomes for future shareholder returns. Moreover, abnormal portfolio returns are estimated on the basis of commonly used asset pricing models (i.e. CAPM, Fama-French and Carhart models).

Our results reveal the existence of a strong negative relationship between (excess) CEO incentive pay and future shareholder returns. More specifically, in the first month after the portfolio construction, firms in the lowest incentive pay decile portfolio earn significant abnormal returns between 6.58% and 10.37% p.a., depending on the utilized asset pricing model. To the contrary, firms in the highest incentive pay decile portfolio yield negative but insignificant risk-adjusted returns. An investment strategy buying firms in the lowest decile of incentive pay and selling short firms in the highest decile of incentive pay would have earned positive and statistically significant risk-adjusted returns of about 6% p.a. during the examined period. By considering portfolios at the extreme tails of the distribution (i.e. bottom 2% and top 2% firms), a strategy buying firms in the lowest 2% of incentive pay and selling short firms in the highest 2% of incentive pay would have yielded abnormal returns of at least 11% p.a., which were also found to be statistically significant in all cases considered.

Furthermore, our results suggest that the outperformance of firms with low incentive pay is less pronounced but still evident when longer investment horizons are considered (e.g. 3-months, 6-months and 12-months). Finally, in contrast to incentive pay, cash pay is not found to be related to post-ranking shareholder returns in a statistically significant way. Taken together, these results are consistent with the view that "hidden" or "camouflaged" forms of CEO pay (e.g. stock options or LTIPs) may be used by senior executives as a rent extraction mechanism, which may explain the subsequent underperformance of companies with excess incentive pay to their CEO.

This study contributes to a growing body of research on the *ex-post* shareholder value consequences of CEO pay in several ways. To the best of our knowledge, this is the first study to examine the relationship between CEO pay and future shareholder returns for firms listed on LSE. The UK market is often used as a model for sound governance when it comes to CEO pay. This is due to the perceived relatively low pay for UK CEOs and also the existence of legislation that mandates an advisory shareholder vote, "say on pay", on the executive compensation report (see Ferri and Maber, 2012). However, a recent study by Conyon et al. (2011) shows that risk-adjusted pay for US CEOs is not consistently higher than that for CEOs in the UK. In particular, Conyon et al. (2011, p. 433) find that: "while US CEOs have higher risk-adjusted pay in 1997, UK CEOs have higher risk-adjusted pay in 2003". Moreover, following poor performance relative to their peers during the recent financial crisis, several leading UK listed companies have suffered the embarrassment of losing, or coming close to losing, a shareholder vote on executive pay (e.g. Aviva, Barclays, Xstrata, Premier Foods).[33] To this end, the UK market is a particularly attractive setting to study the relationship between CEO compensation and future shareholder value. Our analysis complements a recent study by Cooper et al. (2011), which provides evidence for US firms and finds that those with the highest-paid CEOs produced future shareholder returns that are substantially lower than their peers.

Another contribution of the current study is the use of a multi-factor asset pricing framework to construct measures for risk-adjusted returns for low-pay and high-pay firms. Our approach, which is facilitated by the abundance of CEO-pay data for large number of firms over a long time period, allows for the examination of the relationship between CEO pay and subsequent stock returns for a wide range of investment horizons (1-month, 3-month, 6-month, 1-year, 2-years and 3-years). Such a long-term perspective is required because CEOs that are awarded high stock-based compensation schemes may have incentives to conceal bad news about future growth options, an action which leads into suboptimal investment policies, temporary overvaluation and a subsequent crash in the stock price (see Benmelech et al., 2010). By constructing and comparing risk-adjusted returns for both short- and long-term investment horizons, our study goes beyond earlier research that is restricted to event-study methodologies, focusing only on the short-term effects of CEO pay on stock returns (see e.g., Yermack, 1997, Fich and Shivdasani, 2005, Chang et al., 2010, Minnick et al., 2011).

The rest of the chapter is organized as follows: Section 4.2 provides an overview of the literature on managerial compensation and positions our study in relation to previous work. Section 4.3 describes our dataset and portfolio construction methods. Section 4.4 presents our empirical results while Section 4.5 concludes.

[33] See BBC News-Business: “Aviva boss Andrew Moss to step down”, 8th May, 2012.

4.2 Motivation and Related Literature

Agency theory postulates that the interests of managers do not always correspond exactly with those of shareholders (Jensen and Meckling, 1976, Fama and Jensen, 1983). In an attempt to maximize their own welfare, managers may take actions that disadvantage certain types of shareholders (e.g. excessive risk-taking). Drawing upon agency theory, a large academic literature suggests that CEO pay can be appropriately designed to resolve this problem (Hall and Liebman, 1998, Himmelberg and Hubbard, 2000, Bizjak et al., 2008, Gabaix and Landier 2008, Kaplan, 2008, Kaplan and Rauh, 2010). A contrasting view, which draws upon the managerial power approach (see Bebchuk and Fried, 2003, 2004), suggests that CEO pay exacerbates rather than alleviates agency conflicts (Yermack, 1997, Bertrand and Mullainathan, 2001, Bebchuk and Grinstein, 2005).

Building upon this strand of the literature, which largely examines CEO pay from an *ex-ante* perspective, a growing body of research focuses on how ex-ante compensation arrangements are related to *ex-post* indicators of firm value and performance (e.g., Abowd, 1990, DeFusco et al., 1991, Yermack, 1997, Core et al., 1999, Hayes and Schaefer, 2000, Carpenter and Sanders, 2002, Hanlon et al., 2003, Conyon and Freeman, 2004, Brick et al., 2006, Malmendier and Tate, 2009, Sun et al., 2009, Cooper et al., 2011, Bebchuk et al., 2011, Minnick et al., 2011). Once again, there is no consensus regarding the nature of the relationship between executive pay and firms' subsequent performance/value.

A number of studies provide evidence consistent with the alignment role of CEO pay. Abowd (1990) uses data on more than 16,000 managers in 250 large US corporations and finds that increased performable sensitivity in compensation leads to superior economic and market-based performance in the following fiscal year. Using data from the Forbes Executive compensation survey over the period 1974-1995, Hayes and Schaefer (2000) find that CEO pay is informative about future accounting performance. They view their results as support for the assertion that boards reward top executives for value-maximizing actions with effects that have not materialized yet, and hence that are not observable to outsiders, such as the shareholders. In a randomly selected sample of 199 firms from the S&P 500, Carpenter and Sanders (2002) document a positive link between top management team (TMT) member pay and future firm performance as proxied by the return on assets and Tobin's Q. They also find that CEO pay is related to future performance, but its effect may be indirect through such factors as TMT pay.

Using a sample of UK firms, Conyon and Freeman (2004) report a positive relationship between shared compensation plans (profit sharing, profit related pay, save as you earn schemes and company stock option plans) and stock market performance in the 1990s. Hanlon et al. (2003) examine the impact of stock options granted to top executives (ESO) on future operating earnings in a large sample of S&P 1500 firms from 1992 to 2000. Their results indicate a positive relationship between option grants and operating income, which is consistent with the incentive alignment perspective. In a similar spirit, Fich and Shivdasani (2005) analyze a sample of Fortune 1000 firms from 1997 to 1999 and show that option plan adoptions generate positive cumulative abnormal returns (CARs).

Sun et al. (2009) build upon and extend the work of Hanlon et al. (2003) and Fich and Shivdasani (2005) by focusing on the role of compensation committees on the relationship between option grants and future firm performance. Using a sample of 474 US firms, they document a positive relationship between stock option grants and future firm performance, which becomes more pronounced as compensation committee quality increases. By focusing on a sample of 298 CEO departures, Chang et al. (2010) provide evidence consistent with the view that more capable CEOs are rewarded with higher pay and that their departures are viewed by the market as "bad" news, leading to a significantly negative stock market reaction. Finally, Minnick et al. (2011) analyze 159 acquisitions made by bank holding companies and show that pay-for-performance sensitivity in executive compensation leads to higher stock returns around the announcement as well as better operating performance.

On the other hand, there are also a number of studies who find evidence consistent with the "managerial power" or "skimming view" of managerial compensation. DeFusco et al. (1991), based on a sample of 987 NYSE firms over the period 1978-1982, find that cumulative abnormal stock returns and accounting performance decline subsequently to stock-option plan adoption. In a sample of Fortune 500 companies between 1992 and 1994, Yermack (1997) uses an event-study methodology and finds that CEO option awards are followed by positive cumulative abnormal stock returns. However, Yermack's study concludes that this outperformance is not necessarily linked to superior managerial decisions but rather to the informational advantage of managers and their power to influence their compensation committees to award more performance-based pay at times when they expect impending improvements in performance. Core et al. (1999), using a sample of 205 publicly traded US firms over the period 1982-1984, document a negative relationship between excess-compensation and subsequent operating and stock return performance.

Along the same lines, Brick et al. (2006) construct measures of excessive compensation and examine the link between excessive compensation and future firm performance. In a large sample of US firms, they provide evidence consistent with the cronyism hypothesis, which suggests that excessive compensation is symptomatic of agency conflicts between managers and shareholder, and hence value-destroying. Malmendier and Tate (2009) analyze a sample of CEOs and other top-executives of S&P 500, MidCap 400 and SmallCap 600 firms over the period 1992-2002 and find that "superstar" CEOs (i.e. those winning prestigious business awards) extract more compensation from their firms. They also find that firms with "superstar" CEOs subsequently underperform, in terms of both stock market and accounting performance. In a sample of US firms from 1993 to 2004, Bebchuk et al. (2011)

construct a measure of CEO pay slice (CPS), defined as the fraction of the aggregate compensation of the top-five executive team captured by the CEO. Their findings show that CPS is negatively associated with firm value, accounting profitability and stock performance.

The study that is closest to ours is the one by Cooper et al. (2011). It also examines the link between CEO pay and stock returns using a comprehensive sample of NYSE, AMEX and NASDAQ firms. They find that excess incentive pay, defined as payment of restricted stock, options and other long term compensation in excess of the median pay to peer firms in the same industry and size group, is negatively related to future shareholder returns. Using a panel-data regression framework, Cooper et al. (2011) also examine the drivers of the underperformance of firms in extreme excess pay deciles. Their findings are consistent with the overconfidence hypothesis, which suggests that overconfident CEOs attract high levels of incentive pay, leading investors to overreact to these pay arrangements and get subsequently disappointed. Their results rule out explanations related to managerial risk-shifting, which occurs when managers with high levels of in-the-money options and high exposure to idiosyncratic (firm-specific) risk make decisions that benefit themselves but not shareholders.

The current study is designed to extend the findings of Cooper et al. (2011) by assessing the impact of CEO pay on stock returns for a large sample of UK listed firms. As mentioned above, the CEO compensation practice in the UK and the existence of legislation that mandates an advisory shareholder vote on the executive compensation report ("say on pay") make the UK market a particularly attractive setting in which to examine whether companies that pay their CEOs higher fees relative to their peers generate superior subsequent shareholder returns. Overall, our study attempts to yield a wider understanding about the *ex-post* consequences of different CEO pay arrangements for shareholder value for firms listed on LSE.

4.3 Data and Portfolio Construction

We use *BoardEx* database to obtain detailed information on CEOs compensation for companies listed on LSE during the period 1998-2010. We begin from year 1998 because *BoardEx* has only limited coverage prior to that year; we could only identify 83 firms with complete data in year 1997. We initially construct three measures of CEO compensation: *i)* cash-based pay (i.e. salary, bonus and pension payments), *ii)* incentive-based pay (i.e. options, long-term incentive plans and other non-cash compensation) and *iii)* total pay (i.e. the sum of cash and incentive pay). We also construct industry- and size-adjusted compensation measures to control for the fact that firms benchmark pay on peer groups (see Bizjak et al., 2008).

Following Cooper et al. (2011), we calculate industry- and size-adjusted compensation as follows: Firstly, firms are assigned into industry portfolios using the FTA Level 3 Sector Code (FTAG3) from Thomson DataStream. Secondly, firms in each industry are allocated into two size groups, small and large, based on their sales levels relative to the industry median in the year of classification. Industry- and size-adjusted compensation is the difference between the compensation of firm *i* and the median compensation of firms in the same industry and size portfolio.

CEO compensation data are matched at a firm/year level with stock returns data that are obtained from Thomson DataStream. We construct a series of different holding period returns using the datatype RI, a return index that shows the growth in value of a share over a specified period assuming that dividends are reinvested for the purchase of additional units of equity. To ensure that our dataset is free of any potential survivorship bias, our analysis covers both active and dead stocks, i.e. stocks of firms that were de-listed at some point during the sample period. To this end, particular attention is paid to firms' delisting reason. Utilizing the London Share Price Database (LSPD) and following Soares and Stark (2009), we set the return in the delisting month equal to -100% when a share's death code is assigned by LSPD as 7, 14, 16, 20 or 21. Following common practice in UK stock market studies, we exclude from the analysis unit trusts, investment trusts and ADRs. Our final sample includes 1,787 firms for the entire sample period.

The next step involves classifying firms into portfolios according to the raw and industry/size adjusted compensation measures and calculating these portfolios' post-ranking returns. At the end of calendar year *t*, stocks are assigned to decile, quintile and percentile portfolios according to both raw and industry/size-adjusted measures of CEO compensation. We then calculate portfolio returns for different investment horizons. Following the practice of Soares and Stark (2009) for accounting data, we lag compensation data by 6 months. This accounts for the fact that the Financial Services Authority (FSA) in the UK allows firms to make public their annual financial report within a certain period after the end of each financial year.[34] For example, the 1-month return for the lowest decile portfolio, which is constructed on the basis of CEO pay data referring to fiscal year end of December 1998, is firstly calculated in July 1999. Similarly, the 3-month (6-month) holding period return for the same portfolio is firstly calculated in September 1999 (December 1999).

Following Cooper et al. (2011), portfolios are rebalanced on an annual basis, starting from December 1998 and ending in December 2010. Then, the post-ranking, equally-weighted return for each portfolio is calculated for each month during our sample period. Since there might be a delay before information on CEO pay is fully impounded into stock prices, we assess the performance of each portfolio considering different investment horizons (1-month, 3-months, 6-months, 1-year, 2-years and 3-years). This enables us to assess the impact of CEO pay on both short-term and long-term subsequent returns.

[34] For accounting periods beginning before 2007, firms listed on LSE were allowed by the Financial Services Authority (FSA) to make their financial reports public up to 6 months after the end of their fiscal year. For details see http://fsahandbook.info/FSA/html/handbook/DTR/4/1.

Portfolios' performance is assessed using both raw and risk-adjusted returns. As explained in Section 4.4.2, risk-adjusted returns are calculated using three popular asset pricing models: the Capital Asset Pricing Model (CAPM), the 3-factor Fama-French (1993) model and the 4-factor Carhart (1997) model. These models account for returns' exposure to the market, size, value and momentum factors. The market portfolio return is proxied by the FTSE All Share Index returns. We use the size, value and momentum factors constructed for the UK market by Gregory et al. (2009).[35]

4.4 Results

4.4.1 Descriptive Statistics and Preliminary Results

We begin the discussion of our empirical results by presenting descriptive statistics on raw levels of CEO compensation. Table 4.1 reports the mean, median, standard deviation, skewness and kurtosis for both components of compensation, namely CEO cash pay and CEO incentive pay as well as for CEO total pay, which is the sum of cash pay and incentive pay. The statistics are presented for each year separately, along with those for the pooled sample (1998-2010). As shown in Panel C, the mean (median) value of total pay over sample period is £823K (£349K). The distribution has a standard deviation of £1,567K and a skewness of 6.51, indicating considerable pay variation among the CEOs included in our sample. The mean (median) value of cash pay (Panel A) is £404K (£250K) and that for incentive pay (Panel B) is £419K (£46K). At the mean level, the proportion of incentive pay to total pay is approximately 50.9%. The distribution of incentive pay is characterized by high values for both standard deviation (£1,247K) and skewness (8.27), which possibly suggests that a non-negligible proportion of CEOs in our sample receive little of no incentive

[35] Factors are available at http://xfi.exeter.ac.uk/researchandpublications/portfoliosandfactors

compensation (e.g. options & LTIPs). The corresponding numbers for cash pay are £494K and 4.34, respectively.

Looking at the evolution of CEO pay over time, we observe that average total pay has increased from £664K in 1999 to £912K in 2007.[36] It declined substantially in 2008 due to the financial crisis but rebounded and reached a peak of £948K in 2009. The cash component of CEO pay reached a peak in 2010, at £453K, while the incentive component of CEO pay reached a peak in 2009, at £501K. At the median level, however, total pay displays an almost monotonic negative trend from 1999 to 2006. It temporarily increased in 2007 but then dropped again during the period of the financial crisis. Median incentive pay is found to be more volatile over the period 1999-2010, while its post-2007 levels are significantly lower than those prevailing in the pre-crisis period.

Table 4.2 reports the annualized post-ranking, equally-weighted returns for portfolios of firms with different levels of CEO compensation over the period July 1999-December 2010. We restrict our attention to the extreme portfolios, i.e. low CEO pay versus high CEO pay. Portfolios are formed on the basis of both raw measures of compensation (Panel A) and industry- and size-adjusted measures of compensation (Panel B). Results are reported separately for cash pay-, incentive pay- and total pay-sorted portfolios. Columns 2, 3 and 4 present the results for firms that lie on the left tail of the pay distribution (lowest 2%, lowest 10% and lowest 20%, respectively). Columns 5, 6 and 7 present the results for firms that lie on the right tail of the pay distribution (highest 20%, highest 10% and highest 2%, respectively). We also report the average return of the strategy that buys firms with low CEO pay (i.e. Portfolio_2%, Portfolio_10% and Portfolio_20%) and sells short firms with high CEO pay (i.e. Portfolio_80%, Portfolio_90% and Portfolio_98%), along with the corresponding *t*-statistic under the null hypothesis of equal average returns.

[36] Our sample includes only 69 firms with complete compensation data for 1998. We therefore refrain from comparing 1998 statistics with those for the rest years.

Starting with Panel A, the findings suggest that the post-ranking returns of portfolios containing firms with low incentive pay (i.e. Portfolio_2%, Portfolio_10% and Portfolio_20%) are all statistically significant at 11.96%, 16.87% and 13.95% p.a., respectively. These are much higher than the corresponding returns of the portfolios containing firms with high incentive pay (i.e. Portfolio_80%, Portfolio_90% and Portfolio_98%), which are all insignificant at 6.19%, 6.11% and 2.92% p.a., respectively. The annualized spreads Portfolio_2%-Portfolio_98%, Portfolio_10%-Portfolio_90% and Portfolio_20%-Portfolio_80% are 9.04%, 10.76% and 7.76%, respectively. In all cases, these spread returns are statistically significant. The outperformance of low CEO pay portfolios is weakened or not preserved at all when portfolios are sorted on the basis of cash pay or total pay. This suggests that the negative association between CEO pay and subsequent stock returns is found only for the incentive component of CEO compensation.

Moving to Panel B of Table 4.2, which reports results for portfolios constructed using industry- and size-adjusted compensation measures, we observe a significant outperformance of portfolios with low incentive pay (Portfolio_2%, Portfolio_10% and Portfolio_20%) over portfolios with high incentive pay (Portfolio_80%, Portfolio_90% and Portfolio_98%). The annualized spreads Portfolio_2%-Portfolio_98%, Portfolio_10%-Portfolio_90% and Portfolio_20%-Portfolio_80% are 12.93%, 7.37% and 3.68%, respectively, which are also statistically significant at least at the 10% level. Once again, the results do not provide evidence for superior performance of low pay portfolios when cash pay and total pay are used for portfolio construction. Overall, the findings presented in Table 4.2 provide some preliminary evidence supporting a negative association between CEO incentive pay and subsequent shareholder returns.

The next step involves assessing the cumulative performance of low-pay and high-pay decile portfolios (P1 versus P10). For purposes of brevity, we report only the results based on industry-and size-adjusted compensation measures.[37] Figure 1 plots the cumulative return of decile portfolios P1 and P10 over time, expressed as the growth of a £1 investment in June 1999, using cash pay (Figure 1a), incentive pay (Figure 1b) and total pay (Figure 1c) to sort firms and construct portfolios. The dark line shows the cumulative value of P1 while the compound line shows the cumulative value of P10 over the period June 1999-December 2010. For ease of comparison, we also plot the performance of the market portfolio (FTSE All Share) and the compound return of the risk-free rate over the same period.

For portfolios sorted on the basis of cash pay (Figure 1a), the results suggest that P1 beats P10 but not by a considerable amount. In particular, £1 invested in P1 (P10) in June 1999 would have grown into £2.47 (£2.00) by December 2010. As shown in Figure 1b, however, which refers to incentive pay-based portfolios, P1 beats P10 by a large amount. In particular, £1 invested in P1 in June 1999 would have grown to £4.21 by December 2010. In contrast, £1 invested in P10 would have grown to £1.82 over the same period. This is equivalent to annualized returns of about 12.6% for P1 and 5.2% for P10, a spread of 7.4%. Moreover, while P10 only marginally outperforms the market and the risk-free rate strategy, P1 outperforms both strategies by a wide margin. The performance differential between P1 and P10 persists but it is less pronounced in Figure 1c, which refers to portfolios formed on the basis of total CEO pay. This provides further evidence that firms with low incentive pay generate higher subsequent returns for shareholders relative to firms with high incentive pay.

In summary, these results indicate a negative relationship between CEO incentive pay and future shareholder returns. The average post-ranking returns of portfolios containing firms with the lowest incentive pay (i.e. Portfolio_2%, Portfolio_10% and Portfolio_20%) are significantly higher than the corresponding returns of the portfolios containing firms with the

[37] The results based on raw compensation measures are qualitatively similar. For portfolios sorted on the basis of incentive pay, we find that £1 invested in P1 (P10) in June 1999 would have grown into £5.03 (£1.53) by December 2010. The complete set of results is available upon request.

highest incentive pay (i.e. Portfolio_80%, Portfolio_90% and Portfolio_98%). Moreover, £1 invested in June 1999 in the decile portfolio consisted of the lowest incentive pay firms would have produced a cumulative return of 321% by December 2010. The same £1 invested in the portfolio consisted of the highest incentive pay firms would have return returned 82%, which only marginally beats the 50% cumulative return of FTSE All Share Index.

4.4.2 Risk-Adjusted Performance

In this section, we assess the relative performance of portfolios containing low CEO pay and high CEO pay firms utilizing three commonly used asset pricing models. The use of an asset pricing framework allows us to test whether the return differentials across the portfolios are driven by differences in their riskiness or "style". In other words, we calculate risk-adjusted portfolio returns over the period July 1999-December 2010, adjusting for the market, size, value and momentum factor exposures of each portfolio. Firstly, we estimate the Jensen alpha from the CAPM regression:

$$R_{i,t} - R_t^f = \alpha_i + \beta_{i,MKT}\left(R_{m,t} - R_t^f\right) + \varepsilon_{i,t} \tag{4.1}$$

where $R_{i,t}$ is the return of portfolio *i* in month *t*, R_t^f is the risk-free rate for month *t*, $\left(R_{m,t} - R_t^f\right)$ is the excess market return in month *t* and $\beta_{i,MKT}$ is the market beta of portfolio *i*. Secondly, we compute Fama-French alpha, i.e. the intercept of the 3-factor Fama-French (1993) model:

$$R_{i,t} - R_t^f = \alpha_i + \beta_{i,MKT}\left(R_{m,t} - R_t^f\right) + \beta_{i,SMB}SMB_t + \beta_{i,HML}HML_t + \varepsilon_{i,t} \tag{4.2}$$

where SMB_t and HML_t stand for the size and value factors respectively, while $\beta_{i,SMB}$ and $\beta_{i,HML}$ denote the corresponding factor loadings of portfolio *i*. Thirdly, we estimate Carhart alpha, i.e. the intercept of the 4-factor Carhart (1997) model:

$$R_{i,t} - R_t^f = \alpha_i + \beta_{i,MKT}\left(R_{m,t} - R_t^f\right) + \beta_{i,SMB} SMB_t + \beta_{i,HML} HML_t + \beta_{i,MOM} MOM_t + \varepsilon_{i,t} \qquad (4.3)$$

where MOM_t stands for the momentum factor and $\beta_{i,MOM}$ denotes the corresponding factor loading of portfolio *i*.

We opt for a system-based estimation. In particular, factor loadings and alphas are estimated via GMM, with Newey-West standard errors corrected for heteroscedasticity and serial correlation. We further test and report in each case the significance of the risk-adjusted performance of the return differential (spread) between portfolios consisted of the lowest CEO pay companies (e.g. Portfolio_2%, Portfolio_10% and Portfolio_20%) and portfolios consisted of the highest CEO pay companies (e.g. Portfolio_80%, Portfolio_90% and Portfolio_98%).

Table 4.3 reports the estimated alphas for portfolios of firms constructed on the basis of raw measures of cash pay (Panel A), incentive pay (Panel B) and total pay (Panel C). With respect to cash pay, the results do not suggest any significant association between pay and post-ranking returns. For example, firms in the lowest cash pay decile (Portfolio_10%) earn a market-adjusted return (i.e. CAPM alpha) of 5.40% p.a.. Firms in the highest cash pay decile (Portfolio_90%) earn a similar market-adjusted return of 5.05% p.a.. A strategy buying firms in the lowest decile and selling short firms in the highest decile would have earned 0.35% p.a., which is statistically insignificant. This finding holds for other measures of abnormal performance (Fama-French alpha and Carhart alpha) as well as for the cases where portfolios at the extreme tails of the distribution (e.g. Portfolio_2% and Portfolio_98%) or quintile portfolios (Portfolio_20% and Portfolio_80%) are considered.

As shown in Panel B of Table 4.3, however, our findings support a negative and statistically significant relationship between incentive pay and post-ranking stock returns. Firms in the lowest incentive pay decile (Portfolio_10%) earn a market-adjusted return of 12.21% p.a. while firms in the highest cash pay decile (Portfolio_90%) earn a return of only

1.16% p.a.. The corresponding spread of 11.05% p.a. is statistically significant. In other words, an investment strategy buying firms in the lowest decile and selling short firms in the highest decile would have earned 11.05% p.a.. The return on this strategy varies between 7.45% and 11.05% p.a., depending on the asset pricing model utilized, and remains statistically significant in all cases considered. As expected, a lower spread is observed for the case of quintile portfolios. For example, a strategy buying firms in the lowest quintile and selling short firms in the highest quintile would have yielded a return between 5.46% and 7.97% p.a.. The decline of the spread, which is of some significance in economic and statistical terms, can be explained by the fact that quintile portfolios include a much larger number of firms (about 150 on average). The spread remains above the level of 9% p.a. when portfolios at the extreme tails of the distribution are considered, even under the Carhart model, which is the most general among the model specifications considered.

In Panel C of Table 4.3, we present the results for portfolios constructed on the basis of total CEO pay. Although a strategy buying firms in the lowest pay decile and selling short firms in the highest pay decile would have yielded a non-negligible abnormal return of 8.10% p.a. under the CAPM, 7.04% p.a. under the 3-factor model and 4.78% p.a. under the 4-factor model, these alphas are not statistically significant. As expected, the spread declines for the case of quintile portfolios and turns into a negative one when extreme portfolios are considered. These findings suggest that the negative link between CEO pay and future shareholder returns holds only for the incentive component of CEO pay.

In Table 4.4, we conduct the same exercise using industry- and size-adjusted measures of pay to construct portfolios. The results are almost identical to those obtained using raw compensation measures. We document evidence supporting a negative association between incentive pay and post-ranking shareholder returns. Specifically, portfolios of low incentive pay firms earn a much higher alpha than portfolios of high pay firms. The return differential between the lowest incentive pay decile (Portfolio_10%) and the highest incentive pay decile (Portfolio_90%) is also statistically significant for most of the cases considered, equal to 7.58% p.a. for the CAPM model and 5.92% p.a. for the 3-factor model. The 4-factor model yields a spread of 4.26% p.a., which is statistically insignificant (t=1.25). However, our findings show that firms at the extreme portfolios (i.e. Portfolio_2% *vs.* Portfolio_98%) differ significantly in terms of their returns, both in statistical and economic terms, regardless of the asset pricing model utilized. An investment strategy buying firms in the lowest 2% of the incentive pay distribution (Portfolio_2%) and selling short firms in the highest 2% of the incentive pay distribution (Portfolio_98%) would have earned a statistically significant CAPM alpha of 13.21% p.a., Fama-French alpha of 11.06% p.a. and Carhart alpha of 14.57% p.a. over the sample period.

Overall, we find significant evidence that portfolios containing low incentive pay firms outperformed those portfolios containing high incentive pay firms during the period June 1999-December 2010. These results hold after controlling for common factors such as market, size, value and momentum. On the other hand, the reported results do not indicate any significant relation between cash/total pay measures of CEO pay and future shareholder returns.

4.4.3 Longer Investment Horizons

The results presented so far are based on monthly returns of portfolios formed on the basis of CEO compensation over the period 1998-2010. In this section, we report results that are based on cumulative abnormal returns in the year before and up to three years after the portfolio construction, referring to firms that are in the bottom (Portfolio_10%) and top (Portfolio_90%) deciles of CEO compensation. We restrict our attention to portfolios ranked on the basis of incentive CEO pay, which were previously reported to differ substantially in terms of their performance according to monthly returns. Firms are sorted each year on the basis of their raw (Table 4.5) and industry- and size-adjusted incentive pay (Table 4.6). In Panel A of each table, we report equally-weighted, raw and risk-adjusted portfolio returns for firms in the bottom decile of incentive pay (Portfolio_10%). In Panel B of each Table, we report the corresponding results for firms in the top decile of incentive pay (Portfolio_90%). We construct the cumulative returns for Portfolio_10% and Portfolio_90% over the following investment horizons: 12 months before (-12m), one month (+1m), three months (+3m), 6 months (+6m), one year (+12m), two years (+24m) and three years (+36m) after portfolio construction. While calculating cumulative returns, we still lag compensation data by 6 months to account for the period that elapses from the end of the financial year until the time that UK firms make their annual financial reports publicly available.

Similar to the results based on 1-month investment horizon (see Tables 4.2-4.4), we find important differences in the performance of the extreme decile portfolios (Portfolio_10% and Portfolio_90%) during the examined period. Starting with Table 4.5, which refers to portfolios constructed using raw compensation measures, firms in Portfolio_10% earn a statistically significant CAPM (Carhart) alpha of 14.31% (10.58%) p.a., while firms in Portfolio_90% earn an insignificant CAPM (Carhart) alpha of 2.60% (3.35%) p.a. in the three months after portfolio construction. The performance differences between Portfolio_10% and Portfolio_90% are also highly pronounced when the analysis is based on 6-month cumulative returns. Specifically, firms in Portfolio_10% earn a Carhart alpha of 11.83% p.a., while firms in Portfolio_90% earn a Carhart alpha of 4.47% p.a..

One year after sorting firms on the basis of their incentive pay (+12m), the lowest pay firms earn average risk-adjusted returns between 9.78% and 10.68% p.a., depending on the asset pricing model used. The high pay firms earn much lower, though not completely negligible, returns that range between 2.48% and 3.79% p.a.. The spread in performance between the lowest incentive pay and the highest incentive pay firms shrinks as the investment horizon increases to 24 and 36 months. For example, at the 24-month investment horizon, firms in Portfolio_10% earn an insignificant Carhart alpha of 1.72% p.a., while firms in Portfolio_90% earn a Carhart alpha of 1.13% p.a., which is also statistically insignificant. The results presented in Table 4.6, referring to portfolios constructed using excess compensation measures, are quite similar for the 1-month and 3-month investment horizons. However, the outperformance of firms in Portfolio_10% is less pronounced but still evident when the 6-month investment horizon is considered. Finally, the findings reported in Table 4.6 support the view that the outperformance of the lowest incentive pay firms diminishes as the investment horizon increases to 12, 24 or 36 months.

In summary, the results presented in Tables 4.5 and 4.6 suggest that firms in the extreme incentive compensation decile portfolios exhibit striking differences with respect to their stock market performance. Specifically, firms in the lowest compensation decile exhibit higher post-ranking returns than firms in the highest compensation decile. The underperformance of firms with high incentive pay continues in the 6-months after portfolio formation, but not for longer investment horizons. It is also worth mentioning that this underperformance indicates a reversal from the year leading to portfolio formation, when firms in the highest decile (Portfolio_90%) performed better than firms in the lowest decile (Portfolio_10%). This finding is in agreement with the study of Cooper et al. (2011) for US firms, who found that firms whose CEOs received the highest incentive pay also had significantly higher risk-adjusted returns in the year before portfolio formation.

4.5 Conclusions

There has been considerable disagreement whether the level and structure of CEO pay in large companies serves the interests of both managers and shareholders. Existing research provides mixed evidence on this issue. The recent financial crisis has also revealed severe flaws in corporate compensation practices, such as the weak link between executive pay and corporate performance, which resulted into an intense debate on whether the cross-sectional variation in CEO pay can be fully justified by firms' fundamentals.

This study is designed to contribute to this debate by analyzing CEO compensation from an *ex-post* perspective; we hypothesize that attractive compensation contracts induce senior managers to exert costly effort to increase their firms' future growth opportunities, eliminating in this way agency conflicts between top-managers and shareholders and improving future shareholder returns. This hypothesis is tested using a sample of 1,787 firms listed on LSE over the period from 1998 to 2010. Given the large increase in CEO pay in recent decades, the introduction of legislation to require nonbinding "say on pay" votes for all publicly listed companies and the spate of the recent shareholders revolts over pay (e.g. Barclays, Aviva, Xstrata), the UK market provides an ideal setting to examine whether companies that pay their CEOs excess fees generate superior future returns.

Our results indicate a strong negative relationship between CEO incentive pay and subsequent shareholder returns. Firms that pay their CEOs in excess of the median pay in peer firms in the same industry and size group earn significantly lower risk-adjusted returns. To illustrate the return differential, an investment strategy buying firms in the lowest 2% of the incentive pay distribution and selling short firms in the highest 2% of incentive pay distribution would have earned monthly abnormal returns of more than 11% p.a. during the sample period. The results also suggest that the outperformance of firms with low pay is less pronounced but still apparent when longer investment horizons are considered. Finally, we document evidence that in contrast to incentive pay, cash pay is not related to subsequent shareholder returns in a statistically significant way. The latter finding is consistent with the view that "hidden" or "camouflaged" forms of CEO pay (e.g. stock options or LTIPs) may be used by senior executives as a rent extraction mechanism, which may explain the future underperformance of companies with excess incentive pay to their CEO.

The findings of this study are of considerable practical interest and policy relevance. They provide indirect evidence that commonly used pay instruments such as options and LTIPS, which are by far the largest components of incentive pay in the UK, may encourage managerial short-termism and suboptimal investment decisions, leading to lower subsequent returns for shareholders. They also contribute to the debate as to whether the size or the type (e.g. salary, bonus, options, LTIPs) of executive compensation requires reform. These findings may be relevant to companies, investors, regulators and media commentators, by determining which pay practices constitute good governance and the contrary. Finally, they may inform future deliberations by regulatory bodies, such as the Financial Reporting Council, with respect to the UK Corporate Governance Code.

Figure 4.1a: Cumulative value of £1 invested in firms in the lowest decile (P1) and highest decile (P10) of CEO Cash Pay

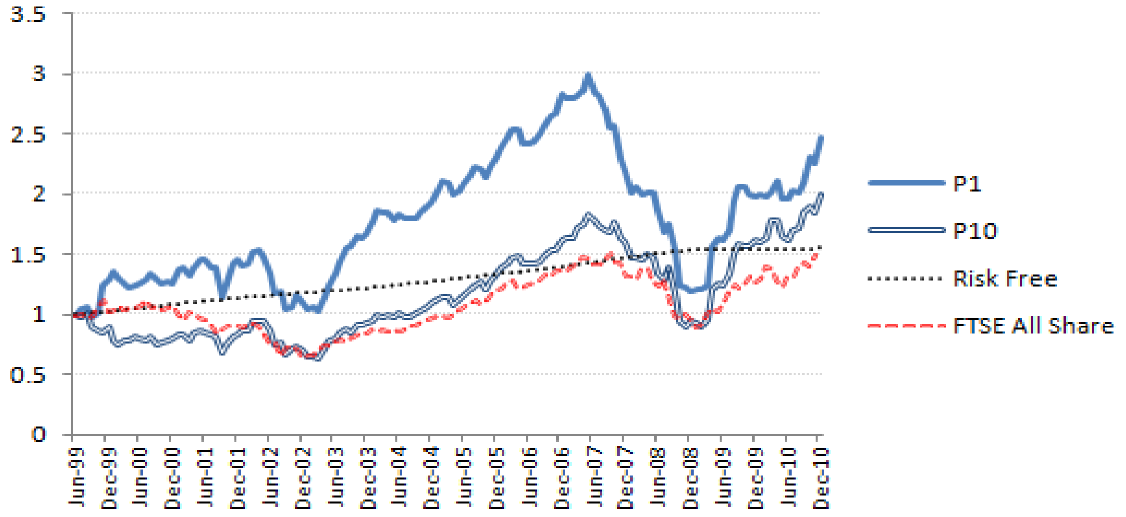


Figure 4.1b: Cumulative value of £1 invested in firms in the lowest decile (P1) and highest decile (P10) of CEO Incentive Pay

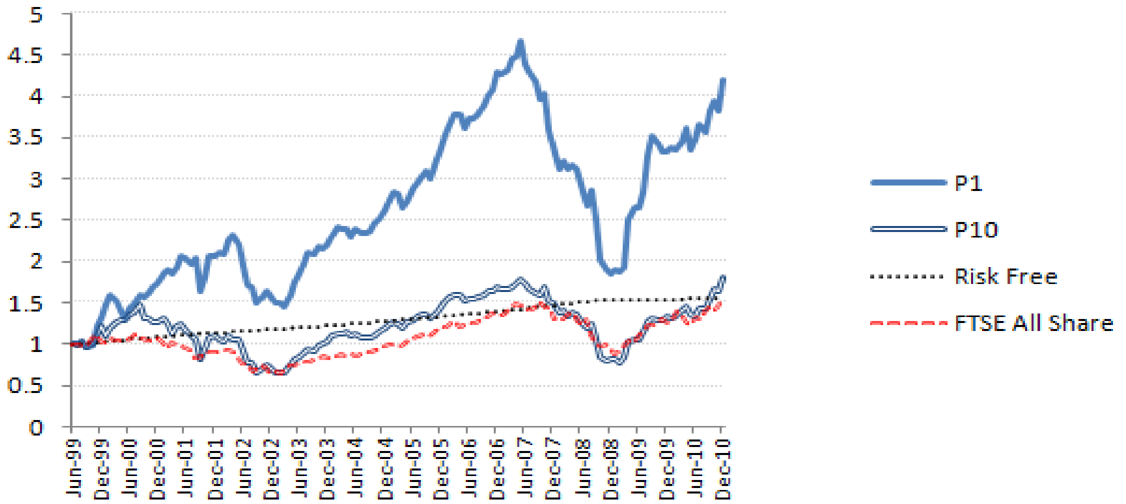


Figure 4.1c: Cumulative value of £1 invested in firms in the lowest decile (P1) and highest decile (P10) of TOTAL CEO Pay

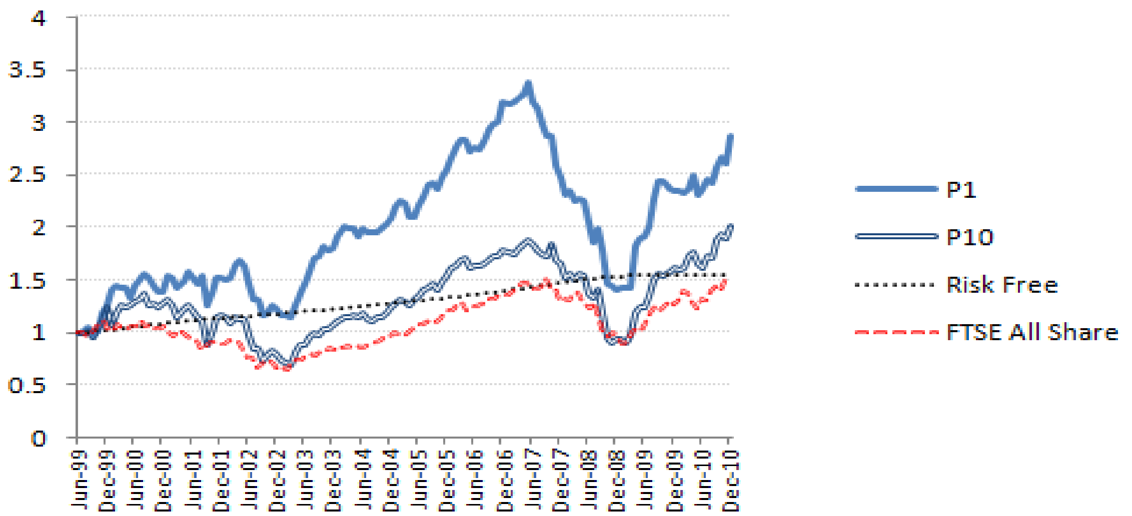


Table 4.1
Descriptive statistics on CEO compensation

This table presents descriptive statistics (mean, median, standard deviation, skewness and kurtosis) on CEO compensation for our sample firms over the period 1998-2010. The statistics are reported separately for *CEO Cash Pay* (sum of all cash based compensation for the period, such as salary and bonus) in Panel A, *CEO Incentive Pay* (sum of shares awarded, estimated value of options awarded and value of LTIPs awarded) in Panel B and *Total CEO Pay* (sum of cash pay and incentive pay) in Panel C. The value of stock options awarded is estimated using a generalised Black-Scholes option pricing model. The statistics are presented for each year separately as well as for the entire sample period.

		YEAR													*ALL YEARS*
		1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	*(1998-2010)*
Panel A	Mean	531.05	365.65	372.2	382.91	386.78	385.84	383.95	368.55	383.40	438.26	425.70	420.97	452.49	403.98
Cash CEO Pay	Median	473.00	300.00	276.00	270.00	280.50	255.50	249.0	230.00	215.00	233.00	245.00	250.50	252.00	250.00
	St.Dev	302.71	241.72	335.77	441.28	382.33	413.30	424.22	443.60	505.26	665.15	561.30	506.69	540.16	494.18
	Skewness	1.14	1.74	3.29	6.23	3.08	3.69	3.31	3.13	3.65	5.75	4.03	2.94	3.02	4.34
	Kurtosis	4.69	7.01	22.01	64.41	15.80	23.72	20.68	16.86	24.45	60.27	31.10	15.63	16.30	40.74
Panel B	Mean	357.96	297.95	431.80	385.58	394.95	393.80	367.34	376.48	408.88	473.28	391.36	500.55	495.21	419.15
Incentive CEO Pay	Median	93.00	55.00	73.00	59.00	38.00	62.00	39.00	44.50	48.50	64.50	38.00	33.50	14.00	46
	St.Dev	766.84	805.38	1238.55	1396.73	1718.98	1281.59	1156.13	1016.70	1077.69	1289.10	1160.04	1371.25	1293.60	1247.18
	Skewness	3.83	6.19	6.56	9.68	9.94	8.57	9.92	7.03	7.76	6.47	7.82	7.17	6.67	8.27
	Kurtosis	18.53	48.71	60.28	118.98	117.88	92.00	143.21	72.48	93.05	59.17	89.98	79.38	76.84	101.39
Panel C	Mean	889.01	663.61	804.01	768.47	781.72	779.63	751.28	745.02	786.27	911.53	817.06	921.51	947.69	823.12
Total CEO Pay	Median	690.00	420.50	401.00	405.00	361.0	367.50	342.00	314.50	307.00	342.00	319.50	320.50	340.5	349
	St.Dev	918.94	915.04	1372.29	1696.78	1885.41	1526.46	1422.46	1316.09	1443.91	1710.06	1570.22	1746.83	1678.08	1566.95
	Skewness	3.20	5.09	5.86	8.84	8.42	6.90	7.22	5.71	6.10	5.24	6.24	5.75	5.24	6.51
	Kurtosis	14.91	35.32	51.60	100.28	89.59	63.26	79.70	52.76	61.27	42.11	60.88	55.38	50.88	66.32
Number of Observations		69	312	490	531	686	802	933	1068	1150	1166	1096	1032	1138	10473

Table 4.2

Performance of CEO compensation-sorted portfolios

This table reports equally-weighted post-ranking annualized returns for firms with different levels of CEO compensation over the period July 1999-December 2010. Portfolios are formed on the basis of both raw measures of compensation (Panel A) and industry- and size-adjusted measures of compensation (Panel B). Results are reported separately for cash pay-, incentive pay- and total pay-sorted portfolios. Columns 2, 3 and 4 present the results for firms that lie on the left tail of the pay distribution (lowest 2% or Portfolio_2%, lowest 10% or Portfolio_10% and lowest 20% or Portfolio_20%). Columns 5, 6 and 7 present the results for firms that lie on the right tail of the pay distribution (highest 20% or Portfolio_80%, highest 10% or Portfolio_90% and highest 2% or Portfolio_98%). The Table also reports the average return of the strategy buying firms with low CEO pay (i.e. Portfolio_2%, Portfolio_10% and Portfolio_20%) and selling short firms with high CEO pay (i.e. Portfolio_80%, Portfolio_90% and Portfolio_98%), along with the corresponding *t*-statistic (in parentheses) under the null hypothesis of equal returns for each pair of portfolios. * and ** indicate statistical significance at the 10% and 5% levels, respectively.

Panel A: Portfolios of firms based on RAW compensation measures

	LOWEST PAY FIRMS			*HIGHEST PAY FIRMS*			*SPREAD: LOWEST PAY – HIGHEST PAY*		
	(2)	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**			
	Portfolio_2%	**Portfolio_10%**	**Portfolio_20%**	**Portfolio_80%**	**Portfolio_90%**	**Portfolio_98%**	**(4)-(5)**	**(3)-(6)**	**(2)-(7)**
CEO Cash Pay (% p.a.)	2.16	10.17	11.45	10.06	9.91	4.61	1.38	0.26	-2.47
	(0.27)	(1.23)	(1.60)	(1.71)*	(1.69)*	(0.79)	(0.29)	(0.04)	(-0.38)
CEO Incentive Pay (% p.a.)	11.96	16.87	13.95	6.19	6.11	2.92	7.76	10.76	9.04
	(1.88)*	(2.39)**	(2.17)**	(0.98)	(0.95)	(0.39)	(1.89)*	(2.11)**	(1.85)*
Total CEO Pay (% p.a.)	-0.88	15.51	13.58	7.79	7.63	3.95	5.79	7.88	-4.83
	(-0.10)	(1.86)*	(1.89)*	(1.26)	(1.19)	(0.56)	(1.14)	(1.23)	(-0.59)

Panel B: Portfolios of firms based on INDUSTRY- AND SIZE-ADJUSTED compensation measures

	LOWEST PAY FIRMS			HIGHEST PAY FIRMS			*SPREAD: LOWEST PAY – HIGHEST PAY*		
	(2)	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**			
	Portfolio_2%	**Portfolio_10%**	**Portfolio_20%**	**Portfolio_80%**	**Portfolio_90%**	**Portfolio_98%**	**(4)-(5)**	**(3)-(6)**	**(2)-(7)**
CEO Cash Pay (% p.a.)	3.63	10.10	8.70	10.06	8.16	9.14	-1.36	1.94	-5.51
	(0.42)	(1.63)	(1.42)	(1.66)*	(1.35)	(1.46)	(-0.44)	(0.48)	(-0.65)
CEO Incentive Pay (% p.a.)	15.08	15.14	10.17	6.49	7.77	2.15	3.68	7.37	12.93
	(1.80)*	(2.25)**	(1.68)*	(1.06)	(1.17)	(0.29)	(1.70)*	(1.93)*	(1.68)*
Total CEO Pay (% p.a.)	15.86	11.36	9.02	8.71	8.48	3.68	0.31	2.88	12.18
	(1.90)*	(1.85)*	(1.48)	(1.40)	(1.32)	(0.51)	(0.11)	(0.72)	(1.52)

Table 4.3
Risk-adjusted performance of CEO compensation-sorted portfolios

This table reports the estimated annualized alphas for different portfolios of firms as constructed using raw measures of *CEO Cash Pay* (Panel A), *CEO Incentive Pay* (Panel B) and *Total CEO Pay* (Panel C). Alphas are estimated using three asset pricing models, namely the CAPM, the Fama-French (1993) three-factor model and the Carhart (1997) four-factor model, as analytically discussed in Section 4.4.2. Columns 2, 3 and 4 present the results for firms that lie on the left tail of the pay distribution (lowest 2% or Portfolio_2%, lowest 10% or Portfolio_10% and lowest 20% or Portfolio_20%). Columns 5, 6 and 7 present the results for firms that lie on the right tail of the pay distribution (highest 20% or Portfolio_80%, highest 90% or Portfolio_90% and highest 2% or Portfolio_98%). The table also reports the average return of the strategy buying firms with low CEO pay (i.e. Portfolio_2%, Portfolio_10% and Portfolio_20%) and selling short firms with high CEO pay (i.e. Portfolio_80%, Portfolio_90% and Portfolio_98%), along with the corresponding *t*-statistic (in parentheses) under the null hypothesis of equal returns for each pair of portfolios. * and ** indicate statistical significance at the 10% and 5% levels, respectively.

	Panel A: CEO Cash Pay-based Portfolios								
	LOWEST PAY FIRMS			*HIGHEST PAY FIRMS*			*SPREAD: LOWEST PAY – HIGHEST PAY*		
	(2)	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(4)-(5)**	**(3)-(6)**	**(2)-(7)**
	Portfolio_2%	**Portfolio_10%**	**Portfolio_20%**	**Portfolio_80%**	**Portfolio_90%**	**Portfolio_98%**			
CAPM alpha (% p.a.)	-2.61	5.40	6.71	5.20	5.05	-0.12	1.51	0.35	-2.49
	(-0.36)	(0.56)	(0.95)	(1.72)*	(1.71)*	(-0.03)	(0.25)	(0.04)	(-0.34)
Fama-French alpha (% p.a.)	-6.10	2.57	3.33	2.84	2.99	-1.64	0.49	-0.42	-4.46
	(-1.02)	(0.40)	(0.74)	(1.41)	(1.39)	(-0.42)	(0.11)	(-0.06)	(-0.67)
Carhart alpha (% p.a.)	-3.10	2.79	3.93	4.17	4.36	0.53	-0.24	-1.57	-3.63
	(-0.47)	(0.40)	(0.77)	(2.12)**	(1.98)**	(0.13)	(-0.05)	(-0.21)	(-0.48)
	Panel B: CEO Incentive Pay-based Portfolios								
CAPM alpha (% p.a.)	7.22	12.21	9.23	1.26	1.16	-2.06	7.97	11.05	9.28
	(1.31)	(1.63)	(1.62)	(1.42)	(0.38)	(-0.42)	(1.70)*	(1.73)*	(1.89)*
Fama-French alpha (% p.a.)	4.14	9.44	6.49	-1.29	-0.70	-2.58	7.78	10.14	6.72
	(1.21)	(2.23)**	(1.93)*	(-0.62)	(-0.27)	(-0.68)	(2.32)**	(2.39)**	(1.60)
Carhart alpha (% p.a.)	5.03	8.98	6.83	1.37	1.53	-4.14	5.46	7.45	9.17
	(1.34)	(2.09)**	(1.89)*	(0.69)	(0.60)	(-1.01)	(1.58)	(1.76)*	(2.01)**
	Panel C: Total CEO Pay-based Portfolios								
CAPM alpha (% p.a.)	-5.55	10.76	8.86	2.88	2.66	-0.97	5.98	8.10	-4.58
	(-0.69)	(1.13)	(1.22)	(1.01)	(0.92)	(-0.21)	(0.94)	(0.95)	(-0.51)
Fama-French alpha (% p.a.)	-8.66	7.92	5.64	0.46	0.88	-1.08	5.18	7.04	-7.58
	(-1.19)	(1.28)	(1.25)	(0.25)	(0.35)	(-0.32)	(1.18)	(1.17)	(-0.93)
Carhart alpha (% p.a.)	-7.30	7.80	6.17	2.72	3.02	-2.52	3.45	4.78	-4.78
	(-0.99)	(1.19)	(1.22)	(1.50)	(1.24)	(-0.71)	(0.69)	(0.73)	(-0.61)

Table 4.4
Risk-adjusted performance of CEO compensation-sorted portfolios-Adjusted Measures

This table reports the estimated annualized alphas for different portfolios of firms as constructed using industry- and size- adjusted measures of *CEO Cash Pay* (Panel A), *CEO Incentive Pay* (Panel B) and *Total CEO Pay* (Panel C). Alphas are estimated using three asset pricing models, namely the CAPM, the Fama-French (1993) three-factor model and the Carhart (1997) four-factor model, as analytically discussed in Section 4.4.2. Columns 2, 3 and 4 present the results for firms that lie on the left tail of the pay distribution (lowest 2% or Portfolio_2%, lowest 10% or Portfolio_10% and lowest 20% or Portfolio_20%). Columns 5, 6 and 7 present the results for firms that lie on the right tail of the pay distribution (highest 20% or Portfolio_80%, highest 10% or Portfolio_90% and highest 2% or Portfolio_98%). The table also reports the average return of the strategy buying firms with low CEO pay (i.e. Portfolio_2%, Portfolio_10% and Portfolio_20%) and selling short firms with high CEO pay (i.e. Portfolio_80%, Portfolio_90% and Portfolio_98%), along with the corresponding *t*-statistic (in parentheses) under the null hypothesis of equal returns for each pair of portfolios. * and ** indicate statistical significance at the 10% and 5% levels, respectively.

	LOWEST PAY FIRMS			*HIGHEST PAY FIRMS*			*SPREAD: LOWEST PAY – HIGHEST PAY*		
	(2)	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(4)-(5)**	**(3)-(6)**	**(2)-(7)**
	Portfolio_2%	**Portfolio_10%**	**Portfolio_20%**	**Portfolio_80%**	**Portfolio_90%**	**Portfolio_98%**			
Panel A: CEO Cash Pay-based Portfolios									
CAPM alpha (% p.a.)	-0.97	5.38	4.00	5.20	3.29	4.43	-1.20	2.09	-5.40
	(-0.15)	(1.20)	(0.84)	(1.61)	(0.89)	(0.92)	(-0.43)	(0.46)	(-0.61)
Fama-French alpha (% p.a.)	-3.62	2.02	0.48	2.52	0.89	2.76	-2.04	1.13	-6.38
	(-0.69)	(0.78)	(0.16)	(1.13)	(0.31)	(0.59)	(-0.79)	(0.34)	(-0.85)
Carhart alpha (% p.a.)	-3.55	3.16	1.95	4.05	2.59	4.46	-2.10	0.57	-8.00
	(-0.63)	(1.14)	(0.58)	(1.82)	(0.84)	(0.94)	(-0.73)	(0.17)	(-1.07)
Panel B: CEO Incentive Pay-based Portfolios									
CAPM alpha (% p.a.)	10.39	10.37	5.40	1.62	2.79	-2.82	3.78	7.58	13.21
	(1.13)	(1.96)**	(1.31)	(0.49)	(0.84)	(-0.55)	(1.93)*	(1.83)*	(1.67)*
Fama-French alpha (% p.a.)	7.70	6.58	2.04	-1.01	0.66	-3.36	3.05	5.92	11.06
	(1.14)	(2.34)**	(0.89)	(-0.42)	(0.25)	(-0.84)	(1.89)*	(1.80)*	(1.89)*
Carhart alpha (% p.a.)	9.58	7.26	3.49	1.36	3.00	-4.99	2.13	4.26	14.57
	(1.41)	(2.55)***	(1.42)	(0.55)	(1.16)	(-1.15)	(1.30)	(1.25)	(1.84)*
Panel C: Total CEO Pay-based Portfolios									
CAPM alpha (% p.a.)	11.29	6.69	4.31	3.82	3.53	-1.27	0.48	3.16	12.56
	(1.19)	(1.47)	(0.95)	(1.12)	(1.23)	(-0.28)	(0.22)	(1.01)	(1.52)
Fama-French alpha (% p.a.)	8.11	3.31	0.67	1.10	1.65	-1.27	-0.43	1.66	9.38
	(1.22)	(1.29)	(0.96)	(0.50	(0.74)	(-0.38)	(-0.22)	(0.67)	(1.38)
Carhart alpha (% p.a.)	10.09	4.17	2.15	3.17	3.66	-2.85	-1.02	0.51	12.94
	(1.56)	(1.50)	(0.74)	(1.46)	(1.64)	(-0.81)	(-0.47)	(0.19)	(1.73)

Table 4.5
CEO Incentive Compensation and Shareholder Returns: Different Investment Horizons

This table reports annualized cumulative returns for firms in the top and bottom deciles of CEO incentive pay during the period 1999-2010. For the portfolio construction, raw measures of CEO incentive pay are used. Panel A reports equally-weighted (EW) raw and risk-adjusted returns (CAPM alpha, Fama-French alpha and Carhart alpha) for firms in the bottom decile of incentive pay (Portfolio_10%). Panel B reports the results for firms in the top decile of incentive pay (Portfolio_90%). We calculate the cumulative returns for Portfolio_10% and Portfolio_90% over the following investment horizons: 12 months before (-12m), one month (+1m), three months (+3m), 6 months (+6m), one year (+12m), two years (+24m) and three years (+36m) after the portfolio construction. While calculating cumulative returns after the portfolio formation, we lag compensation data by 6 months to account for the period that elapses from the end of the financial year until the time that firms listed on LSE make their annual financial reports publicly available. *t*- statistics are reported in parentheses. *, ** and *** indicate statistical significance at the 10%, 5% and 1% levels, respectively.

Panel A: Firms in the lowest decile of CEO Incentive Pay (*Portfolio_10%)*

	MONTHS (m)						
	-12m	**+1m**	**+3m**	**+6m**	**+12m**	**+24m**	**+36m**
EW Returns (% p.a.)	20.53	16.87	19.45	20.38	16.12	10.67	8.60
	(5.45)***	(2.39)**	(3.26)***	(3.75)***	(4.67)***	(4.47)***	(4.70)***
CAPM alpha (% p.a.)	13.45	12.21	14.31	14.81	10.68	5.65	4.35
	(2.37)**	(1.63)	(1.72)*	(1.80)*	(3.13)***	(1.75)*	(1.71)*
Fama-French alpha (% p.a.)	8.38	9.44	12.24	12.98	9.78	2.10	2.26
	(2.87)***	(2.23)**	(2.47)**	(2.86)***	(2.72)***	(1.07)	(1.33)
Carhart alpha (% p.a.)	7.72	8.98	10.58	11.83	9.80	1.72	3.72
	(2.22)**	(2.09)**	(2.10)**	(2.21)**	(2.01)**	(0.89)	(2.55)**

Panel B: Firms in the highest decile of CEO Incentive Pay (*Portfolio_90%)*

	MONTHS (m)						
	-12m	**+1m**	**+3m**	**+6m**	**+12m**	**+24m**	**+36m**
EW Returns (% p.a.)	15.00	6.11	7.60	9.22	9.32	7.56	5.37
	(6.30)***	(0.95)	(1.80)*	(2.46)**	(3.19)***	(3.47)***	(3.67)***
CAPM alpha (% p.a.)	8.94	1.16	2.60	3.27	3.31	2.48	1.10
	(4.09)***	(0.38)	(0.95)	(1.32)	(1.95)*	(2.55)**	(1.53)
Fama-French alpha (% p.a.)	7.29	-0.70	0.89	1.98	2.48	1.12	0.26
	(5.48)***	(-0.27)	(0.38)	(0.92)	(1.97)**	(1.32)	(0.39)
Carhart alpha (% p.a.)	7.33	1.53	3.35	4.47	3.79	1.13	-0.42
	(4.20)***	(0.60)	(1.34)	(1.94)*	(2.12)**	(1.25)	(-0.45)

Table 4.6

Adjusted CEO Incentive Compensation and Shareholder Returns: Different Investment Horizons

This table reports annualized cumulative returns for firms in the top and bottom deciles of CEO incentive pay during the period 1999-2010. For the portfolio construction, industry- and size-adjusted measures of CEO incentive pay are used. Panel A reports equally-weighted (EW) raw and risk-adjusted returns (CAPM alpha, Fama-French alpha and Carhart alpha) for firms in the bottom decile of incentive pay (Portfolio_10%). Panel B reports the results for firms in the top decile of incentive pay (Portfolio_90%). We calculate the cumulative returns for Portfolio_10% and Portfolio_90% over the following investment horizons: 12 months before (-12m), one month (+1m), three months (+3m), 6 months (+6m), one year (+12m), two years (+24m) and three years (+36m) after the portfolio construction. While calculating cumulative returns after the portfolio formation, we lag compensation data by 6 months to account for the period that elapses from the end of the financial year until the time that firms listed on LSE make their annual financial reports publicly available. *t*-statistics are reported in parentheses. *, ** and *** indicate statistical significance at the 10%, 5% and 1% levels, respectively.

Panel A: Firms in the lowest decile of CEO Incentive Pay (*Portfolio_10%)*

	MONTHS (m)						
	-12m	**+1m**	**+3m**	**+6m**	**+12m**	**+24m**	**+36m**
EW Returns (% p.a.)	12.12	15.14	16.25	17.12	12.54	9.83	8.93
	(4.85)***	(2.25)**	(3.39)***	(4.20)***	(4.90)***	(5.11)***	(6.13)***
CAPM alpha (% p.a.)	5.57	10.37	11.09	11.78	7.29	4.91	4.82
	(2.72)***	(1.96)*	(2.15)**	(2.37)**	(2.94)***	(3.12)***	(3.17)***
Fama-French alpha (% p.a.)	2.67	6.58	7.29	7.59	4.52	1.81	2.07
	(1.66)	(2.34)**	(2.84)***	(4.03)***	(4.75)***	(2.41)**	(3.36)***
Carhart alpha (% p.a.)	3.52	7.26	7.00	7.26	3.49	0.03	-0.50
	(2.11)**	(2.55)**	(2.75)***	(3.68)***	(3.18)***	(0.04)	(-0.66)

Panel B: Firms in the highest decile of CEO Incentive Pay (*Portfolio_90%)*

	MONTHS (m)						
	-12m	**+1m**	**+3m**	**+6m**	**+12m**	**+24m**	**+36m**
EW Returns (% p.a.)	17.44	7.77	8.59	9.95	9.63	8.12	5.78
	(6.67)***	(1.17)	(1.97)**	(2.53)**	(3.16)***	(3.66)***	(4.22)***
CAPM alpha (% p.a.)	11.11	2.78	3.60	3.96	3.55	2.81	1.51
	(4.25)***	(0.84)	(1.24)	(1.51)	(2.03)**	(2.77)***	(2.29)**
Fama-French alpha (% p.a.)	8.73	0.66	1.76	2.48	2.46	1.27	0.83
	(5.96)***	(0.25)	(0.74)	(1.22)	(2.27)**	(1.38)	(1.24)
Carhart alpha (% p.a.)	8.99	3.00	4.33	4.72	3.29	1.52	0.16
	(4.29)***	(1.10)	(1.63)	(2.20)**	(2.37)**	(1.42)	(0.22)

CHAPTER 5

Conclusions

This thesis has examined how stock returns on London Stock Exchange are related to two specific firms' characteristics that have attracted the interest of the media, policy makers and researchers due to their importance during the recent global financial crisis: i) the financial constraints that firms face in their attempt to invest and grow at their desirable pace and ii) the level and structure of the compensation that corporations pay their executives.

Chapter 2 has provided, for the first time in the literature, comprehensive evidence on the relationship between firms' financial constraints and their stock returns on LSE using a survivorship bias-free dataset of non-financial firms during the period 1988- 2010. A series of proxies have been used to measure the degree of financial constraints for each firm in our sample. These proxies utilize information embedded into the assets and the liabilities side of a firm's balance sheet as well as its cash flows. In particular, the following measures have been used: firm's size proxied by the book value of its assets, its ratio of tangible-to-total assets as a measure of debt capacity, its total debt-to-common equity and total debt-to-market value ratios, its cash holdings-to-total assets ratio, its interest coverage ratio, the composite KZ-index proposed by Kaplan and Zingales (1997) and the composite WW-index proposed by Whited and Wu (2006).

Using each of these financial constraints proxies, firms have been sorted and classified to the corresponding portfolios. The post-ranking returns of these portfolios are calculated to examine the potentially differential behaviour of the most financially constrained firms versus the least constrained ones. Standard asset pricing tests are also conducted to examine whether commonly used risk factors, such as market, size, value and momentum, can help explain the cross-section of these portfolios' returns. The main finding of our study is that investors in highly constrained firms were not rewarded for being exposed to this aspect of risk, regardless of the utilized proxy. To the contrary, the portfolio containing the most constrained firms underperformed the portfolio containing the least constrained firms in almost every case we have examined. With the exception of leverage ratios and cash holdings that did not yield significant differential performance, the relative underperformance of the most constrained firms was highly significant, both in economic and in statistical terms. The reported underperformance was even more striking using the composite WW-index that jointly captures various aspects of financial constraints. This remarkable finding was confirmed via a series of asset pricing tests and it was found to be robust to potential industry effects, higher co-moments risk-adjustment or alternative portfolio classfication schemes.

Apart from the obvious implications for asset pricing and investment management, our results have important implications for firms' capital structure decisions too. Since investors on LSE did not penalize financially constrained firms by requiring higher premia for holding their shares, one could argue that managers were acting rationally in leveraging up their firms. The offsetting mechanism of the trade-off theory broke down, the cost of capital did not increase in line with the debt-to-equity capital mixture, and hence managers rationally chose to utilize the cheaper source of external capital. Empirical tests of capital structure theories in the UK market should take our findings into account.

The findings of Chapter 2 resemble the evidence provided, inter alia, by Campbell et al. (2008) on the "distress risk anomaly" in the US market, according to which firms with high probability of default yield significantly lower risk-adjusted post-ranking returns relative to firms with low probability of default. There are a series of prior studies trying to explain this puzzling evidence that contradicts the predictions of standard asset pricing theory. For example, Griffin and Lemon (2002) argued that the market misprices default risk, while

Campbell et al. (2008) attributed the persistence of this anomaly to various “limits to arbitrage”, i.e. frictions that prevent investors from exploiting it, such as informational asymmetries, illiquidity and noise traders. More recently, Garlappi and Yan (2011) proposed a rational framework to explain this finding. According to their model, when shareholders have high bargaining power they can extract rents from claimholders in the event of distress, and hence the equity risk they bear is not as high as it appears to be. Drawing insights from this strand of the literature, future research should attempt to explain why stock returns are inversely related to firms’ financial constraints in the UK market.

Chapter 3 has contributed to the literature by examining the return response of the most and the least constrained firms listed on LSE to UK monetary policy shocks during the period June 1999- December 2011. Following Bredin et al. (2007) and Bredin et al. (2009), these shocks are extracted on Bank of England’s Monetary Policy Committee meeting days, relative to expectations embedded in LIBOR futures prices. Using a large number of constraints proxies to provide comprehensive evidence, we derive a series of interesting conclusions.

Firstly, we find no significant evidence to support the argument that the return response of the most constrained firms is of greater magnitude relative to corresponding response of the least constrained firms, apart from some cases where the tangible-to-total assets ratio and KZ-index are used as proxies. The opposite is actually true for most of the measures we use. This evidence is at odds with the intuition provided by the credit channel of the monetary policy transmission mechanism and the limited existing evidence for the US market provided by Ehrmann and Fratzscher (2004), Basistha and Kurov (2008) and Jansen and Tsai (2010). The main explanation we put forward for this finding is that investors on LSE do not regard the interaction between financial constraints and monetary conditions to be an important source of risk, especially at very short horizons, and hence they do not differentiate across listed firms on the basis of their constraints when reacting to monetary policy shocks.

Secondly, these results also highlight the large degree of heterogeneity in the return response across the proxies we use, revealing that they capture different aspects of the elusive concept of financial constraints. Therefore, relying only on a subset of these measures to derive strong conclusions regarding the effect of financial constraints on the relationship between monetary policy shocks and stock returns would be rather misleading. Thirdly, in line with the recent studies of Gregoriou et al. (2009) and Florackis et al. (2011), our results show that the inverse relationship between monetary policy shocks and stock returns that is documented excluding the 2007-2009 crisis period became positive during the crisis. This is true both for the market index and for the majority of the portfolios containing the most and the least constrained firms listed on LSE. This finding remains intact when we use the recession period of September 2008- August 2009 to define an alternative, narrower crisis period.

Finally, we test for the first time in the UK market whether the relationship between stock returns and monetary policy shocks is state dependent by investigating how this relationship is modified across different market phases, credit, volatility and liquidity conditions. The reported results reveal that the relationship between stock returns and monetary policy shocks in the UK market exhibits state dependence. In particular, we find that excluding the crisis period, this inverse relationship is of greater magnitude during bull market phases, tight credit conditions, high market volatility and illiquidity periods. However, this differential magnitude is statistically significant only in the case of tight credit conditions.

The results of Chapter 3 have important implications for policy makers and investors, shedding light on the transmission of UK monetary policy via the stock market and across firms in different economic and market conditions. Most importantly, these results show that despite the theoretical rigour of the credit channel of the transmission mechanism, investors on LSE may not actually take the degree of firms' financial constraints considerably into account in their decision making process when responding to monetary policy actions, especially in the very short run. Future research should provide a more detailed examination of the impact of UK monetary policy decisions on stock returns during and after the recent financial crisis period. Drawing insights from the call of Blinder (2012) for further research on this issue, the reduction of policy rates to levels close to the zero lower bound and the introduction of unconventional monetary policies, such as quantitative easing and credit easing, require a new framework to assess the impact of these policies on the returns of financially constrained firms. This is a challenging topic for future research.

Chapter 4 has examined whether companies that pay their CEO excess fees, relative to their peer firms in the same industry and size group, generate superior future returns. There has been considerable disagreement whether the level and structure of CEO pay in large companies serves the interests of both managers and shareholders. Existing research provides mixed evidence on this issue. The recent financial crisis has also revealed severe flaws in corporate compensation practices, such as a weak link between executive pay and performance, which resulted into an intense debate on whether the cross-sectional variation in CEO pay can be fully justified by firms' fundamentals.

Chapter 4 contributes to this debate by analyzing CEO compensation in UK firms from an ex-post perspective. We hypothesize that attractive compensation contracts induce senior managers to exert costly effort to increase their firms' growth opportunities, eliminating in this way agency conflicts between top-managers and shareholders and improving future shareholder returns. This hypothesis is tested using a carefully constructed compensation dataset for 1,787 firms listed on LSE during the period 1998-2010. Given the large increase in CEO pay during the recent decades, the introduction of legislation to require nonbinding "say on pay" votes for all publicly listed companies and the spate of recent shareholder revolts over pay (e.g. Barclays, Aviva, Xstrata), the UK market provides an ideal setting to examine whether companies that pay their CEOs excess fees generate superior subsequent returns.

The results in Chapter 4 indicate a strong negative relationship between CEO incentive pay and future shareholder returns. Firms that pay their CEOs in excess of the median pay to peer firms in the same industry and size group earn significantly lower raw and risk-adjusted returns. To illustrate this finding, an investment strategy buying shares of firms in the lowest 2% of the incentive pay distribution and selling short shares of firms in the highest 2% of incentive pay distribution would have earned abnormal monthly returns of more than 11% p.a. during the sample period. The results in Chapter 4 also suggest that the outperformance of firms with low pay is less pronounced but still apparent when longer investment horizons are considered. Finally, we provide evidence that, in contrast to incentive pay, cash pay is not found to affect future shareholder returns in a statistically significant way. The latter finding is consistent with the view that “hidden” or “camouflaged” forms of CEO pay (e.g. stock options or LTIPs) may be used by senior executives as a rent extraction mechanism, which may explain the subsequent underperformance of companies with excess incentive pay to their CEO.

The findings of Chapter 4 are of considerable practical interest and policy relevance. They provide indirect evidence that commonly used pay instruments such as options and LTIPS, which are by far the largest components of incentive pay in the UK, may encourage managerial short-termism and suboptimal investment decisions, leading to lower subsequent returns for shareholders. These results also contribute to the debate on whether the size or the type (e.g. salary, bonus, options, LTIPs) of executive compensation requires reform. These findings may be relevant to companies, investors, regulators and media commentators, identifying which pay practices constitute good governance or the contrary. Finally, they may inform future deliberations by regulatory bodies, such as the Financial Reporting Council, with respect to the UK Corporate Governance Code. Concluding, the main challenge for future research is to analyze the reasons why investors on LSE overprice the shares of firms with high incentive-based executive compensation, even though they subsequently underperform.

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