

DOES DERIVATIVE USAGE AFFECT FIRM-LEVEL RISK?

A Master's Thesis

by
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January 2008

To My Family

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The Institute of Economics and Social Sciences
of
Bilkent University

by

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In Partial Fulfillment of the Requirements for the Degree of
MASTER OF SCIENCE

in

THE DEPARTMENT OF
MANAGEMENT
BİLKENT UNIVERSITY
ANKARA

January 2008

I certify that I have read this thesis and have found that it is fully adequate, in scope and in quality, as a thesis for the degree of Master of Science in Management.

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ABSTRACT

DOES DERIVATIVE USAGE AFFECT FIRM-LEVEL RISK?

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January 2008

This thesis aims to explore the effect of derivative usage on firm-level risk among U.S. non-financial firms for the year 2004, by using accounting information. Firm-level risk is proxied by four different risk measures; standard deviation of daily stock returns, beta, idiosyncratic risk and RiskGrade. First, univariate analyses are employed to test the difference in risk levels between firms that use and do not use derivatives. Second, regression analyses are conducted by taking into account control variables that are documented to affect risk in the literature. As a result of these analyses, it is documented that derivative usage leads to a decrease in firm-level risk.

Keywords: Derivative Usage, Firm-Level Risk

ÖZET

TÜREV ÜRÜN KULLANIMI FİRMA RİSKİNİ ETKİLER Mİ?

Küçükbahçıvan, Yüstra

Yüksek Lisans, İşletme Bölümü

Tez Yöneticisi: Doç. Dr. Aslıhan Altay-Salih

Ocak 2008

Bu tez, muhasebe verilerinden faydalanarak 2004 yılında finans dışı sektörlerde yer alan Amerikan şirketleri için türev ürün kullanımının firma riski üzerine etkisini araştırmayı amaçlamaktadır. Firma riski; günlük hisse senedi getirilerinin standart sapması, beta, firmaya özgü risk ve RiskGrade olarak dört farklı yolla ölçülmüştür. İlk olarak tek değişkenli analiz yoluyla, türev ürün kullanan ve kullanmayan firmaların risk seviyeleri arasındaki fark test edilmiştir. İkinci metod olarak ise literatürde firma riskini etkilediği belirtilen diğer değişkenleri de dikkate alarak regresyon analizleri yapılmıştır. Yapılan analizler sonucu, türev ürün kullanımının firma riskinde düşüşe yol açtığı tespit edilmiştir.

Anahtar Kelimeler: Türev Ürün Kullanımı, Firma Riski

ACKNOWLEDGMENTS

I would like to thank my supervisor Assoc. Dr. Aslıhan Altay-Salih for her patience and guidance throughout this study. She was always with me whenever I needed advice, which extended beyond academic studies. I feel extremely privileged for having been the student of such an honorable teacher.

I am thankful to Assoc. Dr. Levent Akdeniz for his guidance from the beginning of my undergraduate study till the end of this thesis.

I am grateful to Assist. Prof. Refet Gürkaynak, for his valuable comments throughout this thesis.

I would like to thank TÜBİTAK for the financial support they provided for my graduate study.

I am also indebted to Ziya Parıltılı, for the unconditional support and encouragement he gave me for the completion of this thesis.

I cannot find the exact words to express my love and gratitude to my family. My father Mevlüt was a perfect teacher I could have in my lifetime. My mother Şükran, who always wanted me to be an academician, was always with me with her best wishes and prays. My sister Esra has made me feel positive with her sweet voice on the phone all the time. They made me feel their love and support at every step of my life. Without them, it would simply be impossible for me to obtain the success I achieved from the beginning of my primary school till the end of my graduate study.

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CHAPTER 1

INTRODUCTION

In the past, stakeholders of a firm would be willing to bear risks which are related to bad financial outcomes that occurred due to reasons not under the control of management. Nevertheless, as stated by Bodnar and Gebhardt (1998), today they expect that managers should foresee and take actions against possible risks. The greater concern with the volatility in interest rates, foreign exchange rates, commodity prices or equity prices led the firms to find the ways of managing those risks. The use of derivative instruments is considered a reasonable way of hedging the exposures; a situation which led to a widespread use of these instruments, particularly since the last few decades.

As Stulz (2004) argues, in the 1970s, volatility in interest rates and exchange rates considerably increased. Moreover, these years witnessed a great development in derivative markets: Black and Scholes found a way to price options in the early 1970s. The economic conditions of that period and developments in pricing of derivatives enabled the growth in derivative markets to gain acceleration. Chicago

Mercantile Exchange started trading currency futures in 1972 and Chicago Board Options Exchange is founded in 1973; to trade stock options. Trade in swaps, over the counter, has considerably increased in the beginning of 1980s.

Following the widespread use of derivatives, academic research concerning the corporate use of these instruments has considerably increased. Earliest empirical studies were based on survey data; where data about derivative usage is collected through questionnaires. These survey studies were conducted for various countries, like U.S., Germany, U.K., Australia, Canada, Japan, Sweden, New Zealand, Netherlands, Belgium, Switzerland, Hong Kong and Singapore. Most of these survey studies are descriptive in nature and aim to investigate why firms hedge, what kind of risks they hedge, which instruments they use, how they report and control their hedging activities and so on. However, is possible that survey studies might lack power, due to non-response bias, dishonest responses or relatively small sample sizes.

After the initiation of disclosure requirements in the early 1990s, research examining corporate derivative use has increased. The changes in accounting standards mandated that firms that use derivatives should disclose the information regarding their use of off-balance sheet financial instruments in the footnotes to their financial statements. These requirements made the information on derivative activity publicly available, therefore, enabled researchers to conduct in-depth analyses concerning corporate derivative use.

Most of the studies that use data from footnotes to financial statements of the firms investigate the determinants of corporations' derivative usage. However, despite the presence of various survey and empirical evidence that firms use derivatives to reduce their return volatility, academic research on the consequence of derivative usage and its effect on firm-level risk is limited. Allayannis and Weston (2001) examines the effect of foreign currency derivative usage on firm value, in a sample of 720 large U.S. non-financial firms. They find some evidence that use of foreign currency derivatives lead to an increase in firm value. As for risk implications of derivative usage; Hentschel and Kothari (2001) studies 425 large U.S. corporations using accounting data. Due to the increased public concern about dangers of derivative usage; Hentschel and Kothari investigate whether firms use derivatives to speculate. Their findings suggest no association between firms' derivatives holding and stock return volatility. Guay (1999) also examines the effect of derivative usage on firm-level risk, by using 254 new user observations, where a new user firm is defined to be a firm that did not use derivatives in year $t-1$, but reported its derivatives use in year t ; between June 1990 and December 1994. His empirical study reveals that using derivatives leads to a decrease in firm-level risk; proxied by different risk measures.

This thesis aims to examine the relationship between derivative usage and firm-level risk in an attempt to broaden our understanding about the effects of derivative usage on firm-level risk. Unlike most of the studies concerning corporate derivative use, this study makes use of a sample composed of not only large firms, but also smaller-size firms; by using a sample composed of 211 firms, of which 97 are traded on NASDAQ, 70 are traded on NYSE, 32 are traded on AMEX and 12 are traded on

other exchanges. Besides, this is the first study to incorporate RiskGrade data; which is provided by Riskmetrics group, to give an insight about the effect of derivative usage on firm-level risk.

Our hypothesis is that derivative usage should be associated with lower risk. To test this hypothesis, univariate and multivariate analyses are employed; by using four different risk measures to proxy firm-level risk. The risk measures are standard deviation, beta, idiosyncratic risk and RiskGrade. Derivative dummy is used as independent variable, together with market value and book-to-market value as control variables.

The sample is composed of only non-financial firms, as non-financial firms use derivatives mainly to manage risk exposures. Financial firms, however, may have other motives to use derivatives. Univariate analyses conducted on a sample of 211 non-financial firms using year 2004 data reveal that firm-level risk, in terms of each of the four different risk measures, is lower for firms that use derivatives. When regression analyses are conducted using derivative usage as the unique variable, derivative usage turned out to be a significant determinant of risk, regardless of the risk measure used. When control variables are added into the model, regression analyses indicate that firm-level risk for derivative users are lower than firm-level risk for non-users in terms of three risk measures, which are standard deviation, beta and RiskGrade. Overall, the evidence is consistent with our hypothesis that derivative usage leads to a decrease in firm-level risk.

The remaining of the paper is organized as follows: Chapter 2 provides information about the previous literature on derivative usage among firms; including both survey studies and studies that use accounting data. Chapter 3 introduces the data used and methodology employed in the study. Chapter 4 discusses the descriptive statistics both for derivative usage and financial characteristics of sample firms, and presents the results of univariate tests and regression analyses. Chapter 5 concludes.

CHAPTER 2

LITERATURE REVIEW

Corporations have been using financial derivatives for hedging purposes for a long time. However, academic literature has documented very little evidence about the impact of the derivative usage of corporations on risk management until the last two decades. The main reason behind this is the lack of publicly available information on the derivative usage of corporations until the beginning of 1990s. Therefore, the earliest empirical studies about derivatives have primarily relied on survey-based data; where the derivative policies of firms are analyzed through questionnaires. After the initiation of accounting disclosure requirements about derivative instruments in the early 1990s, various academic studies have investigated derivative usage of corporations.

The changes in accounting standards required the firms to disclose their off-balance sheet financial instruments in the footnotes to their financial statements. As stated by The Financial Accounting Standard Board (1990), SFAS No.105, namely “Disclosure of Information about Financial Instruments with Off-Balance Sheet Risk

and Financial Instruments with Concentration of Credit Risk” mandated that corporations should disclose the information about their use of off-balance sheet financial instruments; providing comparable data for the previous year; in the footnotes to their financial statements for fiscal years ending after June 15, 1990. These requirements enabled the researchers to conduct better empirical studies by making the information on derivative activity publicly available. Most of these studies analyzed the impact of usage of derivative instruments of U.S. corporations due to the strict disclosure requirements and the large number of non-financial firms that use derivatives in U.S. market.

A survey study conducted by Bodnar and Gebhardt (1998) evaluates the derivative usage of U.S. and German non-financial firms. They compare the findings of 1995 Wharton School survey of derivative usage among U.S. non-financial firms and a parallel survey conducted in 1997 for German firms. The sample is comprised of 197 U.S. and 126 German firms. Survey findings indicate that percentage of German firms that use derivatives (77,8%) is greater than that of U.S. firms (56,9%). This result is also valid across 11 industry groups with only one exception. This greater propensity to use derivatives among German firms is explained by a smaller, more open German economy compared to U.S. Both countries use derivatives to manage primarily foreign exchange rate and interest rate risk. Again, the percentage of firms using derivatives in all three classes –exchange rate, interest rate and commodity prices- is higher for German respondents. As for the goals of derivatives usage; the primary goal for the majority of U.S. firms is to minimize the variability in cash flows; while it is minimizing accounting earnings for German firms. The survey also pointed out that U.S. firms are more concerned about using derivatives, due to

the disclosure requirements, need to value and evaluate derivatives and complex accounting treatments.

The paper analyzes the derivative usage in each class as well. For foreign exchange risk management both countries prefer to use currency forwards; then the OTC options and swaps. The ranking changes for interest rate risk management. The most popular instruments for both countries are swaps, forwards and options in this particular order. Lastly; for commodity price risk management, German firms have a propensity to use primarily forwards, while U.S. firms choose to make use of futures contracts.

The final issue mentioned in the paper is about the reporting and control of derivative activities. The findings indicate that the proportion of firms using derivatives which have a documented policy is around 80% for both countries; but while U.S. firms tend to report derivatives activity to higher management when needed; German firms prefer a more frequent reporting schedule. Besides, firms in both countries rely primarily on commercial banks as the counter party for derivative transactions and majority of the firms of both countries; but especially those of Germany, care about the creditworthiness of the counter party. Finally; the most popular techniques for valuing derivatives are stress testing, value-at-risk and duration methods for both countries; where German firms value their portfolios more frequently compared to U.S. firms.

Derivative practices of U.K. firms are analyzed by a survey study of Mallin, Ow-Yong and Reynolds (2001). The questionnaire is sent to 800 UK non-financial

companies that were randomly selected from Hemmington Scott's Corporate Register, which lists the corporations on the main London Stock Exchange. 231 firms replied the questionnaire, representing a response rate of 28,9%. Among these 231 respondents, 138 firms, (60%) reported that they use derivatives. Analysis of derivative usage by business sector and company size reveals that utilities, services and general manufacturing are the business sectors that has the highest rate, among other industries and derivatives usage is positively related with firm size. Non-user firms are asked to identify the reasons of not using these instruments. Top three answers turned out to be having no significant exposure, high costs of derivatives programs and possibility to manage exposure by other means. As for types of instruments used; like their U.S. and German counterparts; UK firms prefer to use, OTC forwards, OTC options and swaps to hedge currency risk. To manage interest rate risk, the most popular instruments are swaps, followed by OTC and exchange options. No one instrument is predominantly used for commodity and equity price risk. The low rate of futures usage is primarily linked to the fact that these instruments are not traded in UK during the study period, so they are associated with high costs and low confidence.

In UK the most important objective of hedging strategy is managing accounting earnings, similar to German firms. According to the answers given to the question of concerns about derivative usage; evaluation of the risks of instruments, transaction costs and lack of knowledge about derivatives are the issues most concerning the companies. Firms are also asked the consequence of UK's joining to single European currency and the answers suggest that a significant number of firms would decrease their use of derivatives due to a possible decrease in foreign currency risk.

The final issue considered in the survey is controlling and reporting procedures. Seventy one percent of derivative users are identified to have a documented policy on the use of derivatives. Besides, 48% of user firms do not have a preset schedule for reporting derivative activities; instead these firms choose to report to the board of directors as needed, like their US counterparts. Reporting on an ad hoc basis is primarily valid for smaller firms. These firms are also more likely to value their derivatives portfolio as needed. Finally stress testing and scenario analysis, followed by value-at-risk are the mostly used methods to evaluate the risk level of the derivative portfolios; as is the case for US and German firms. This result is valid for each business sector and company size level as well.

Benson and Oliver (2004) survey study analyzes the reasons behind the decisions of firms to use derivatives for Australian firms. Data is obtained via a mailed questionnaire sent to the CEO/CFO of top 500 listed companies of seven industries of Australia and the response rate turned out to be 23%. Among the respondents, 76% use derivatives. In an attempt to investigate why firms use derivatives; 19 different issues are documented and for each issue, firms are asked to rank on a Likert scale, the importance of derivatives for hedging. The results indicate that the most important reasons of using derivatives are decreasing the volatility of cash flows and the accounting earnings. The firms are also asked if they have a risk management plan and only 12% of the user firms asserted that they did not have.

Firms are also asked to indicate their exposure to different categories of financial risks and the technique they use to hedge these risks. Survey results reveal

that 72 of the firms have exposure to foreign currency risk; of these, 62 hedge their exposure, 58 use derivatives as hedging technique and forwards are the most popular instrument used. As for interest rate risk; 80 out of 100 firms indicate that they are exposed to interest rate risk; of these 63 hedge their exposure and none of these firms use non-derivative means for hedging. Firms mainly use swaps to manage interest rate risk. Finally, 32 firms specify their exposure to commodity price risk, 30 out of 32 hedge their exposure and just 1 firm uses non-derivative means for hedging. User firms prefer to use forwards and options as derivative instruments to hedge commodity price risk. For foreign exchange risk, 30% of the firms use no benchmarks and another 30% use forward rates at the beginning of the period as a method to evaluate risk management. Most popular benchmarks used to evaluate the interest rate risk management are volatility of revenue and volatility of cash flows to interest rate exposure; which is also the case for risk management of commodity prices.

One of the first fundamental studies concerning the determinants of hedging among U.S. firms belongs to Nance, Smith and Smithson (1993). The paper makes use of a survey study to explore the derivative usage of firms for the fiscal year 1986. The questionnaire is sent to 535 firms; comprised of the union of Fortune 500 and S&P 400. 194 firms responded; but the final sample includes 169 firms due to incomplete data. The financial data of these firms are obtained from Compustat database. Of the respondent firms, 104 used derivatives in 1986 while 65 did not. Nance et al. list the possible determinants of hedging as reduction in expected taxes, reduction in expected transactions costs of financial distress, reductions in agency costs and substitutes for hedging. Therefore, the factors affecting the use of

derivatives are determined as firm's use of tax loss carry forwards and tax credits, the probability of firm's pretax income being in the progressive region, the fraction of fixed claims in firm's capital structure, size, leverage, growth options, use of convertible debt and preferred stock, liquidity and dividend payout ratio.

The univariate tests imply that, hedger firms are larger than non-hedgers, have significantly larger R&D expenditures, less liquid and have higher dividend yields. Furthermore hedger firms are those that have more investment tax credits and more of the range of their pretax income in the progressive region.

Nance, Smith and Smithson also conduct logit method where derivative usage is the binary dependent variable. The paper employs 48 different logistic regressions, using different combinations of variables and the results of these tests, in general, imply that dividend yield and use of investment tax credits are statistically significant while pretax income in the progressive region of the tax schedule and R&D expenditure are statistically significant only at the 20% level. Nevertheless, the paper reminds that the power of these logistic regressions is low, due to small sample size relative to the parameters estimated and due to correlations existing among independent variables.

Other survey studies are Downie, McMillan and Nosla (1996) for Canadian firms, Yanagida and Inui (1995) for Japanese firms, Grant and Marshall (1997) and Judge (2002) for UK firms, Alkeback and Hagelin (1999) for Swedish firms; Berkman, Bradbury and Magan (1997) for New Zealand firms; Bodnar, Jong and Macrae (2002) for Dutch firms, DeCeuster et al. (2000) for Belgian firms, Loderer

and Pichler (2000) for Swiss firms and Sheedy (2002) for Hong Kong and Singapore firms. As summarized above some of these studies take the form of descriptive studies that inform about the percentage of firms using derivatives in the analyzed market, which instruments they utilize, which exposures they try to hedge, how they report and control their derivatives activity and so on. Others test why firms use derivatives, aiming to explore the motives behind the derivative usage. However, survey studies might lack power, because of non-response bias, dishonest responses or relatively small sample sizes.

Second set of studies uses derivatives disclosures in annual reports rather than survey data. For example, Nguyen and Faff (2002) investigates the determinants of derivative usage among Australian firms using disclosures. The sample analyzed consists of 469 firm/year observations comprised of largest Australian non-financial companies listed on the Australian Stock Exchange during 1999 and 2000. The financial reports are obtained from the Connect4 database and other related data is drawn from Datastream. The aim of the study is to examine not only the factors that affect the decision to use derivatives, but also the extent of usage of these instruments. Univariate tests between users and non-users reveal that users have higher leverage, lower liquidity, lower current ratio, pay higher dividends and are larger in size.

Logit analysis, suggests that leverage and size are significant incentive factors while liquidity is a significant disincentive factor affecting the decision to use derivatives. The intuition behind these results is as follows: firms that are using more debt are more likely to encounter a financial distress, so to lower this probability,

they hedge themselves. Furthermore, larger firms benefit from the economies of scale after setting up a hedging program; which may be very costly for small firms. Finally, firms that are more liquid are less likely to have the problem of underinvestment, because they would possess the financial slack for financing potential investments; a situation that leads to a lower probability of giving a decision to use derivatives.

To measure the effects of independent variables on the extent of derivative usage, Tobit analysis is employed; where the dependent variable is represented by total notional amount of derivative contracts divided by the firm size. The results indicate the significance of leverage; if a firm has more debt in its capital structure, it uses derivatives more extensively. Furthermore, firms with high dividend payout policy tend to use derivatives more extensively due to low liquidity and hence underinvestment problems. The paper also makes use of some robustness checks, but almost none of these attempts lead to significant changes in the results.

In their subsequent paper; Nguyen and Faff (2003) analyzes their findings from 2002 study in two separate parts; foreign currency derivatives and interest rate derivatives. Employing the same sample in their previous study, they determine the factors that affect both the decision to use derivatives and the extent of use of those instruments.

The logistic regression results indicate that interest rate derivative usage is mainly affected by size, leverage, dividend yield and liquidity. As for foreign

exchange derivatives, the regression output yields that size and leverage are the two main factors affecting the adoption of foreign exchange derivatives as well.

Tobit regression for interest rate derivatives results imply that, leverage and dividend yield are two main factors affecting the intensity of the use of the instruments. Tobit regression results regarding the extent of the use of foreign exchange derivatives point out that leverage, size and dividend yield are significant factors; where size and dividend yield have negative signs. These negative signs is attributed to the fact that smaller firms are affected heavily from a financial disaster; therefore aim to hedge more extensively to overcome that potential distress; by the same token, firms having less dividend yield are those with more volatile cash flows and need to hedge more extensively.

Mian (1996) provides evidence on determinants of hedging using a sample of 3022 U.S. non-financial firms. The information related to hedging policies of these firms is obtained from 1992 annual financial statements on the LEXIS/NEXIS database and related financial data is obtained from Compustat database. Out of 3022 firms, 543 firms explicitly disclosed their hedging activities, 228 firms disclose their use of derivatives but not hedging, and the remaining 2251 firms are classified as non-hedgers. Mian hypothesizes that hedgers should have higher market-to-book ratios and less likely to be in regulated utilities, since those firms are likely to have more discretion in their choice of investment decisions. Besides, hedgers should be more likely to have tax related progressivity, foreign tax credits, tax loss carry forwards due to the tax incentives provided by hedging; and the relation between

hedging and firm size should be indeterminate, due to the costs of financial distress for small firms and economies of scale for larger-size firms.

However, univariate tests imply that the results regarding market-to-book ratio, tax loss carry forwards and progressivity is contrary to the predictions. As expected firm size of hedgers is significantly higher than that of non-hedgers. Besides, hedger firms are those with more foreign tax credits and those in less regulated industries.

Results of logistic regressions also reveal that, the probability of hedging is negatively related to the market-to-book ratio, positively related to foreign tax credits and firm value, and regulated firms are less likely to hedge.

The paper conducts additional tests to see whether the evidence presented is robust across a different definition of hedging. 228 firms, which state just their use of derivatives but not hedging, are excluded from the sample and only 543 firms, which disclosed their hedging activities, are reported as hedgers. The results are not qualitatively different from the previous tests that use a full sample of 3022 firms.

Geczy, Minton and Schrand investigate the determinants of solely the use of currency derivatives in their 1997 paper. Their sample represents 372 of the Fortune 500 non-financial firms in 1990; which have exposure to foreign currency risk through foreign operations, foreign denominated debt or a high concentration of foreign competitors. The financial information related to these corporations is obtained from their annual reports and Compustat database. The paper distinguishes itself from the previous literature by analyzing the incentives for hedging among the

perspectives of managers, bondholders and equityholders separately, using different set of variables for each.

Univariate tests indicate that derivative users have greater ratios of R&D/sales, smaller market to book ratios and quick ratios; implying greater investment growth opportunities and low short term liquidity. Users also have larger size, larger managerial option holding and greater exposure to foreign currency risk.

The paper also conducts logistic regressions; using different combinations of variables and presents marginal changes in the probability of using derivatives that result from a unit change in the independent variables. Test outcomes imply that financing constraints, underinvestment costs, exposure to foreign exchange risk, and economies of scale provide incentives for using currency derivatives. On the other hand, R&D expenses and short-term liquidity are not significant for firms with foreign operations and foreign denominated debt; which implies that foreign denominated debt acts as a natural hedging for firms with foreign operations.

Geczy et al. also investigate firms' choices among types of derivatives. For this purpose, they perform univariate tests and multinomial logit tests classifying firms as those using currency swaps and swap combinations and those using currency forwards and forward combinations. Univariate tests indicate that firms in swap group have significantly higher levels of long term foreign denominated debt while firms in forward group have higher foreign exchange rate exposure from import competition, than firms that do not use any type of currency derivatives. Multinomial logit estimates reveal that firms with higher levels of operating and competitive

exposure to foreign exchange risk are likely to choose both classes of currency derivatives; but more likely to use forwards rather than swaps; while firms with larger size tend to use swaps relative to forwards; where firm size is a significant and negative determinant of both choices of currency derivatives. Managerial wealth is a negative and significant determinant of swaps use but not forwards; while managerial option holding, R&D expenditures to sales and analyst following are positive and significant only for forward use. Finally firms with lower quick ratio are more likely to use both types of derivative instruments.

Despite the excess amount of research investigating the determinants of derivatives use; studies that analyze the consequences of using derivatives are few. One such study belongs to Allayannis and Weston (2001). Since most of the papers studying the incentives of hedging argue that increasing value is one of the main objectives behind employing a derivatives strategy; Allayannis and Weston try to investigate whether derivatives use really has an effect on firm value. For this purpose, they construct a sample of 720 non-financial firms that are in the Compustat database, have total assets of more than \$500 million in each year between 1990 and 1995 and have non-missing data on size and market value. The paper uses Tobin's Q as a proxy for firm value and the analysis is done separately for firms that are identified as having foreign sales and firms without foreign currency exposure, and also separately for years in which the dollar appreciated and depreciated. Univariate analysis reveal that the mean and median hedging premium between user firms and non-user firms is statistically significant both for firms with and without foreign sales and both for the period in which dollar depreciated and appreciated; a result consistent with the hypothesis that users should have higher value than non-users.

They also conduct multivariate analysis, using size, access to financial markets, leverage, profitability, investment growth, industrial diversification, geographic diversification, industry effect, time effect and credit quality as explanatory variables. OLS regression results for firms with foreign sales indicate that derivative users are rewarded with higher valuation. When industry adjusted Q's are used as dependent variable, there still exists a positive and significant relationship between derivative usage and value. Besides, when the same regressions are run for firms with no foreign operations, the magnitude of the hedging premium is smaller and insignificant.

Moreover, sensitivity analysis is used to check the robustness of the results by alternative measures of firm value and alternative estimation techniques that control for outlier effects. It is observed that there is no material change in the previous OLS results both for firms with and without foreign sales. The paper tries to investigate the presence of reverse causality as well; that is, do derivatives increase firm value, or do firms with higher value have an incentive for hedging? According to the tests conducted for this purpose, there is no evidence that the correlation between hedging and derivatives use stems from reverse causality.

The study of Allayannis and Weston helps to shed light on one aspect of the effect of derivatives on firm; value. However, the consequence of derivatives use on firm-level risk is also an important research question and there are few studies on this question. Hentschel and Kothari (2001) is one of those studies that aim to investigate the effect of derivative usage on firm-level risk. Due to the public concern that firms

use derivatives to increase their risk exposures; i.e. to speculate; the purpose of the paper is to investigate the possibility of speculation among corporations. The sample constructed is large corporations from the April 25, 1988 issue of Fortune Magazine, which can be grouped into 325 non-financial and 100 financial firms. The annual reports of the corporations are searched to identify whether the firm uses derivatives for the years 1992 and 1993 and additional financial data is obtained from the equity files of Compustat and CRSP. The final sample comprises of 929 firm-years. Of these firm-years, 586 use derivatives and 343 not.

The risk measures used are standard deviation of daily returns σ , standard deviation of daily returns normalized by the standard deviation of CRSP value weighted index σ/σ_m , leverage, and β , which is obtained by regressing daily returns on the CRSP value weighted index return. Univariate tests imply that the standard deviation and normalized standard deviation of non-financial firms with derivatives are slightly higher than those of non-financial firms without derivatives. For financial firms, firms with derivatives have smaller values of standard deviation and normalized standard deviation; but again the difference is statistically insignificant. In terms of beta and leverage; both financial and non-financial firms with derivatives have significantly higher leverage and beta than those without derivatives. This outcome implies that firms with derivatives have higher market risk but lower idiosyncratic risk, since total standard deviation is not different for firms with and without derivatives. Nevertheless the paper does not test the effect of derivative usage on idiosyncratic risk of firms. A proxy for idiosyncratic risk is included in this study as an additional risk measure, however.

In the multivariate analysis, standard deviation of daily equity returns is regressed on derivative holdings normalized by the market value of assets, market value of equity, leverage and book-to-market ratio. The first regression is done for non-financial firms. When only derivative holding is included in the model, it is observed that the R^2 of the model is too low, and when other explanatory variables are added into the regression, the value of R^2 extremely rises. Furthermore, if derivative variable is excluded from the regression, there is a very slight decrease in R^2 , implying that derivative usage does not add much value to the explanatory power of the model. Moreover, the sign of the coefficient of derivative holdings is positive in these regressions and the coefficient is too low; that is, a non-financial firm that raises its derivative holdings by 1% of total assets, should experience only a 0,04% increase in its volatility. As expected, the increase in market value and book-to-market leads to a decrease in risk level while an increase in leverage increases risk as well. The regressions run for financial firms also indicate that there is little association between firms' derivative holdings and volatility. This time the sign of derivative holdings is negative but again small and insignificant. Using σ/σ_m or β as risk measure; or running regressions using a sample composed of only firms with derivatives, does not change the main findings.

The paper also conducts analyses to control for the industry effects by deflating all variables in the model by their respective industry average values, to control for autocorrelations in the regression variables by using firm-specific average values and to control for serially correlated residuals by constructing Cochrane-Orcutt transformed variables. None of these attempts create a significant change in the results of the main regressions; the core finding is that derivative holding has weak

association with the firms' volatility. To further control for industry effects, regressions are run separately for each industry. Most of these test results are similar to the results of pooled regressions. For non-financial firms, the coefficient of derivatives is negative in 5 of the 13 industry and the coefficient is significant only in gas and electric utilities industry.

To check to robustness of the test, derivative holdings/market value of assets variable is replaced with a binary variable that takes the value of 1 if a firm uses derivatives and zero otherwise. The results of the regressions suggest that derivatives use lead to an increase in return variance of non-financial firms by 0,19% and a decrease in return variance of financial firms by 0,02%. Again, the significance of these models is low and similar to the previous analyses.

The paper considers the endogeneity problem as well; that is, it may not be that high derivative holdings lead to high firm-level risk, but it may be that riskier firms are more prone to hold high amount of derivatives. For this purpose, the paper makes use of the method of two-stage least squares by using instruments for all the variables in the model. The instruments are portfolio rankings where the three portfolios are constructed according to the intensity of the variables; for instance portfolio 0 consists of non-derivative users and portfolio 2 represents firms with upper-median level of derivatives as a fraction of market value. This attempt to correct for endogeneity in the model does not alter the previous results.

The article analyzes the relation between derivative holdings and interest rate and exchange rate exposure as well. The exposures are estimated by regressing the

portfolios' returns on the return on a trade-weighted dollar exchange rate index and six-month LIBOR returns. Both for financial and non-financial firms, it is observed that there is no systematic association between firms' level of derivative holdings and currency and interest rate risks. The results are again inconsistent with the hypothesis of speculation. Thus, the main finding of the paper is that derivatives neither cause a significant increase nor leads to a significant decrease in the risk level of the firms.

The effect of derivatives on risk is examined by Guay (1999) as well. His hypothesis is that firms use derivative securities primarily for hedging purposes; therefore he expects a decrease in risk after initiating a derivatives program. His sample used is divided into three groups as users, non-users and new users of derivatives. A new user is defined to be a firm that did not report derivatives activity in year $t-1$, but reported their derivatives use in year t . A non-user firm is that did not use derivatives both in year t and year $t-1$; whereas a user firm is that reported derivatives activity both in year t and year $t-1$. To detect these firms, annual financial statements of all non-financial firms in the Compact Disclosure database from June 1990 to December 1994 are searched and additional financial data is obtained from Compustat and CRSP databases. The final sample is comprised of 254 new users, 3124 non-users and 1597 user observations.

The risk measures used for the analysis are total risk, market risk, firm-specific risk, exchange-rate exposure and interest-rate exposure. The univariate tests indicate that the mean and median changes in total risk, firm-specific risk and interest-rate exposure, from year $t-1$ to t are significantly negative, when firms start using

derivatives. The same analysis is also conducted by using control-sample adjusted changes. The results are similar to the previous ones. These findings are robust across years and when percentage changes in risk is used instead of level changes.

Guay examines relations between new users' risk exposures and the type of derivative positions. He partitions the sample as those consistent with hedging and inconsistent with hedging. A firm is defined as 'consistent with hedging' if its exposure to exchange rate or interest rate risk is short (long) and its derivative position is long (short). 59% of the new user firms are detected to be consistent with hedging. When the median change in new users' risk relative to a control sample is compared between 'consistent with hedging' and 'inconsistent with hedging' firms; it is observed that consistent with hedging firms experience a reduction in their risk levels, while the risk of 'inconsistent with hedging' firms is higher relative to the control sample.

He also explores how the changes in stock return volatility of new users vary as a function of their incentives to hedge and the magnitude of derivative usage. For this purpose, the change in total risk is regressed on notional principal of derivatives. The hypothesis of Guay is that firms using derivatives for hedging, experience greater reductions in their risk as the size of their derivatives holdings increases. The incentives for hedging are described as financial distress costs, proxied by leverage, interest burden and ROA; underinvestment problem; proxied by book-to-market value and regulation dummy; costly external financing; proxied by operating-income volatility; and firm size; proxied by the market value of assets. Each of these proxy variables is classified into 5 quintiles, where the smallest variable values receive 1

and largest values receive 5. By multiplying these quintile values with notional principals of derivatives; interaction variables are formed, which are going to be used in the regressions. The regression results imply that the relation between changes in total risk and the interaction variables support the predictions. When notional principal is the only independent variable in the regression, its coefficient is negative as expected; but insignificant. When the interaction variables are added to the model, it is observed that there is a negative relation between changes in total risk and notional principal as the proportion of growth options and the lagged leverage interactive variable; consistent with the underinvestment and financial distress hypotheses respectively; whereas interest burden and ROA, as other proxies of financial distress are insignificant. When only one proxy of financial distress is included in the model; all of them turned out to be significant in their own models. Finally, to strengthen his findings, Guay tests whether the decision to begin using derivatives is a function of firms' incentives to hedge; which are described above. This should be true; if, as hypothesized, derivatives are used to hedge firm-level risk. The results of logit analysis support the expectations; decision to use derivatives turned out to be influenced by each of the incentives to hedge: firm size, financial distress costs, underinvestment problem and costly external financing.

As can be seen from the brief review of literature on corporate derivative use, number of studies examining the role of derivative usage on firm level risk is limited. This thesis aims to analyze the effect of derivative usage on firm level risk, through four different risk measures and with a sample composed of firms from different industries, exchanges and size levels.

CHAPTER 3

DATA AND METHODOLOGY

3.1 Empirical Data

The sample used in this study is U.S. non-financial firms that participate in the Annual Reports Service¹ and constitute the firm list reported on the website of NASDAQ. The sample represents the whole U.S. non-financial firms, since it covers all the industries with differing financial characteristics. Therefore this study differs from the majority of the studies in the literature, which makes use of larger-size firms; since those firms are presumed to be intense derivative users². To capture the entire market of non-financial firms, this study especially takes into account the small-size firms which are excluded from many previous studies.

The sample consists of 2004 data that belongs to 364 non-financial firms. Financial firms are excluded, since their motivation to hold derivative portfolios can

¹ Annual Reports Service is a service provided by PrecisionIR Group.

² For example, Hentschel and Kothari (2001) examines the effect of derivatives on the risk of Fortune 500 firms.

be different from that of non-financial firms. To illustrate, Office of the Comptroller of the Currency (2003) reports that, in the third quarter of 2003, banks with the largest 25 derivative portfolios held 96,6% of those instruments for trading purposes while just 3,4% held them for hedging purposes.

Financial data about these companies are obtained from Datastream database. Firms with missing data are excluded from the sample. Hence, the final sample is comprised of 211 companies from 20 different sectors.

The exchanges that the sample firms are traded are also identified. The related data could be collected for 205 firms. The distribution of these firms in terms of the exchange they are traded in is as follows:

TABLE 3.1

Breakdown of Sample Firms among Stock Exchanges

Exchange	Number of Firms
NASDAQ	97
NYSE	70
AMEX	32
OTHER	12

Note. This table presents the breakdown of sample firms among stock exchanges where they are traded. Note that the total number of firms shown on the table (211) exceeds the number of firms with data about the exchange that they are traded (205). This stems from the fact that there exist firms that are traded in more than one exchange.

3.1.1 Derivative Usage

The information about derivative usage of companies is obtained primarily from their 10-K reports and sometimes from the discussions in their annual reports.

This study investigates the effect of derivative usage in fiscal year 2004 on firm's risk level in the same year; therefore annual and 10-K reports of the companies for the year ending in December, 2004 are collected; to identify whether they have employed derivatives in 2004 or not. Since disclosure of derivative activities is mandatory according to the Financial Accounting Standard Board's SFAS No.105³, after June 15, 1990; the information about derivative usage can be obtained from the annual reports of the companies; particularly from Item 7A of firm's 10-K reports, 'Quantitative and Qualitative Disclosures about Market Risk' section. For confirmation purposes and in cases when 10-K reports of the firms are not available or informative, the reports are also searched manually, through the search of the words "derivative", "hedge", "hedging", "risk" "forward", "futures", "swap" or "option" in the reports. A firm is identified to be a "user" if it clearly discusses its use of derivatives in its 2004 reports. In contrast, a firm is defined to be a "non-user", if either it does not explicitly state that it has used derivatives in 2004, or there observed no information regarding the above words, that are used to investigate derivative activity.

Of 211 sample firms, 104 (49%) firms are found to have used derivatives in fiscal year 2004, while the remaining 107 (51%) are identified as "non-user" for the related period.

These 104 user firms may have used any type of instrument and may have hedged any type of risk. However these firms differ in their use of derivatives; in

³ Amended later by SFAS 133, Accounting for Derivative Instruments and Hedging Activities; that became effective after June 15, 1999.

terms of the instrument they use and the type of risk they hedge as well. Table 3.2, Panel A presents the distribution of firms according to the risk type they hedge.

TABLE 3.2

Derivative Usage across Risk Types and Instruments Used

Panel A: Derivative Usage Across Risk Types			
Risk Type	Number of Firms Using Derivatives		
Interest Rates	58		
Exchange Rates	44		
Commodity Prices	27		
Panel B: Types of Instruments Used to Hedge Risks			
Number Of Firms Using to Hedge:			
Instrument	Interest Rate Risk	Exchange Rate Risk	Commodity Price Risk
Forwards	1	38	14
Swaps	55	6	15
Options	5	14	14
Futures	0	0	10

Note. This table provides information about the derivative usage among sample firms. Panel A presents the distribution of user firms across risk types that are hedged. As the table suggests, the sum of the number of firms using derivatives, which is 129; exceeds the number of derivative user firms in total; which is 104. This discrepancy stems from the fact that a firm may have hedged more than one risk using derivatives. Panel B presents the breakdown of user firms across different derivative instruments to hedge each risk type. Again, the sum of the number of firms in each risk class may exceed the number of firms hedging that exposure; since one firm may be using more than one instrument to manage an exposure.

Panel A of Table 3.2 indicates that the sample firms primarily use derivatives to manage interest rate risk and foreign exchange risk, in order. Among all users, the percentage figures are 56%, 42% and 26% for interest rate, exchange rate and commodity hedging respectively.

Panel B presents the distribution of the firms in terms of the derivative instruments they use to manage their different types of exposures. As the results suggest, swap is by far the most common type derivative instrument to hedge interest

rate risk, with 95% of users of interest rate derivatives; while options (9%) come the second. The most preferred technique for managing exposure to exchange rate risk is forwards, used by 86% of users of exchange rate derivatives, followed by options (32%) and swaps (14%). Finally, as for commodity price risk, the table indicates that none of the instruments significantly dominate the others.

Moreover, the Table 3.3 provides information about derivative usage among various business sectors.

TABLE 3.3
Derivative Usage by Sector

Business Sector	Total Number of Firms	Number of Derivative Users
Aerospace & Defense	5	3
Agriculture, Paper & Packaging	4	3
Automotive	1	1
Biotechnology	22	3
Business & Support Services	7	2
Chemicals	6	3
Building & Construction	11	6
Computer, Technology & Internet	30	13
Food Manufacturing and Products	7	4
Publishing & Media	6	4
Leisure & Entertainment	8	3
Transportation	9	6
Healthcare & Pharmaceuticals	17	5
Consumer & Retail Products	10	5
Electronics & Engineering	7	3
Industry & Manufacturing	14	12
Metals & Mining	2	1
Telecommunications	11	3
Utilities	10	7
Oil, Gas & Energy	24	17
Total	211	104

Note. This table presents the number of firms that use derivatives in each sector among the total number of sample firms in that sector.

Finally, as it is indicated by Table 3.4; the percentage of users is considerably higher than that of non-users for larger size groups. The case is reversed as the size decreases.

TABLE 3.4
Derivative Usage by Firm Size

Size Groups (in millions)	Number of Firms	Users	Non-Users
> \$ 5.000	27	26	1
\$ 1.000 - \$ 5.000	38	25	13
\$ 500 - \$ 1.000	36	25	11
\$ 250 - \$ 500	23	5	18
\$ 100 - \$ 250	39	12	27
< \$ 100	48	11	37
Total	211	104	107

Note. This table presents the number of user firms in each size group among the total number of sample firms in the respective size group. The size of a firm is the average of daily market value data obtained from Datastream database for the year 2004.

As Table 3.4 suggests, the sample is comprised of firms, which belong to various size levels; particularly small-sized firms. Hence, different from previous literature, which usually takes into account larger-size firms, this study employs firms from every size level, and mainly firms with smaller size.

3.1.2 Control Variables

3.1.2.1 Variables Used

To identify whether derivative usage has an effect on firm-level risk; the impact of other variables that may have an influence on the risk of the firm should also be

considered. Those variables that are chosen on the basis of existing literature on derivative usage and firm-level risk, are as follows:

a) *Size*: Datastream's "Market Value" data; which is defined as the share price multiplied by the number of ordinary shares in issue; is used to proxy firm size. The data is collected on a daily basis and the average of that data for the year 2004 is used in the model, so as to fully capture its effect on risk throughout the year. It is presumed that small firms tend to be more risky; and Ben-Zion and Shalit (1975) list four arguments supportive of this assumption. First one is marketability; which asserts that assets of larger-size firms are more liquid, which makes them less risky. Second is the probability of bankruptcy. This argument suggests that, there is a general tendency that failing firms disappear in their early years. But large firms reach to their existing sizes in a considerable period of time; therefore size can be regarded as a measure of performance and large size may be deemed as an indicator of a lower risk. Third argument, diversification, states that since large firms are more likely to diversify their operations more efficiently, they are expected to diversify their risks as well. Final argument is economies of scale; which suggests that if a firm earns technical and/or managerial scale economies –which are associated with larger-size firms-, this leads to lower unit costs, higher profits and consequently lower probability of bankruptcy; thus risk. To sum up; it is expected that size has a negative impact on firm-level risk.

b) *Book-to-Market Value*: Book-to-market value is a proxy for investment opportunities existing for a firm. Market value reflects market participants' valuation of the firm, while book value represents the level of net assets in place. Thus, book-

to-market value can be used as a measure of firm's investment opportunities. A low book-to-market ratio implies that investors value this firm more than what its accounting reports indicate. Thus, there exist many investment projects to benefit from; however these projects may be bearing potential risks behind and investing in these projects may lead to higher firm-level risk. Moreover, as Nguyen and Fuff (2002) argues, the more a firm has growth opportunities, the lower the probability that all of these projects will be undertaken. This situation may lead to the use of external financing, which increases the risk of default. This hypothesis is also pointed out by Hurdle (1974), which asserts that fast-growing firms are more likely to use debt. Therefore it is expected that low book-to-market value is associated with higher risk. Book-to-market value is calculated by taking the reciprocal of market-to-book value reported on Datastream; which is defined as the ratio of market value of equity divided by net book value. This data is also collected on a daily basis and average value is calculated for 2004 to capture the whole year.

3.1.2.2 Financial Characteristics of Sample Firms

In this section, descriptive statistics for the financial characteristics of the sample firms in terms of control variables are provided, by grouping the firms as users and non-users of derivatives.

Table 3.5 presents the summary statistics separately for all firms, for firms with derivatives and for firms without derivatives. The first row of each variable indicates the mean of the variable for that particular group of firms, the second row indicates

the respective median value and the third row shows the standard deviation of the variable for the corresponding firm group.

TABLE 3.5
Summary Statistics for Firm Characteristics

	All Firms	Users	Non-Users	Statistics for Equality
Number of Firms	211	104	107	
ln (Market Value)				
Mean	20,38353	21,27849	19,2281	9,808395***
Median	20,29564	21,10277	19,27797	79,90026***
Standard Deviation	2,080018	2,041639	1,475358	
ln (Book-to-Market Value)				
Mean	-0,94044	-0,82689	-1,08704	3,227212***
Median	-0,85399	-0,68047	-0,9864	8,732910***
Standard Deviation	0,711205	0,628709	0,783671	

Note. This table reports summary statistics for the control variables used in the study. The statistics are presented for all firms, user firms and non-user firms separately. Comparison tests are conducted though equality of means and equality of median tests served by Eviews. For mean comparisons, the final columns indicate t-statistics and for median comparisons, the final columns indicate Kruskal-Wallis test statistics. Market value of a firm is the Datastream's "Market Value" data; which is defined as the share price multiplied by the number of ordinary shares in issue. Book-to-market value of a firm is the reciprocal of market-to-book value reported on Datastream; which is defined as the ratio of market value of equity divided by net book value. Averages of 2004 daily data for market value and book-to-market value data for each firm are used to capture the whole year. Natural logarithms of these data are computed for normalization. *, ** and *** denote significance at 10%, 5% and 1% level respectively.

A comparison of market values for firms with and without derivatives indicates that firms that use derivatives are significantly larger than their non-user counterparts, both in terms of mean and median market values. The expertise needed and ability to overcome fixed costs of initiating a derivatives program that large-scale firms possess, is the possible reason leading to this outcome, which is also pointed out by Guay (1999).

Based on book-to-market values, tests of equality for mean and median values reveal that users firms have higher ratios than non-user firms at 0,01 significance level.

3.1.3 Risk Measures

This study makes use of four different risk measures to identify the effect of derivatives on firm-level risk. These measures are total risk, beta, idiosyncratic risk and RiskGrade.

a) Standard Deviation: This risk measure is obtained by calculating the standard deviation of daily returns of stocks for 2004. Daily returns are computed as,

$$R_t = (P_t - P_{t-1})/P_{t-1}$$

where P_t is day t-1's closing price and P_{t-1} is day t-2's closing price. Price data is obtained from Datastream database, which is represented as "Price - Default, Adjusted".⁴

b) Beta: Beta, which can also be identified as systematic risk, is defined by Miller and Bromiley (1990) as a risk measure that reflects the sensitivity of the stock's return to market movements in general. This measure is obtained from a regression of excess return of the stock on excess return of the market.

⁴ Price-Default, Adjusted data is defined on Datastream database as "previous day's closing price from the default exchange, except where more recent or real-time prices are available. These stored prices are adjusted for subsequent capital actions."

The well-known Capital Asset Pricing Model (CAPM) asserts that a stock's return can be obtained by adding the risk-free return to the multiplication of excess return of the market over risk-free return with beta; represented as follows:

$$r_i = r_f + \beta_i \cdot (r_m - r_f)$$

Therefore the following regression is run and the estimated coefficient is used as the risk measure β .

$$r_i - r_f = \alpha_i + \beta_i \cdot (r_m - r_f) + \varepsilon_i$$

where r_i is stock i 's return calculated as described above; r_m is the monthly return on the CRSP value-weighted index and r_f is the monthly risk-free rate, that is proxied by 1-month T-bill return; which are obtained from the Data Library section of the website of Kenneth R. French.

For this calculation, a time period of 5 years and monthly returns are used, as suggested in Fama and French (1992). This time period starts from January 2000 and ends at December 2004. Similar to the calculation of daily stock returns to compute total risk; monthly returns are computed as;

$$R_t = (P_t - P_{t-1}) / P_{t-1}$$

where P_t is the price data reported for the last trading day of month t , and P_{t-1} is the price data reported for the last trading day of month $t-1$. Monthly price data is obtained from Datastream as well. For firms where monthly price data is not available for the last 60 months, the maximum number of months that exists on the database within the last five years⁵ is used for the regression analysis to compute their beta.

⁵ Provided that we have at least 24 months of data; as suggested by Fama and French (1992).

c) Idiosyncratic Risk: As stated by Miller and Bromiley (1990), this risk measure represents the component of the risk that is specific to the firm or industry and is not shared by the market in general. Idiosyncratic risk can also be named as unsystematic risk, in other words, the extent to which a stock's return cannot be explained by general market movements. As previous literature suggests, error terms of the beta regressions are used to obtain idiosyncratic risk. After running the above mentioned regression of daily returns on the CRSP equal-weighted index for a stock, the residual series particular to that regression is stored. This operation is repeated for all the firms and in the end; a set of residual series specific to a total of 211 firms is obtained. These residuals are supposed to represent the part of firm's risk that cannot be explained by the market risk. Hence, the standard deviation of these residuals is used as a proxy for idiosyncratic risk.

d) RiskGrade: RiskGrade is a measure of volatility devised by Riskmetrics group to measure the risk of a particular asset. In Kim and Mina (2001), the logic behind RiskGrade and its calculation is well-explained. It is a risk indicator based on the volatility of returns; hence, similar to standard deviation, takes into account both the systematic and unique risk. However it differs from standard deviation in the sense that RiskGrade estimates are based on exponential weighting, which gives more importance on recent data. This feature of RiskGrades enables that the measured risk is more adaptive to current market conditions. When an extreme event occurs, RiskGrade quickly incorporates the effect of this shock into the measured risk by giving more weight and exponentially reduces the effect of this event as time passes. Nevertheless, an equally weighted risk measure delays the incorporation of the influence of a recent extreme event into the estimate and when taken into

account, the influence of such events remains in the volatility estimate for a long time.

RiskGrade data for the sample firms is obtained from the website of Riskgrades, “Asset Selection” section. After the symbol of the firm is entered, and the time period is chosen as 01.01.2004-31.12.2004; the average RiskGrade of the firm throughout 2004 can be obtained. RiskGrades could be collected for a total of 195 firms due to missing data for some firms.

3.2 Methodology

To analyze the relationship between derivative usage and firm-level risk, first univariate tests are conducted without taking into account other control variables. Then, in the main analysis, linear regression models are constructed and four equations are estimated, by making use of four different risk measures as dependent variable. Statistical analyses are carried out using Eviews.

The models employed in the study are as follows:

$$\text{Model 1: } \ln(\text{STDEV})_i = \beta_{10} + \beta_{11} * \text{DERIV}_i + \beta_{12} * \ln(\text{MV})_i + \beta_{13} * \ln(\text{BTM})_i$$

$$\text{Model 2: } \text{BETA}_i = \beta_{20} + \beta_{21} * \text{DERIV}_i + \beta_{22} * \ln(\text{MV})_i + \beta_{23} * \ln(\text{BTM})_i$$

$$\text{Model 3: } \ln(\text{IDIO})_i = \beta_{30} + \beta_{31} * \text{DERIV}_i + \beta_{32} * \ln(\text{MV})_i + \beta_{33} * \ln(\text{BTM})_i$$

$$\text{Model 4: } \ln(\text{RISKGR})_i = \beta_{40} + \beta_{41} * \text{DERIV}_i + \beta_{42} * \ln(\text{MV})_i + \beta_{43} * \ln(\text{BTM})_i$$

β_{ij} (where $i = 1,2,3,4$ and $j = 1,2,3$ denote the model and independent variable respectively) is used to refer to the coefficients of independent variables and β_{i0} to denote the constant term in the models. All of the models share the same set of independent variables, where DERIV stands for the derivative usage, MV is the market value and BTM is the book-to-market value. The dependent variables in each model is a different risk measure where STDEV; standard deviation of daily returns represents total risk, BETA is the systematic risk, IDIO is the idiosyncratic risk and RISKGR is the risk level assigned by Riskmetrics. The calculations of all these variables are explained in detail in the previous section.

These models are inspired by the study of Fama and French (1992), where they document that the combination of size and book-to-market equity can capture the variation in average stock returns, absorbing the effect of other financial characteristics under consideration, leverage and E/P ratio. Moreover, the two variables size and book-to-market equity are also employed in the studies of Guay (1999) and Hentschel and Kothari (2001), in an attempt to explore the effect of derivatives use on firm-level risk.

CHAPTER 4

ANALYSIS

The aim of this study is to analyze the effect of derivatives use on firm-level risk; making use of different risk measures. For this purpose, two methods are employed: univariate analysis and multivariate analysis.

The first part of this section presents the results of univariate analyses. In the next section the results of regression analyses are discussed.

4.1 Univariate Analysis

In this section, the main hypothesis that firms that use derivatives bear lower risk is tested, by comparing the values of four different risk measures, for users and non-users of derivatives. For this purpose, mean difference tests are employed and it is tested whether the difference in mean values of risk measures for users and non-users is different from zero. As Allayannis and Weston (2001) did to analyze the

effect of derivative usage on firm value, it would be reasonable to compare median values as well; since distributions of all dependent variables are skewed.

Table 4.1 presents the mean and median standard deviations for each risk measure, separately for all firms, user firms and non-user firms. (Column 2, 3 and 4). Column 5 shows the difference in mean and median values for firms with and without derivatives respectively. Corresponding test statistics for equality (t-statistics) are presented in column 6.

As Table 4.1 suggests, in logarithmic terms, the mean value of total risk for users is -3,9278, while the mean total risk of non-users is -3,4448; resulting in a hedging discount of 0,4830. As indicated in column 6, this discount is statistically significant at 1% level. The same result is obtained, when the median values of total risk for user and non-user firms are compared. The hedging discount in median terms is 0,5626; and it is also significant at 1% level. These results are consistent with our expectation that firms with derivatives should be less risky than firms without derivatives.

As for beta coefficients, the mean value is 0,9548 for users of derivatives and 1,3496 for non-users. The difference is 0,3948; which is statistically significant at 1% significance level. The case is the same for median beta coefficients; while firms with derivatives have a median beta value of 0,7356; those without derivatives have a median beta value of 1,2599. The difference is again significant at 1% level.

TABLE 4.1**Summary of Univariate Analyses**

	All Firms (1)	Users (2)	Non-Users (3)	Difference (3) - (2)	Statistics for Equality
ln (Standard Deviation)					
Mean	-3,6829	-3,9278	-3,4448	0,4830	7,7338***
Median	-3,6957	-3,9629	-3,4003	0,5626	51,8917***
Beta					
Mean	1,1550	0,9548	1,3496	0,3948	2,9816***
Median	0,9965	0,7356	1,2599	0,5243	11,2322***
ln (Idiosyncratic Risk)					
Mean	-1,9311	-2,1465	-1,7217	0,4248	6,3678***
Median	-1,8880	-2,1528	-1,6737	0,4791	37,9378***
ln (RiskGrade)					
Mean	5,2452	5,0069	5,4960	0,4891	8,0772***
Median	5,2730	4,9938	5,5373	0,5435	51,8181***

Note. This table reports mean and median statistics for the risk measures used in the study and reports the results of univariate analyses employed for these statistics for each risk measure. Univariate tests are conducted though equality of means and equality of median tests served by Eviews. For mean comparisons, the final column indicate t-statistics and for median comparisons, the final columns indicate Kruskal-Wallis test statistics. Standard deviation is the standard deviation of daily returns of stocks for 2004. Daily returns are calculated as, $R_t = (P_t - P_{t-1})/P_{t-1}$, where P_t is day t-1's closing price and P_{t-1} is day t-2's closing price. Beta is the coefficient obtained from a regression of excess return of the stock on excess return of the market. Idiosyncratic risk is the standard deviation of residuals that are obtained from beta regressions. RiskGrade is the risk measure devised and reported by Riskmetrics group. Natural logarithms of standard deviation, idiosyncratic risk and RiskGrade data are computed for normalization. The sample used in the analysis of standard deviation, beta and idiosyncratic risk covers all 211 firms and 104 of these firms are users of derivatives. Due to missing data, RiskGrade analysis is conducted using 195 firms. Of these, 100 firms are users. *, ** and *** denote significance at 10%, 5% and 1% level respectively.

In terms of idiosyncratic risk; users of derivatives have a mean value of -2,1465 whereas non-users have a mean risk of -1,7217; leading to an excess risk of 0,4248; in logarithmic terms. This difference is significant at 1% significance level. Similarly; the median value of idiosyncratic risk for non-users is significantly different from that of the users at 1% significance level.

As with previous three risk measures, firms with derivatives have a lower mean RiskGrade compared to firms that do not use derivatives. In logarithmic terms, the difference between the mean grades is 0,4891; a difference that is significant at 1% significance level. As for median values; the difference is 0,5435 which is also significant at 1% significance level.

Hence; the results of univariate analyses, overall, suggest that for each risk measure users have lower risk values, both in terms of mean and median values. This is consistent with our hypothesis that use of derivatives should lead to a reduction in firm-level risk.

4.2 Regression Analysis

In the previous subsection, the hypothesis that firms with derivatives should have lower risk than those without derivatives is tested in a univariate setting. However, to document a relationship between the use of derivatives and firm-level risk; it is necessary to control for variables that can have an impact on firm-level risk. This analysis is performed in a multivariate setting, in this subsection.

To control for the effect of variables that may affect the variation in stock returns and to be in line with literature; the model is formed of three independent variables; one is the main variable derivative usage and the others are control variables; size and book-to-market equity.

The dependent variables include standard deviation, measured as standard deviation of daily stock returns, beta, the coefficient from a regression of excess stock return on excess market return, idiosyncratic risk, measured as the standard deviation of error terms obtained from beta regressions and RiskGrade, a risk measure provided by Riskmetrics group, using exponential weighting method.

4.2.1 Statistical Characteristics of Variables

Normality of variables is crucial for attaining results that enable constructing statistics for testing hypothesis, from regressions run with those variables, as pointed out by Greene (2003: 50). Hence, prior to conducting the tests, it is checked whether the variables meet the criteria of normality.

The quantile-quantile graphics, histograms and descriptive statistics for the variables used in this study are presented in Figure B.1, Figure B.2, Figure B.3 and Figure B.4 of Appendix B. Both the quantile-quantile graphs and histograms of variables under consideration reveal that the variables are not normally distributed. In particular, the quantile-quantile graph and the shape of the histogram for market value variable indicate that its distribution is far from a normal distribution. Besides, the kurtosis value of each variable greatly exceeds 3, which is the kurtosis of normal distribution. This situation indicates that the frequencies are close to leptokurtic, suggesting a peaked distribution relative to normal. In addition to this, the skewness measure of each variable is above 0, which is the skewness value signaling normal distribution. Finally, for each variable, the Jarque-Bera statistic, which measures the

difference of the skewness and kurtosis values of the series from those representing normal distribution, is another indicator demonstrating non-normality of the series. The hypothesis of normality is rejected at 5% significance level for both independent and dependent variables.

To obtain a variable that have a distribution at least close to normal distribution, natural logarithm of the series are constructed. The only variable that is kept at its original form is beta; since, the quintile-quintile graph and shape of the histogram for beta do not seem to be too far from normality. Moreover, kurtosis of beta is quite close to 3 and skewness measure is close to 0; which are the values signaling normal distribution. Our preference of the functional forms for market value, book-to-market value and beta is also consistent with that of Fama and French (1992).

The new normality indicators for the independent variables and the remaining three risk measures are presented on Figure B.5, Figure B.6, Figure B.7 and Figure B.8 of Appendix B. Quintile-Quintile graphs of the variables indicate that the new functional forms of the series are closer to normality. The shapes of the histograms also reveal that the variables seem to be normally distributed. The Jarque-Bera statistic for each variable also indicates that the hypothesis that the series is normally distributed cannot be rejected, at 5% significance level. The only exception is book-to-market variable, whose Jarque-Bera statistic still suggests non-normality.

Therefore; instead of using the raw forms of the variables, which do not have normal distributions, logarithmic forms of the variables are used -except for beta- to ensure normality.

Thus, the final forms of the models are as follows:

Model 1:

$$\ln(\text{STDEV})_i = \beta_{10} + \beta_{11} * \text{DERIV}_i + \beta_{12} * \ln(\text{MV})_i + \beta_{13} * \ln(\text{BTM})_i$$

Model 2:

$$\text{BETA}_i = \beta_{20} + \beta_{21} * \text{DERIV}_i + \beta_{22} * \ln(\text{MV})_i + \beta_{23} * \ln(\text{BTM})_i$$

Model 3:

$$\ln(\text{IDIO})_i = \beta_{30} + \beta_{31} * \text{DERIV}_i + \beta_{32} * \ln(\text{MV})_i + \beta_{33} * \ln(\text{BTM})_i$$

Model 4:

$$\ln(\text{RISKGR})_i = \beta_{40} + \beta_{41} * \text{DERIV}_i + \beta_{42} * \ln(\text{MV})_i + \beta_{43} * \ln(\text{BTM})_i$$

4.2.2 Check of Multicollinearity among Independent Variables

In this part, the relationship among independent variables in the models is discussed to check whether there exists significant correlation. Table 4.2 presents the correlation among the variables.

TABLE 4.2**Correlation Matrix**

	DERIV	ln(MV)	ln(BTM)
DERIV	1.000000	0.473606	0.212731
ln(MV)	0.473606	1.000000	-0.036549
ln(BTM)	0.212731	-0.036549	1.000000

Note. The table presents the correlation matrix for the independent variables used in the study.

As the correlation matrix indicates the three variables do not have a considerable correlation between each others; all off the correlation coefficients are below 0,5.

Another method for detecting the existence of multicollinearity among variables is “Variance Inflation Factor”. Variance Inflation Factor (VIF) measures the degree to which the collinearity among independent variables in the model corrupts the precision of the model. It is calculated as:

$$VIF = 1 / (1 - R_k^2)$$

where R_k is the coefficient of determination for the regression when the k^{th} independent variable is regressed on the remaining independent variables in the model.

Table 4.3 shows the VIF values for each of the independent variables. To come up with a precise estimation, VIF values are desired to be close to 1. Although there is not a theoretical threshold value for VIF to signal the existence of a problem, as many have noted, (for example Chatterjee and Price, 1991; Hair et. al., 1998) it is commonly accepted that multicollinearity is of concern when VIF value is greater

than 10. Hence, VIF values for none of the variables suggest significant correlation with other variables.

TABLE 4.3
Variance Inflation Factors

Variable	R_k^2	VIF
DERIV	0,277293	1,083296
ln(MV)	0,244048	1,063331
ln(BTM)	0,069557	1,004862

Note. This table reports the coefficient of determination values from the regressions of an independent variable over remaining independent variables in the study. Final column presents the corresponding variance inflation factors calculated through $VIF = 1 / (1 - R_k^2)$. A VIF value greater than 10 is assumed to represent multicollinearity.

It has been noted (Greene, 2003: 56-59) that existence of multicollinearity might lead to coefficients with wrong signs. Moreover, the coefficients might have non-significant t-values while they are jointly significant and while the R^2 value of the regression is high, due to overlapping of information provided by the independent variables. Based on the statistics provided, it is assumed that the results of the regression analyses provide reliable t-statistics.

4.2.3 Regression Results

To analyze the effect of derivatives use on firm-level risk, regression analyses are conducted and for this purpose, Ordinary Least Squares (OLS) method is employed.

To examine the effect of derivatives use on risk, first the regression where derivative usage is the single independent variable is run; for each risk measure. In the second step, the two variables that are documented in the literature to have an effect on firm-level risk are added into the model. Hence, the second model takes into account market value and book-to-market value as control variables.

To make sure that the standard errors of estimates are reliable, “White - Heteroskedasticity Consistent Covariances” option of E-views is employed. In the presence of heteroskedasticity, OLS estimates are still consistent, but the standard errors are incorrect. Using heteroskedasticity consistent covariances does not change the point estimates of the coefficients, but corrects the invalid standard errors.

Below, the regression results are discussed separately for each of the risk measures.

a) Standard Deviation

1st Model:

$$\ln(\text{STDEV})_i = \beta_{10} + \beta_{11} * \text{DERIV}_i$$

2nd Model:

$$\ln(\text{STDEV})_i = \beta_{10} + \beta_{11} * \text{DERIV}_i + \beta_{12} * \ln(\text{MV})_i + \beta_{13} * \ln(\text{BTM})_i$$

The regression results for the above models are presented in Table 4.4.

TABLE 4.4**Summary of Regression Analyses for Standard Deviation***Dependent Variable: ln (Standard Deviation)*

Independent Variables	Predicted Sign	1st Model	2nd Model
Intercept		-3.444772*** (-78,34955)	-0.870498*** (-3,361759)
Derivative Dummy	(-)	-0.483028*** (-7,734447)	-0.126988** (-2,190879)
ln (Market Value)	(-)		-0.145646*** (-10,88434)
ln (Book-to-Market Value)	(-)		-0.170854*** (-4,456990)
R ² (in %)		22,2506	54,0337
Adjusted R ² (in %)		21,8786	53,3675
F-Statistic		59,81233***	81,11001***
N - Sample size		211	211

Note. This table reports the outcome of the regression analyses for standard deviation. 1st model investigates the unique effect of derivative usage and 2nd model examines the effect of derivative usage, together with control variables, market value and book-to-market value, on standard deviation. Standard deviation is the standard deviation of daily returns of stocks for 2004. Daily returns are calculated as, $R_t = (P_t - P_{t-1})/P_{t-1}$, where P_t is day t-1's closing price and P_{t-1} is day t-2's closing price. Derivative dummy is equal to 1 if the firm clearly discusses its use of derivatives in the footnotes to its 2004 financial statements; and 0 otherwise. Market value of a firm is the Datastream's "Market Value" data; which is defined as the share price multiplied by the number of ordinary shares in issue. Book-to-market value of a firm is the reciprocal of market-to-book value reported on Datastream; which is defined as the ratio of market value of equity divided by net book value. Averages of 2004 daily data for market value and book-to-market value data for each firm are employed to capture the whole year. Natural logarithms of standard deviation, market value and book-to-market value data are computed for normalization. The numbers in parentheses are the t-statistics for each coefficient estimate. All t-statistics are corrected for heteroskedasticity through "White-heteroskedasticity consistent covariances" option of Eviews. *, ** and *** denote significance at 10%, 5% and 1% level respectively.

The results indicate that, derivative usage is a significant factor that has an effect on risk, with its estimated coefficient having the expected negative sign. Negative sign indicates that derivative usage is associated with lower risk, a result which is consistent our hypothesis. Besides, the R^2 of the model indicates that; derivative usage, alone, explains 22,25% of the variation in total risk.

The regression result of second model points out that the coefficients of derivative usage, market value and book-to-market value are all significant. Their estimated coefficients also have negative signs as expected; firms that use derivatives are less risky due to hedging benefits provided by derivatives; larger-size firms have lower risk, due to the benefits of economies of scale and firms with lower book-to-market value are more risky because of the growth opportunities that bear risks.

Moreover, the F-statistic reveals that the model is overall significant as well, and these three variables help to explain 54,03% of the variability in total risk.

b) Beta

1st Model:

$$BETA_i = \beta_{20} + \beta_{21} * DERIV_i$$

2nd Model:

$$BETA_i = \beta_{20} + \beta_{21} * DERIV_i + \beta_{22} * \ln(MV)_i + \beta_{23} * \ln(BTM)_i$$

The regression results are presented in Table 4.5.

TABLE 4.5**Summary of Regression Analyses for Beta***Dependent Variable: Beta*

Independent Variables	Predicted Sign	1st Model	2nd Model
Intercept		1,349635*** (13,38073)	1.502952** (2,226123)
Derivative Dummy	(-)	-0,394839*** (-2,989287)	-0.310554* (-1,947294)
ln (Market Value)	(-)		-0.017436 (-0,495303)
ln (Book-to-Market Value)	(-)		-0.155698 (-1,527667)
R ² (in %)		4,0801	5,3455
Adjusted R ² (in %)		3,6212	3,9737
F-Statistic		8,890200***	3,896671***
N – Sample size		211	211

Note. This table reports the outcome of the regression analyses for beta. 1st model investigates the unique effect of derivative usage and 2nd model examines the effect of derivative usage, together with control variables, market value and book-to-market value, on beta. Beta is the coefficient obtained from a regression of excess return of the stock on excess return of the market. Derivative dummy is equal to 1 if the firm clearly discusses its use of derivatives in the footnotes to its 2004 financial statements; and 0 otherwise. Market value of a firm is the Datastream's "Market Value" data; which is defined as the share price multiplied by the number of ordinary shares in issue. Book-to-market value of a firm is the reciprocal of market-to-book value reported on Datastream; which is defined as the ratio of market value of equity divided by net book value. Averages of 2004 daily data for market value and book-to-market value data for each firm are employed to capture the whole year. Natural logarithms of market value and book-to-market value data are computed for normalization. The numbers in parentheses are the t-statistics for each coefficient estimate. All t-statistics are corrected for heteroskedasticity through "White-heteroskedasticity consistent covariances" option of Eviews. *, ** and *** denote significance at 10%, 5% and 1% level respectively.

The estimation results reveal that derivative usage is a significant determinant of beta at 1% significance level. The sign of the coefficient estimate is negative, as

expected. Besides, R^2 of the model indicates that derivative usage, alone, explains 4,08% of the variability in beta.

As for the second model, the p-values for the coefficients of independent variables indicate that derivative usage is significant at 10% significance level; but market value and book-to-market value turn out to be insignificant. F-statistic reveals that the model is overall significant and all the estimated coefficients have signs that are consistent with our hypotheses.

c) Idiosyncratic Risk

1st Model:

$$\ln(\text{IDIO})_i = \beta_{30} + \beta_{31} * \text{DERIV}_i$$

2nd Model:

$$\ln(\text{IDIO})_i = \beta_{30} + \beta_{31} * \text{DERIV}_i + \beta_{32} * \ln(\text{MV})_i + \beta_{33} * \ln(\text{BTM})_i$$

The regression outcomes of the two models are presented in Table 4.6. Regression results yield derivative usage as a significant factor that has a negative effect on idiosyncratic risk and that explains 16,25% of the variability in idiosyncratic risk, alone.

TABLE 4.6**Summary of Regression Analyses for Idiosyncratic Risk***Dependent Variable: ln (Idiosyncratic Risk)*

Independent Variables	Predicted Sign	1st Model	2nd Model
Intercept		-1,721671*** (-37,75880)	0.435666 (1,508966)
Derivative Dummy	(-)	-0,424864*** (-6,363018)	-0.096918 (-1,297146)
ln (Market Value)	(-)		-0.126164*** (-8,096682)
ln (Book-to-Market Value)	(-)		-0.211401*** (-4,426791)
R ² (in %)		16,2490	41,6074
Adjusted R ² (in %)		15,8483	40,7612
F-Statistic		40,54927***	49,16574***
N – Sample size		211	211

Note. This table reports the outcome of the regression analyses for idiosyncratic risk. 1st model investigates the unique effect of derivative usage and 2nd model examines the effect of derivative usage, together with control variables, market value and book-to-market value, on idiosyncratic risk. Idiosyncratic risk is the standard deviation of residuals that are obtained from beta regressions. Derivative dummy is equal to 1 if the firm clearly discusses its use of derivatives in the footnotes to its 2004 financial statements; and 0 otherwise. Market value of a firm is the Datastream's "Market Value" data; which is defined as the share price multiplied by the number of ordinary shares in issue. Book-to-market value of a firm is the reciprocal of market-to-book value reported on Datastream; which is defined as the ratio of market value of equity divided by net book value. Averages of 2004 daily data for market value and book-to-market value data for each firm are employed to capture the whole year. Natural logarithms of idiosyncratic risk, market value and book-to-market value data are computed for normalization. The numbers in parentheses are the t-statistics for each coefficient estimate. All t-statistics are corrected for heteroskedasticity through "White-heteroskedasticity consistent covariances" option of Eviews. *, ** and *** denote significance at 10%, 5% and 1% level respectively.

For second model, however, derivative usage turns out to be insignificant, as expected. Since derivative instruments are employed to hedge risks that are related to

general market movements, such as changes in interest rates or exchange rates; it is reasonable to expect that derivative usage may not lead to a reduction in risk which is specific to a firm, and is not shared by the market in general. Market value and book-to-market value are significant at 1% significance level. Furthermore, the model is overall significant and the three variables help to explain 41,61% of the variability in idiosyncratic risk.

d) RiskGrade

1st Model:

$$\ln(\text{RISKGR})_i = \beta_{40} + \beta_{41} * \text{DERIV}_i$$

2nd Model:

$$\ln(\text{RISKGR})_i = \beta_{40} + \beta_{41} * \text{DERIV}_i + \beta_{42} * \ln(\text{MV})_i + \beta_{43} * \ln(\text{BTM})_i$$

Table 4.7 presents the regression results for RiskGrade. As the regression results suggest, derivative usage is a significant variable with its negative effect on RiskGrade. Alone, derivative usage explains 25,26% of variability in RiskGrade.

After including market value and book-to-market value into the model, derivative usage still turns out to be significant; besides, market value and book-to-market value are also significant determinants of RiskGrade. The coefficient estimates have negative sign, as expected. F-statistic of the model reveals that the model is overall significant as well, where the variables explain almost half of the variability in the risk measure.

TABLE 4.7**Summary of Regression Analyses for RiskGrade***Dependent Variable: ln (RiskGrade)*

Independent Variables	Predicted Sign	1st Model	2nd Model
Intercept		5,495959*** (123,1334)	7,605773*** (25,24855)
Derivative Dummy	(-)	-0,489078*** (-8,065155)	-0,198859*** (-2,869223)
ln (Market Value)	(-)		-0,120084*** (-7,349693)
ln (Book-to-Market Value)	(-)		-0,158603*** (-3,504943)
R ² (in %)		25,2635	48,9484
Adjusted R ² (in %)		24,8762	48,1465
F-Statistic		65,24047***	61,04377***
N – Sample size		195	195

Note. This table reports the outcome of the regression analyses for RiskGrade. 1st model investigates the unique effect of derivative usage and 2nd model examines the effect of derivative usage, together with control variables, market value and book-to-market value, on RiskGrade. RiskGrade is the risk measure devised and reported by Riskmetrics group. Derivative dummy is equal to 1 if the firm clearly discusses its use of derivatives in the footnotes to its 2004 financial statements; and 0 otherwise. Market value of a firm is the Datastream's "Market Value" data; which is defined as the share price multiplied by the number of ordinary shares in issue. Book-to-market value of a firm is the reciprocal of market-to-book value reported on Datastream; which is defined as the ratio of market value of equity divided by net book value. Averages of 2004 daily data for market value and book-to-market value data for each firm are employed to capture the whole year. Natural logarithms of idiosyncratic risk, market value and book-to-market value data are computed for normalization. The numbers in parentheses are the t-statistics for each coefficient estimate. All t-statistics are corrected for heteroskedasticity through "White-heteroskedasticity consistent covariances" option of Eviews. *, ** and *** denote significance at 10%, 5% and 1% level respectively.

Overall, multivariate analyses conducted for each risk measure suggest that three independent variables, particularly derivatives use, are significant determinants of risk. Moreover, the coefficients possess negative signs, which implies that derivatives use and increase in market value and book-to-market value leads to a decrease in firm-level risk. These results are consistent with our hypotheses.

CHAPTER 5

SUMMARY AND CONCLUSION

Despite the presence of various studies on how and why firms use derivatives, there are few studies in the literature that analyze the consequences of derivative usage and its effect on firm-level risk. This thesis aims to analyze the relationship between derivative usage and firm-level risk. First some statistics about derivative usage for the sample firms and financial characteristics of the sample firms are presented. Then univariate analyses are performed by comparing mean and median risk characteristics of derivative users and non-users. Finally regression analyses are conducted by taking into consideration some other control variables that may affect firm-level risk.

To analyze whether firms that use derivatives are less risky than firms that do not use derivatives, four different risk measures are used as proxies of firm-level risk. One measure is standard deviation, calculated as the standard deviation of daily returns of stocks for 2004. Second one is beta, which is the well-known market risk

measure estimated from a regression of excess return of the stock on excess return of the market. Third measure is idiosyncratic risk computed as the standard deviation of error terms of the beta regressions. The final risk measure is RiskGrade, a volatility measure devised by Riskmetrics group, which computes volatility of stock returns through exponential weighting method. The first three measures are used in previous studies in the literature as risk measures when analyzing the effect of derivatives on firm-level risk; however this thesis is the first study to use RiskGrade as risk measure to identify this effect.

The sample is comprised of 211 non-financial firms. For these 211 firms, year 2004 annual reports, which give information about derivative usage for 2004 are searched and 104 firms are identified to be derivative users. Financial data about these 211 firms related to year 2004 are obtained from Datastream. The exchanges that the firms are traded, the industries that they take place and the distribution of their market sizes reveal that the sample used in this study is a good representation of the whole U.S. financial market.

The mean and median difference tests conducted for each risk measure aim to examine whether derivative users have lower risk values than firms without derivatives. It is documented that firms that do not use derivatives have significantly higher mean and median risk values than user firms. This result is consistent with our expectations that firms without derivatives should be more risky than firms with derivatives.

To control for other variables that may have an effect on firm-level risk, in the next step, regression analyses are performed. The determination of the model is primarily influenced from the study of Fama and French (1992). They suggest that size and book-to-market value are two variables that capture the variation in average stock returns. Moreover size and book-to-market value are two variables that are also used in the studies of Guay (1999) and Hentschel and Kothari (2001); which also aim to identify the effect of derivative usage on firm-level risk.

To normalize the variables that form the model; natural logarithms of each series is constructed and the analyses are performed on these new form of variables. Regression analysis for each risk measure is conducted through two steps. First the unique impact of derivative usage on risk is identified; by including only the dummy derivative variable in the model. The sign of the coefficient of derivative usage is negative for each test, as expected. Moreover, derivative usage alone turned out to explain between 16% and 26% of variation in risk measures. Only, variation in beta is explained by a small amount through derivative usage.

In the next step, market value and book-to-market value are added into the model. In each of the four models, it is observed that, the signs of the coefficients of three independent variables are negative, as expected. The negative sign of market value can stem from the fact that larger size firms are less risky due to economies of scale. Book-to-market value also has a negative coefficient, and this can be due to the fact that growth firms bear more risk relative to value firms. Derivative usage turned out to be significant in three of the regressions; where the respective dependent variables are standard deviation, beta and RiskGrade. When idiosyncratic

risk is the dependent variable, derivative usage is insignificant, as expected. The reason is that derivative instruments are used for hedging risks that are related to general market movements, not for firm-specific risks. Book-to-market value and market value are also significant determinants of firm-level risk, except for the beta regression.

Overall, the findings are consistent with our expectations that firms with derivatives should be less risky than firms without derivatives. Even after controlling for the well-known control variables, derivative usage is still significant. The conclusion that derivative usage leads to a decrease in firm-level risk is consistent with that of Guay (1999) but contradicts to that of Hentschel and Kothari (2001). The reason may be due to the characteristics of the sample used. While Guay (1999) uses a large sample with differing financial characteristics, Hentschel and Kothari (2001) employs a sample composed of larger firms, which are listed on the April 25, 1988 issue of Fortune Magazine.

The findings of this thesis should be interpreted cautiously, due to possible industry effects. Although the sample used in this study is formed of firms belonging to 20 different industries, this study does not control for industry effects. Previous literature employed deflating the variables in the model with their industry averages or running additional regressions separately for each industry. In addition to this; the model used in this study only explores whether derivative usage is associated with lower risk. However, incorporating the notional values of derivatives used as an independent variable into the model would enable to examine whether the extent of derivative usage has an influence on firm-level risk as well. Hence, further research

may be to repeat this study by including the notional values of derivative instruments used by the sample firms into the model and taking into consideration the possible industry effects.

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APPENDICES

APPENDIX A

CALCULATION OF RISKGRADES

RiskGrades are volatilities that are scaled by a scaling factor which simplifies interpretation. A RiskGrade of 100 corresponds to an annual volatility of 20%; which is the market-cap weighted average volatility of a group of major equity market indices during the period 1995-1999.

The Riskmetrics volatility estimate; using exponential weighting is:

$$\sigma_{i,t} = \sqrt{\frac{1-\lambda}{1-\lambda^n} \sum_{j=0}^n \lambda^j r_{i,t-j}^2}$$

where λ is the decay factor and $r_{i,t}$ is the return of asset i at time t , computed as a one-day logarithmic return; $\ln(P_{i,t}/P_{i,t-1})$, where $P_{i,t}$ is the price of asset i at time t .

Then, RiskGrade of asset i is computed as:

$$\begin{aligned}\text{RiskGrade}(i) &= \frac{\sigma_i}{\sigma_{base}} \times 100 \\ &= \frac{\sigma_i \sqrt{252}}{0,2} \times 100\end{aligned}$$

where σ_i and σ_{base} denote the Riskmetrics volatility of asset i and base volatility, respectively.

APPENDIX B

TESTS OF NORMALITY

Figure B.1

Quantile-Quantile Graphs of Control Variables

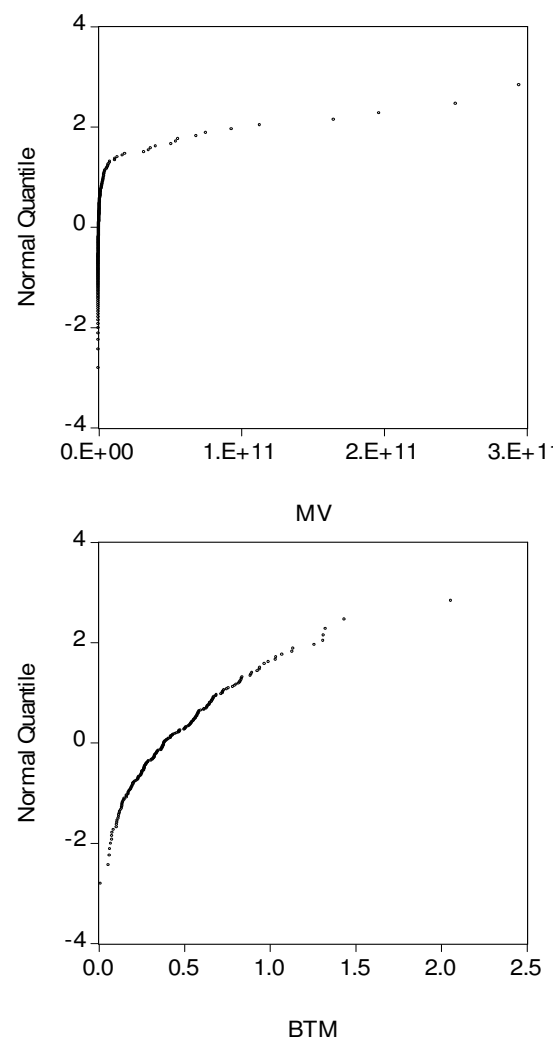


Figure B.2

Histograms of Control Variables

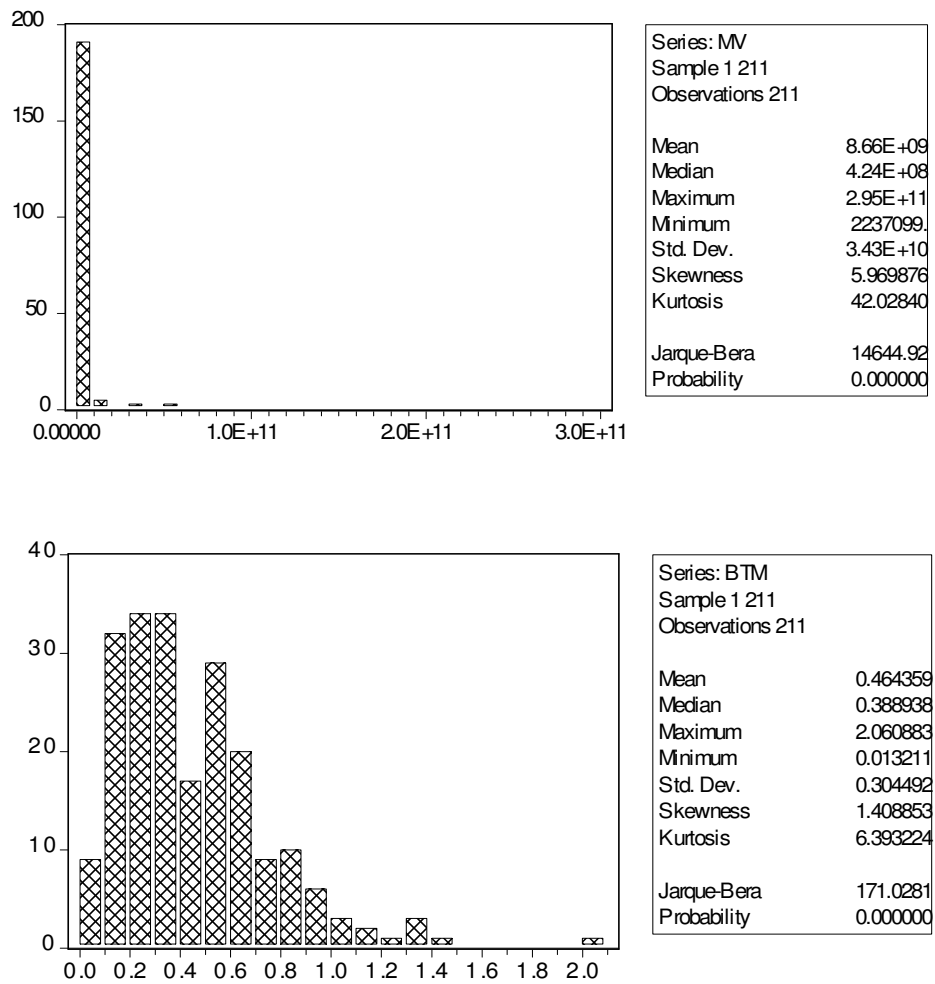


Figure B.3

Quintile-Quintile Graphs of Dependent Variables

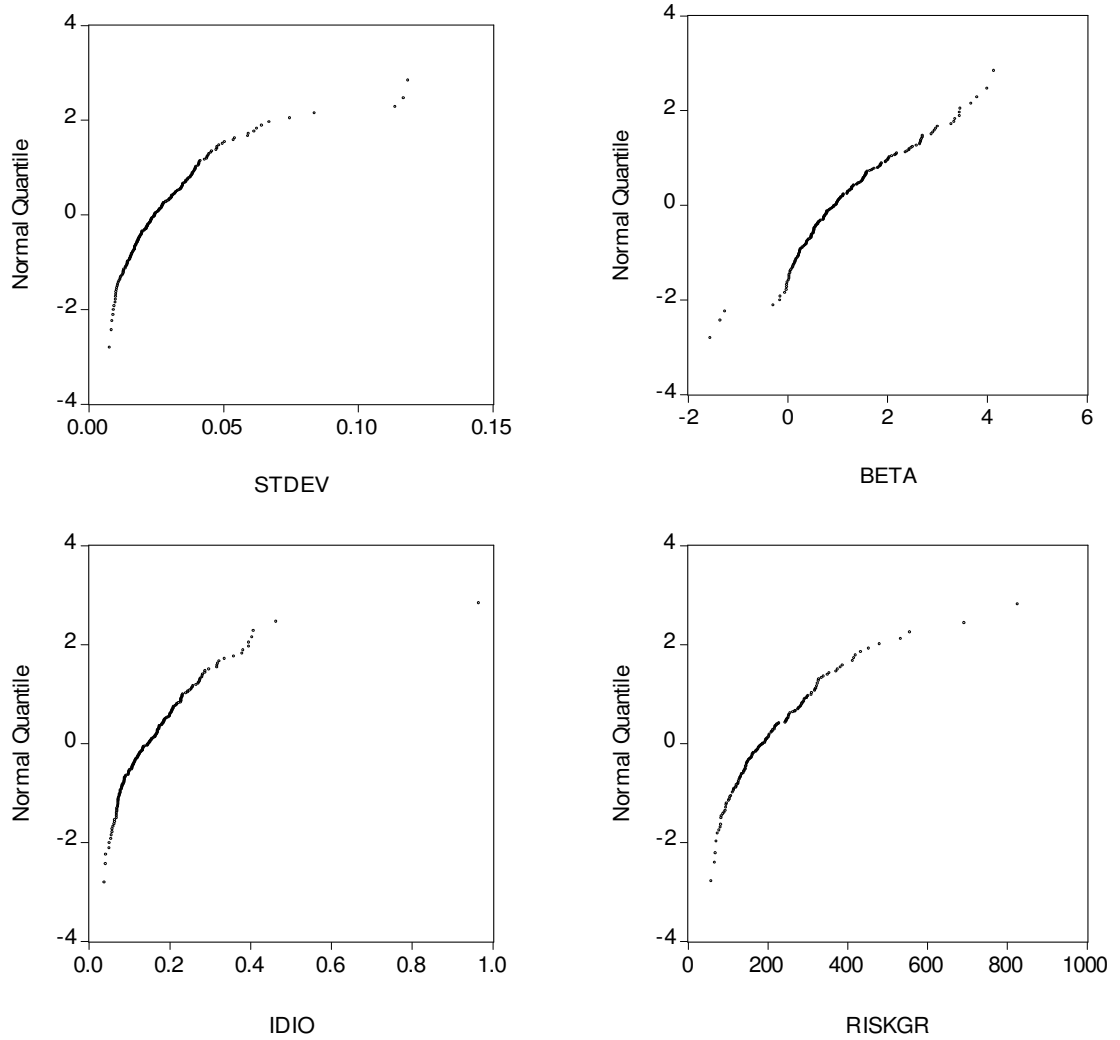


Figure B.4

Histograms of Dependent Variables

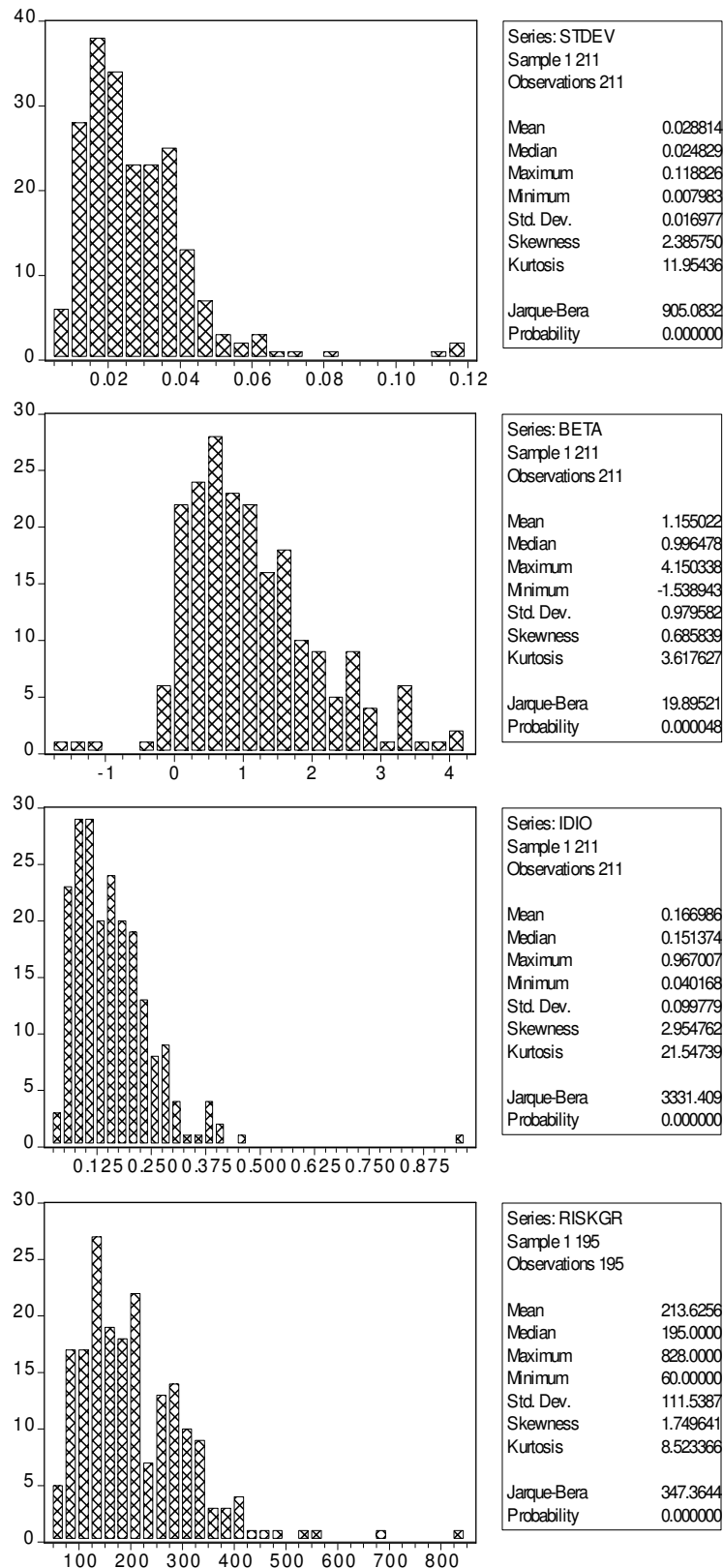


Figure B.5

Quintile-Quintile Graphs of Control Variables – In Logarithmic Form

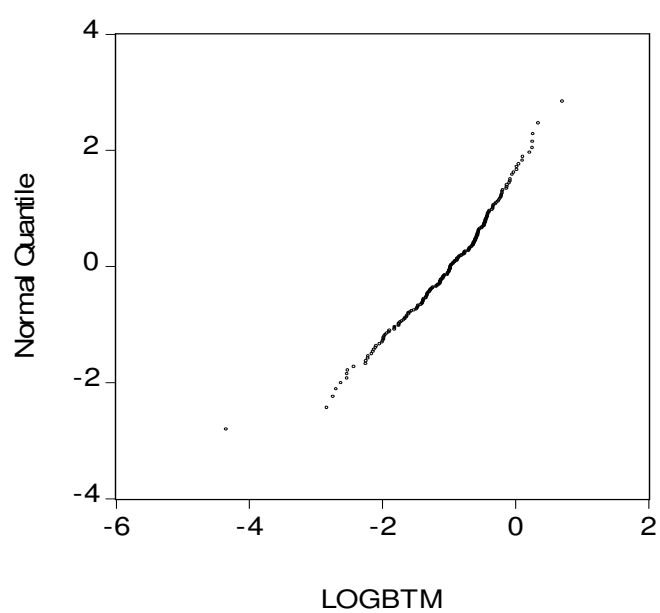
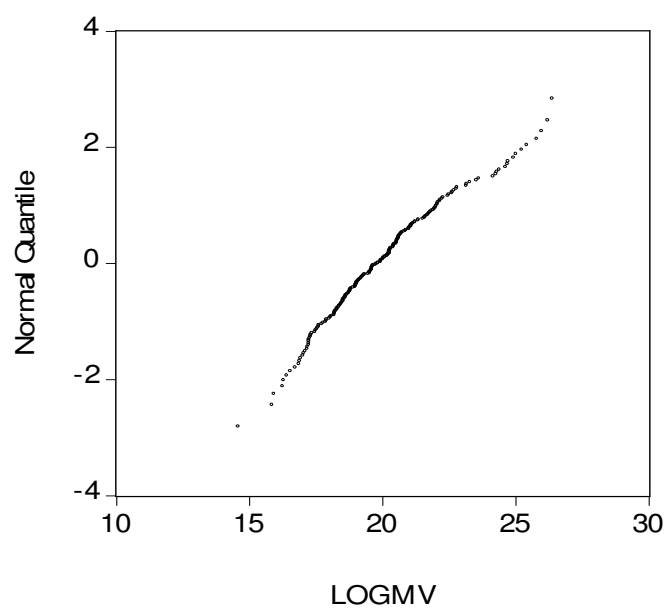


Figure B.6

Histograms of Control Variables – In Logarithmic Form

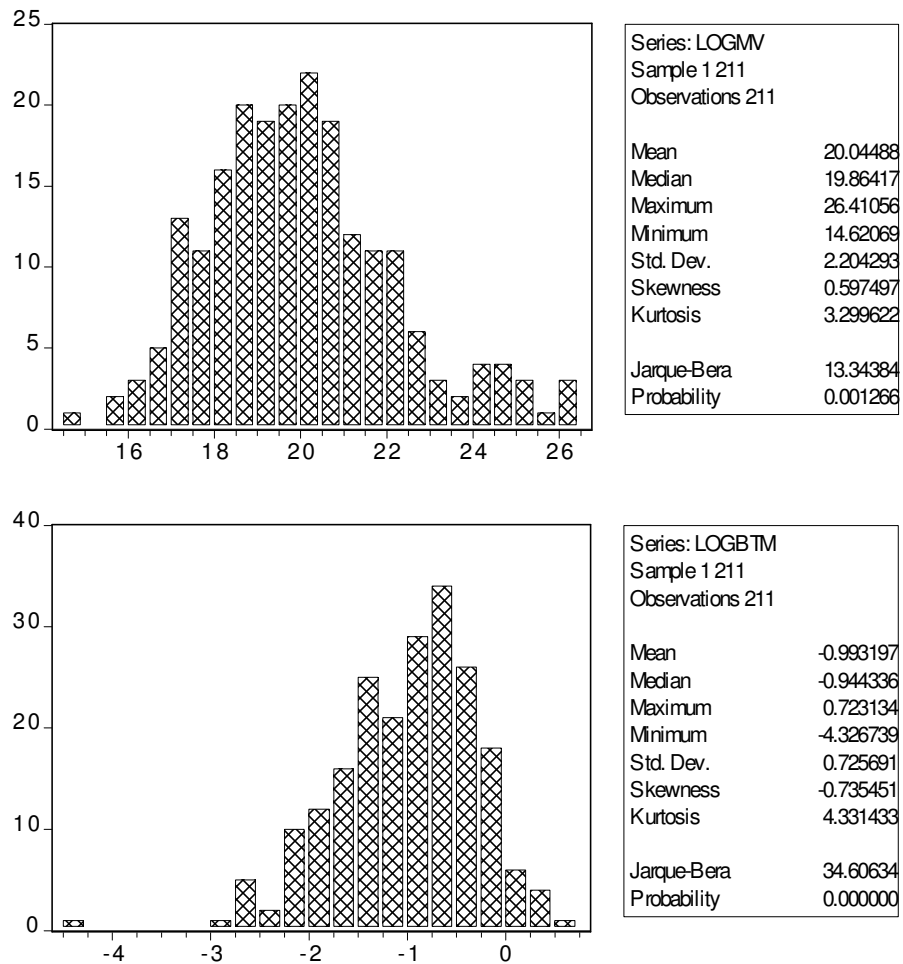


Figure B.7

Quintile-Quintile Graphs of Dependent Variables – In Logarithmic Form

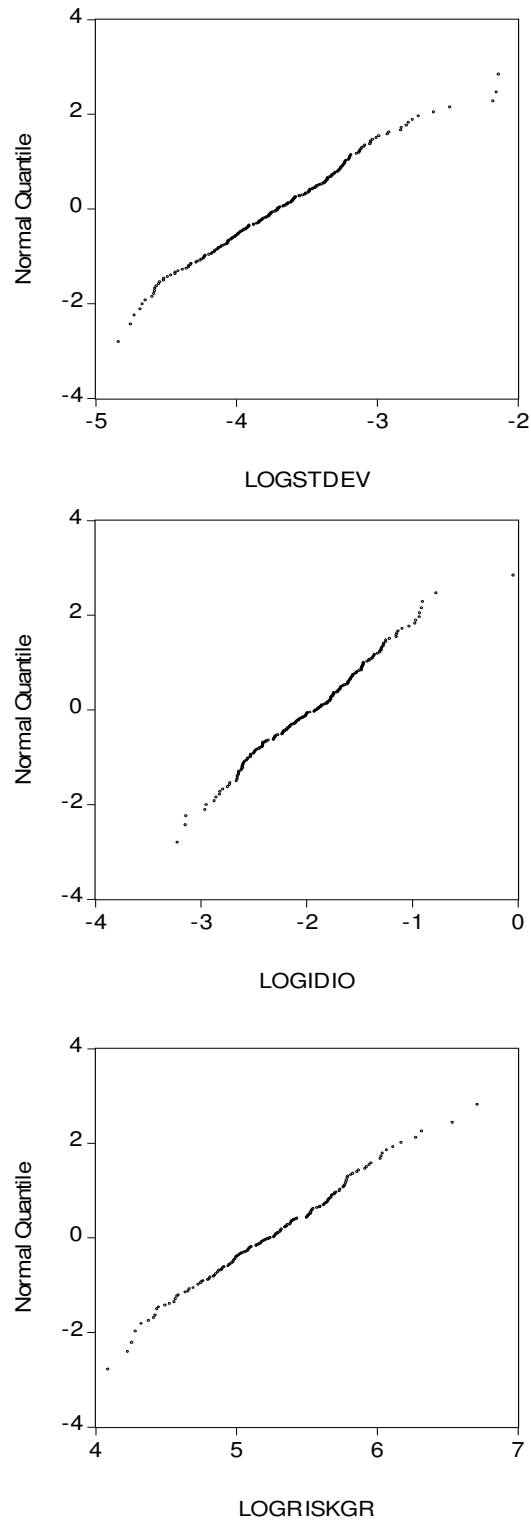


Figure B.8

Histograms of Dependent Variables – In Logarithmic Forms

