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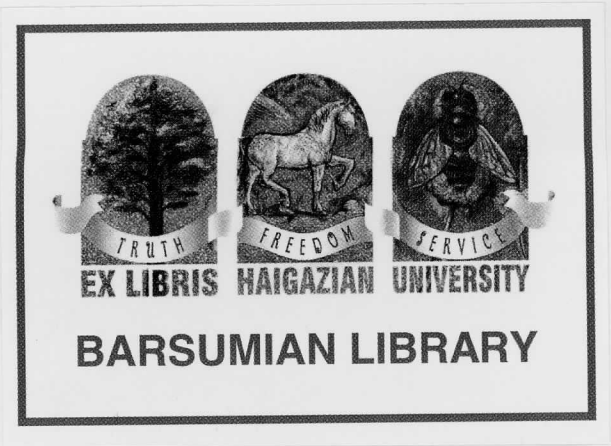

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MARGIN LENDING & FACTORS INFLUENCING DEBIT INTEREST RATES: A CASE STUDY OF A LEBANESE INVESTMENT BANK

By
ANNIE SANDRA BARIKIAN

A Thesis Submitted
In Partial Fulfillment of the Requirements for the Degree of
Master in Business Administration with a Major in Finance
To the Faculty of Business Administration & Economics
At Haigazian University

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HAIGAZIAN UNIVERSITY

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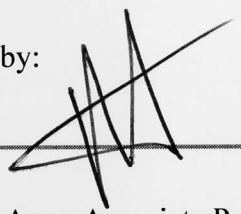

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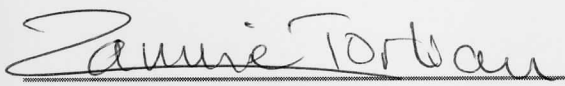

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"Give thanks to the Lord, for he is good; his love endures forever" (1 Chronicles 16:34). By this verse I bestow my deepest gratitude to God who I believe watched over my work.

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I dedicate this thesis to both angels Daniel Haddad and little Christopher Abi Abdallah.

AN ABSTRACT OF THE THESIS OF

Annie Sandra Barikian for Masters in Business Administration

Major: Finance

Title: Margin Lending & Factors Influencing Debit Interest Rates: A Case Study of a Lebanese Investment Bank

Investment Banking has widely spread in Lebanon during the past decade. Several banks took the lead in this field and attracted many local and international clients to either trade securities or purchase their structured products on the prevailing stock exchange markets.

To facilitate the trade transactions of the clients, investment banks offer loans against shares, namely margin loans. The principle condition of the overdraft facilities is the debit interest rate which plays a big role in drawing the clients' attention or on the contrary drive them away.

The principal objective of this thesis is to find out what are the factors that the management and the credit committee of an investment bank take into consideration while charging debit interest rates on different overdraft accounts. Specifically, I wanted to identify the nature of the relation between the portfolio riskiness and the debit interest rate.

For this purpose, I chose a leading Lebanese investment bank to examine its decision making method in applying debit interest rates on the accounts of the clients benefitting from margin facilities.

To achieve the goal of this thesis, I gathered information relating to the clients holding margin accounts with the bank mentioned above for the period starting 2007 and ending 2009.

The foremost findings of this research demonstrate that there are many factors other than portfolio riskiness, such as wealth and discount and loans rate that affect the debit interest rates.

It turned out that the riskiness of portfolio, measured by beta, is negatively related with the debit interest rates exceptionally during the period of time chosen for this thesis. This negative relation was due to the outburst of the financial crisis which played a big role in affecting the debit interest rates opposite to their normal direction.

List of Abbreviations

BBA	British Banker's Association
BCC	Banking Control Commission
BDL	Banque Du Liban
BSE	Beirut Stock Exchange
BSI	BLOM Stock Index
CAPM	Capital Asset Pricing Model
DL rate	Discount and Loans rate
FCF	Free Cash Flow
FED	Federal Reserve System
GLS	Generalized Least Square
IMF	International Monetary Fund
IRM	Interest Rate Margin
ISIN	International Security Identification Number
LIBOR	London Inter-Bank Offered Rate
MRP	Market Risk Premium
OECD	Organization for Economic Co-operation & Development
OTC	Over The Counter
S&P 500	Standard & Poor's 500
SML	Security Market Line

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INTRODUCTION

"How much will you charge?" is the common question asked by a client who wants to benefit from facilities. The private banker or the credit officer will answer to this by saying: "It depends on the credit committee's decision". As a matter of fact, it is the credit committee's decision, but on the other hand what are the factors that the committee takes into account to charge the appropriate debit interest rate?

The credit department of a bank is one of its core assets. It assesses the overall risk of the institution and on the other hand generates revenues through the debit interest charged on its loan accounts. This debit interest rate revenue can be acquired by many ways of lending. In this study's case it is margin lending that is most commonly used by investment banks.

During the past ten to fifteen years many Lebanese banks established their own investment branches and loans against shares became a popular way of borrowing among the clients to trade on securities. The procedures of lending, the rules and regulations may differ from a country to another, but the global reasons affecting the international rates are one.

A. Purpose of the Research

Since I am working in the credit department of an investment bank, and since one of my tasks is to prepare the debit interest rates' sheet to be charged on the clients of overdraft accounts, in addition to raising a written credit request to the credit committee, it was of my curiosity to find out what are the factors affecting the decision of the said committee in charging debit interest rates on the overdraft margin accounts.

The reason why this particular bank is chosen, it is because one of the most reputable and leading investment banks in the country and in the region. It has a successful history and the required experience in the banking industry.

B. Research Questions

The thesis aims at answering the following questions: what are the factors affecting the debit interest rate? Is portfolio riskiness a standalone measure to debit interest rate fees? Is the wealth of a client an important element in deciding the debit interest rate? How the average debit interest rate moves along with the discount and loans rate? What was the role of the credit financial crisis in the decrease of the debit interest rates?

C. Methodology

Theoretical and empirical approaches are used in this thesis. A literature study was conducted by gathering information from various resources such as books, journals, web sites and research papers. The empirical data was collected from the investment bank mentioned above after the consent of the bank's General Manager.

Statistical analysis of the different variables collected was performed with the help of statistical tools, such as excel regression tool and E-views 7 program.

The least square method was used in order to tackle the relationship between the debit interest rate and the remaining variables, wealth, beta and discount and loans rate. In addition, to adjust for heteroskedasticity, the White, Newey West corrections of standard error were employed. Moreover, the Harvey test and its implied generalized least squares were performed.

II - LITERATURE STUDY

Different authors in many time periods depicted the subject of margin debit interest rates and its corresponding influencing factors. Each writer contributed to this topic according to the existing financial and economic situations and according to their respective educational backgrounds during the phase of their studies. The variables chosen in the research papers varied.

"The Determinants of Bank Interest Rate Margins: An International study" published in September 1997, tackled the factors affecting margin interest rates of seven OECD countries, namely France, Italy, United Kingdom, United States, Germany, Switzerland and Spain. The base model of this study is the Ho and Saunders model of 1981. This model highlights the importance of the relationship between interest rate volatility and bank margins. It has as an assumption that the delegate bank is a risk averse mediator that performs as a dealer in a market for the instant provision of deposits and loans. Hence, the interest rate variation is the major factor influencing the portfolio risk. After empirical and theoretical researches, the authors' findings were the following regarding the impact of certain factors on the interest rate margin:

1. Regulatory taxes caused an increase in the interest rate margin, because the higher the taxes the banks paid, the higher the debit interest rate charged on the margin accounts.
2. Reserve requirements' high interests caused a higher interest rate margin
3. The higher the competition the higher the IRM
4. Macro interest rate volatility impacted the IRM, the higher the volatility the higher the IRM, therefore reducing interest rate volatility could contribute to lower interest rate margin. (Saunders & Schumacher, 1997)

Another paper entitled "Determinants of Bank Net Interest Margins of Southeast Asia" highlights the factors that influence the net interest margin of banks in four Southeast Asian countries. The determinants that are put under test are, collateral, liquid assets, operating expenses and loan quality.

The collateral and operating expenses variables are similar to my study's variables respectively wealth and the discount and loans rate. The wealth and or collateral represent the securities portfolio of the clients benefitting from margin facilities. The financial weaknesses of the countries depicted in this review play an important role in their interest margin charging policies. The impact of the collateral on the interest margin is very relevant. When clients provide more collateral than necessary, the bank's lending rate is decreased automatically. The collateral also helps in covering the losses of a client in case of default. The decrease in loan quality may cause an increase in operating costs and in order to compensate for the forgone interest revenues, the IRM is increased. When a bank keeps a high capital requirement it becomes costly, therefore it charges higher interest rate margins. The liquidity of the assets also affects the IRM. If a client's portfolio of securities consists of liquid assets, i.e. they can be sold quickly in the financial markets, the interest rate of margin charged on these debit accounts are low.

The statistical findings summarize the following: there is a significant positive relation between the interest margin and the operating cost, a negative relation between interest margins and collateral, loan quality is positively related with IRM and liquid assets have a negative effect on the interest rate margin. The negative relationship between the debit interest rate and the collateral and the positive bond of margin interest rate and operating expense is also revealed in my research's findings. (Doliente, 2003)

Reference to the article by Mark Cohan, wealth managers consider margin lending a good way to borrow money at a more convenient manner than the ordinary loans. It is considered to be an attractive debt since the interest rates are not as high as those of the commercial loans.

Advisors claim that margin lending is mostly useful for the wealthy individuals who need short term financing. It is remarkable in this study that high end income investors (clients of $ 5,000,000 worth and above) have margin loans. These wealthy clients benefit from loans against shares with more preferable interest rates than those investors with portfolios of less than $ 1,000,000. This wealth variable is a very important factor in my study, since the same reason is used, i.e. wealthier clients demand lower margin interest rates and they have the power to bargain. The debit interest rate charged to these accounts is approximately equal to the prime rate. This prime rate refers also in my research to the discount and loans rate variable that moves along proportionately with the debit interest rate. Reference to this article, wealthy clients get "more decent terms". For example, if a client takes a margin loan of $ 1,000,000 he is charged with 8.5% of debit interest rate and 8.25% if he takes out $ 2,500,000.

Portfolio managers and lenders prefer lending wealthy clients because the risk associated with the latter are minimal. Their source of reimbursements is guaranteed and cash is always available, therefore they will pay their dues on time with no issues. (Cohan, 2006)

Lastly, the paper "Determinants of the Interest Rate Margins of Austrian Banks: Financial stability report 12" examines the grounds for the decrease in the interest rate of margin of Austrian Banks. Globally the interest rate margin has decreased massively during the ten years preceding 2006. The financial stability in the European countries had a great role in this decreasing trend.

According to the author's literature review there are microeconomic and macroeconomic factors that affect the interest rate of margin that the regulators of interest rates must be aware of. The macroeconomic factors were described as being: the state of the business cycle, the volatility of interest rates (meaning their risk). This interest rate volatility can be associated to the beta in my thesis. Beta plays an important role in determining the margin interest rate with respect to the riskiness of the securities portfolio. The microeconomic factors were the following: operating costs, interest rate risk, default risk, the market structure (competition wise) and bank size. Both operating costs and the interest rate risk also refer to the discount and loans rate utilized in my study. It has a positive relation with the margin interest rate. To determine the IRM this paper relies on the Ho and Saunders 1981 model that considers banks to be risk averse mediator between borrowers and lenders. In this sense, banks are pressured by fierce competition and interest rate risk which in fact determine the interest rate margin. The statistical findings of this research highlight the following relationships:

1. The higher the risk aversion, the higher the IRM.
2. The lower the competition, the lower the IRM.
3. The more volatile the money market rates, the higher the IRM.
4. The higher the credit risk, the higher the IRM.
5. The higher the operating cost, the higher the IRM.

In summary, the decreasing interest rate margin can be related to decreasing operating cost, rising competition, high credit risk and high volatility of money market rates. (Liebeg & Schwaiger, 2006)

Margin loan definition and characteristics

Margin loan or loan against shares is the overdraft facility or credit line granted to an individual against securities. The securities are considered to be the collateral for the said bank or lending institution. In other terms, the clients borrow a certain amount of money in order to trade on margin, i.e.: purchase different types of securities. The clients willing to trade on margin will have to open an overdraft account with the bank and trade within the allowed list of tradable securities.

First of all, it is worth to define and get acquainted with the following terms: Initial margin requirement, maintenance requirement, minimum margin requirement, and margin call. The initial margin as its name implies, is the cash or securities amount requested to start a trading position. It is in other words the percentage of the purchase price of securities that the investor must pay for with his or her own cash or marginable securities. Thereafter, the maintenance requirement is the amount of money or security required to be held in collateral until the client decides to close his trading position. It is usually lower than the initial requirement. The maintenance margin's percentage also depends on each bank's or country's regulations and on the securities chosen to constitute one's trading portfolio. It is the obligation of the credit officer to follow up the minimum margin requirement. Once the client has fallen below this requirement, the officer issues a margin call. The margin call can be brought back into its normal position either by injecting cash or securities into the account or sell some of the securities held in the portfolio. If the client fails to do so, the bank or the financial institution has full right to liquidate the remaining securities' portfolio and close the client's position.

For example, this follow up procedure may differ from a bank to another. In the institution where I work, a daily overdraft report is issued for this purpose. It details the clients'

names, their respective account numbers, total portfolio in dollar amounts, their net cash balance (debit and credit balances netted) the required margin ratio (50% as per BDL circular number 51), the debt to securities' ratio, transfer amounts and trading possibilities. The transfer amount is the amount of cash money the client must inject into his or her account whenever faced with a margin call. The trading possibility is the fund available to purchase extra securities and enlarge the clients' portfolio. If the client faces a margin call this amount is the necessary fund to be provided to the bank to return his margin position back to the required 50%.

Margin requirement ratio's history and the Great Depression of 1929

Speaking of the margin requirement, if one goes back in history, in the 1920s, margin requirements were not tight as our days. Brokers demanded only a small portion of the investor's money to be placed as collateral. Unlike today, during the 1920s the Federal Bank allowed 90% financing against securities, whereas nowadays the Federal Reserve's margin requirement allows only 50% financing of portfolio's market value. This decrease in the percentage is due to the fall of the stock market and its crash during 1929 which led to the Great Depression. The Great Depression was a brutal international economic depression which started in 1929. On the 4th of September 1929, the depression began with the stock price decline in the United States of America and later with the worldwide market crash on October 29, 1929, called black Tuesday. During this period, many investors received margin calls, they had to inject more money to their accounts held with the brokers or the latter would have sold their shares. Given the fact that many investors did not have cash or other means to cover their margin positions, their holdings and shares were liquidated, leading to market decline. Therefore, the required margin was decreased to 50% to safeguard any future falls in the stock market. (Madura, 2010).

Currently, the margin requirement percentage can even be as low as 20% to 35% given the portfolio's nature of diversification.

The importance of portfolio diversification

Here, portfolio diversification plays a great role in margin lending. For instance, if the portfolio is poorly diversified, or concentrated on only one stock, the required margin ratio would be less than 50%. Let's take a numerical example. For instance: a client holds in his portfolio only $ 60,000 worth of a single share. The bank will grant him or her facilities of $ 60,000 multiplied by 35%, meaning facilities of $ 21,000. In case the client diversifies his or her portfolio, the credit officer raises a new request to the credit committee to amend the required margin ratio to a higher percentage.

Many Finance books' authors say: "Do not place all your eggs in one basket". An individual can invest in many **different types of securities**, such as *common stocks*, *Treasury bills*, *government* and *corporate bonds*. Treasury bills are promissory notes issued by the government of a certain country to raise funds through open market transactions. It promises the buyer a fixed return at a given maturity. It is a risk free investment, its price is more or less stable (except if inflation occurs) and it is backed by the full faith and credit of the issuer, i.e.: the government. The government bonds differ slightly from the T-bills by their longer maturities and might bare interest rate risk. Corporate bonds are issued by companies to investors for debt financing purposes. For example, companies issue the corporate bonds to finance their capital. It has a standard coupon payment method and can be callable. The collateral for this issue can be either the future earnings of the company or its assets. The corporate bond's risk is higher than the government bonds therefore its interest rates are higher.

The common stock gives the investor partial ownership in the company. The buyer becomes an owner, has voting rights, obligations and is entitled to receive income from the profits of the company. Its risk is higher than the Treasury bills and the government bonds because when the company defaults the investor's stock is worthless. There are different types of stocks, among which are publicly held – listed, privately held and not listed shares. A publicly held security, also called public company or publicly traded, is when a company issues securities through a public offering, and which trades on the open market. The latter is the opposite of a private company whose shares are not traded on an open market. As for the not listed shares, as its name implies, they are not listed on any exchange market and are directly purchased from the issuer of the securities.

The market risk of a portfolio: Beta

The market risk of securities held in a portfolio determines the risk of a well-diversified portfolio. Each security has its own effect on the portfolio with respect to its market risk, sensitivity towards market movements. The best pay off from a portfolio is when the stocks are negatively correlated, meaning the price of one stock decreases while the other stock's price increases at the same time. Beta is a measure of individual stock risk compared to the overall risk of the stock market. In other words, it is the volatility of a stock in relation to the market. It is the systematic risk of the asset that cannot be eliminated by the diversification of the portfolio held by the investors. A zero beta asset means its returns change autonomously with changes in the market's returns. An asset with a positive beta indicates that the asset's returns moves in the same direction as the market's returns, and a negative asset beta returns normally move in the opposite direction of the market's returns. With a beta of -1.0, a stock has the same volatility as

the market, but tends to rise when the market falls, and vice versa (mostly precious metals, such as gold have negative betas because they move inversely with the market).

The beta coefficient is a key factor in the Capital Asset Pricing Model. The latter is used to determine an asset's required rate of return, if that given its non-diversifiable risk. The model takes into account beta (β), in addition to the expected return of the market and the expected return of a risk-free asset. The formula is given by:

$$Expected\ Return_i = Risk\ Free\ rate + \beta_i(Expected\ Market\ return - Risk\ Free\ rate) \quad (1)$$

The difference between the expected market return and the risk free rate is called market risk premium (to be further illustrated in the discussion section). (Brealey, Myers, & Allen, 2006)

Margin lending procedures

The procedure of margin lending in the brokerage firms, financial firms or investment banks could differ in a slight way, but in their core formation are similar. Certainly, the institutions follow the country's Central Banks' and Banking Control Commissions' rules and regulations regarding this matter.

Central Bank of Lebanon – Banque Du Liban

The Banking sector in Lebanon has an interesting history. In 1920, Lebanon was called "Great Lebanon" under the rule of the French government. At that time the governor appointed the Bank of Syria and Great Lebanon to be operate as a financial institution for both governments. The Lebanese-Syrian pound was pegged to the French Franc equivalent to 22FF.

In 1937, the Lebanese pound became the sole currency in Lebanon. Later in 1947, Lebanon became a member of the IMF and of the World Bank. In 1963, after the expiry of the convention of May 29, 1937, Lebanon decided to create a central bank.

On the first of August 1963, the Code of Money and Credit was issued by Legislative Decree N° 13513. It established the Banque du Liban as a moral person of public law, who has the right to issue the national currency. The Central Bank fully operated on April 1964. The Central Bank's main roles are to maintain monetary stability, regulate money transfers, and preserve the soundness of the banking sector. It also grants licenses for the establishment of banks, financial institutions, brokerage firms, money dealers, foreign banks, leasing companies and mutual funds in Lebanon. The Banking Control Commission controls and supervises these institutions. The Central Bank issues circulars and resolutions governing the relations of banks with their customers. (Banque Du Liban - History, 2007)

Central Bank Circular N°51

According to the Lebanese Central Bank's regulations there are circulars regarding margin loans, trading rules and the development of credit files. The basic circular number 51 issued in Beirut on the 22nd of October 1998 under the supervision of the governor Riad Toufic Salameh holds the title "Credit granted against pledged securities". The important features of this circular are: It is strictly forbidden for the financial institutions or banks to finance the purchase of securities other than those tradable in the Lebanese markets, i.e.: local or foreign securities that are traded on the Beirut Stock Exchange. The required margin ratio is 50%, meaning that the loan amount should not at any time exceed the 50% of the portfolio's market value. If the portfolio market value decreases by 25% of its initial value, the client must cover the said

decrease immediately otherwise the bank will liquidate his holdings to bring the required margin ratio back to 50%. (BDL Basic Circular, 2007)

Central Bank Circular N°81

The basic circular number 81 regarding "Operations relating to credit, investment, shareholding and participation" addressed to banks and to financial institutions and pursuant to the Decision of the Central Council of the Banque du Liban, taken in its meeting of February 21, 2001, issued 7 articles. Following are the main articles regarding the study's subject.

All credit loans are subject to the approval of a credit committee which must be composed of the Chairman or his Vice, an expert in the field of credit, and two executives. The committee grants its approval and suggestions and supervises the lending plans. It also evaluates the economic feasibility of the projects in terms of future returns, and run stress test scenarios to measure its risk bearing ability. Every bank in Lebanon must abide by the regulations and laws issued by the BDL and the Banking Control Commission. Before granting credit limits, the banks and financial institutions must study the credit risk exposure, and diversify its risks. Lebanese banks and financial institutions are prohibited from acquiring stocks or shares with unlimited responsibilities. If a specialized bank, such as an investment bank and a commercial bank belong to the same economic group, the procedure of lending and borrowing is forbidden.

Banks and financial institutions are prohibited, from investing on their own account in joint investment plans established or located in Lebanon, without the consent of the Central Bank. They cannot grant facilities if the solvency and liquidity ratios or the reserves demanded by BDL are not kept. The credit limits must not exceed the 50% of the borrower's share in the value of the operation to be financed and 40% of the net financial assets of the borrower and

their respective guarantors. Total credit authorizations granted by a bank must not exceed, at any time, 5% of its shareholders' equity. The total of the said limits must include the limits granted by the bank's head office and branches in Lebanon and abroad, and the affiliated banks and financial institutions in Lebanon, and also on the basis of the consolidated tier-one capital of the latter after deduction of the shareholdings and participations in affiliated banks and financial institutions abroad. Bankers' acceptances, documentary credits, facilities covered by cash or bank guarantees, bank guarantees are excluded from the total limit calculation. (BDL Basic Circulars, 2007)

Banking Control Commission Circular N°238

Beside these two important credit related circulars of BDL, a bank or a financial institution must abide by the Banking Control Commission's circular number 238. The Banking Control Commission of Lebanon was established in 1967 by law N°28/67. It replaces the banking control department of the Central Bank by supervising banks, money dealers, financial institutions, brokerage firms and leasing companies with the coordination of the governor of the Central Bank. BCC circular 238, issued on the 23rd of October 2002, follows Basel requirements and dictates the necessary documents, studies and management for the credit files. Banks must complete files of the borrowers including: full knowledge of the financial and economical situations of the borrower's activities, measure and follow up the credit risk and the market risk of the said activities. It is required to renew the facilities' file once every year, for instance, obtain new financial statements if available.

These documents are to be preserved in a safe place and only the credit officers or selected managers can have access to them. The BCC also entails that each credit file must have the following sections: Inventory of information, correspondence (facilities request form, purpose, reimbursement methods and sources, collaterals and maturity, acknowledgement letter), information request (central des risques, client's reputation, legal standing, financial statements and list of properties) financial information (personal net worth), private information about the huge debtors (facilities above $ 2,500,000), credit requests and approvals (facilities amount, debit rate, commissions, reputation, legal standing, returns, collaterals, capital, reimbursement sources), follow up and remedial, legal documents, contracts and collaterals, archives. (Banking Control Commission of Lebanon, 2007)

United States Central Bank: Federal Reserve System

The Federal Reserve System, established in 1913, is the central banking system of the United States. Its main obligations are to carry out the nation's monetary policy, supervise and regulate banking institutions, sustain the stability of the financial system and offer financial services to depository institutions, the U.S. government, and foreign official institutions. Its authority is derived from the U.S. Congress and is subject to congressional oversight. Unlike Lebanon there is no one single governor, the governing body is the Board of Governors. The board members including its Chairman and Vice-Chairman are appointed by the President of the United States and confirmed by the Congress. (About The Fed, 2011)

The Board of Governors of the FED issues circulars regarding margin lending. There are three essential reports requested: (1) Registration Statement for Persons Who Extend Credit

Secured by Margin Stock, (2) Statement of Purpose for an Extension of Credit Secured by Margin Stock by a Person Subject to Registration under Regulation U, and (3) Statement of Purpose for an Extension of Credit Secured by Margin Stock.

In addition to these reports there are other reports that constitute an important factor in margin lending: Statement of Purpose for an Extension of Credit by a Creditor, Deregistration Statement for Persons Registered Pursuant to Regulation U and Annual Report. The FED is authorized by the Securities Exchange Act of 1934 to standardize securities credit granted by various lenders. The purpose statements are required to file the purpose of the loans collateralized by margin stock. As per the FED, margin stock represents stocks registered on a national securities exchange or trading OTC, bonds and shares of mutual funds. The Federal Reserve applies three regulations concerning the credits extended for the purpose of trading on margin. The *Regulation X* which concerns borrowers of securities credit, and the remaining two regulations T and U are designated for the lenders.

Regulation T is for the credits granted by brokers and dealers. *Regulation U* is applied for banks granting margin credits. In both regulations, the lender must obtain a written facilities request from the customer detailing the purpose of the loan. The said purpose ought to be only for purchasing, carrying and trading securities. The client must abide by the purpose statements which consist a way to authenticate compliance and be used as proof by the Justice Department or the Securities and Exchange Commission. Both the borrower and the lender fill out the purpose statement from. The borrower completes the part where he states the amount of the loan and identifies the specific purpose of the loan and whether the client will deliver the securities against payment. In his turn, the lender completes the part where he lists and values the

collaterals and signs the sheet as being the acceptance of the client's good faith. The FED requires from the non-bank institutions an annual report to follow up the sum of credits granted against the pledge of securities.

On the other hand, Regulation U demands that every person benefitting from margin stock of $ 200,000 or more must complete a registration statement entailing background information, credit information and the amount of credit extended. A non-bank lender that is registered can deregister if it has not had credits up to $ 200,000 during the last six months. If the said amount is exceeded, the lender must re-register. A semi-annual report is requested from the non-bank lenders describing the total amount of credit granted against securities, the nature of people benefitting from the loan (employee stock option plan, ownership, purchase). (Report Forms, 2010) (Margin requirements, margin loans and margin rates: Practice and Principles, 2000)

STATISTICAL ANALYSIS

Methods and data collection description

The basic raw pool of data used in this thesis was collected from a well-known Lebanese investment bank, ranked between the first three financial institutions in the country. The data is selected for the period ranging from the beginning of the year 2007 till the end of the year 2009. It is a monthly based information detailing the date, as at the first day of each month, the clients' account numbers, (no names were mentioned for banking secrecy purposes), the security names, quantity of securities held by each client, every security's ISIN code and debit interest charged for respective clients.

The total number of observations used sums up to 2376. The client selections for this study are the clients who benefit from overdraft facilities against a certain percentage of their securities portfolio market value. Some of the clients' account numbers were repetitive through all the months of all three years which explains the fact that the customer benefits from margin facilities during all the mentioned time frame. On the other hand, some of the clients' account numbers do not appear for all the period due to the cancellation of their credit facilities limit upon their request. Some other accounts emerge randomly; these are new opened accounts for trading on margin purposes. The number of securities owned by the clients differs from each other, diversified to non – diversified portfolios given each client's willingness of bearing a certain level of risk and their respective availability of funds to invest. The securities' nature varies from Lebanese, Middle Eastern, Gulf, European, and American to among many other stocks, funds and shares listed on local or international exchange markets.

Regarding the Lebanese listed stocks, they are listed on the Beirut Stock Exchange. The BSE is a public institution. It is ruled by the provisions of the BSE bylaws, stipulated in the legislative decree number 120, and dated September 16, 1983. Established in 1920 by a decree of the French Commissioner, the BSE is the second oldest stock market in the region. It was initially restricted to gold and foreign currencies trading. Later in the 30s, trading was expanded to include shares of private companies. It was then heading to privatization when many banking and financial services companies listed their stocks on the BSE. During the turmoil of 1975 in Lebanon, the BSE drew back and got suspended until its re-launching in January 22, 1996.

Beirut Stock Exchange has three types of markets: the official market for companies incorporated for more than three years with a capital of at least $ 3,000,000 worth, and the junior market for newly established companies with a capital of $ 1,000,000 worth at least. Both markets are obliged to distribute a minimum of 25% of their share capital to the public being held by a minimum of 50 shareholders. The third market is Over the Counter Market for Lebanese companies with a minimum capital of $ 100,000. The shares of the latter are traded without being listed on the Beirut Stock Exchange. (The BSE - About BSE, 2011)

The stocks listed on the BSE have as index the BSI, BLOM Stock Index. The BLOM Stock Index is a capitalization-weighted index of all the listed companies on the Beirut Stock Exchange. It was developed by Blominvest Bank SAL., with a base level of 1000 as of January 22nd, 1996 during the re-launch of Beirut Stock Exchange.

The ISIN code, another collected information to facilitate the research, is the abbreviation of International Securities Identifying Number, which identifies a security such as bonds, commercial papers, equities and warrants. It is a twelve character alpha-numerical code that does

not contain information characterizing financial instruments but serves for uniform identification of a security at trading and settlement. Furthermore, it is not to be mixed with the ticker or symbol of a security. (Investopedia, 2011). Finally the debit interest rate is the rate charged to each client's overdraft account being the revenues of the bank and the borrowing cost of the customer. These observations were extracted after receiving an approval from the said bank's General Manager.

Beta calculation for stocks

After retrieving these records, the next step was to gather information about the beta of each security in order to further calculate the portfolio risk of each individual client and run a regression analysis to verify its statistical significance with the debit interest rate. The majority of the beta numbers were assembled from the Reuters, Bloomberg, money central msn and Google finance stock reporting sources. On the other hand, some of the Lebanese and Middle Eastern securities' betas were in need for calculation due to the non availability of information. The ISIN codes for each stock were utilized to look for their betas. Since the risk of individual client's portfolio is to be measured, first each stock's beta must be derived.

The value of beta is calculated using price variations of the stocks which are then compared to the movements of an overall market indicator over the same period of time. In order to calculate the betas of the above mentioned various stocks, first a weekly data of each security's historical closing prices and its corresponding benchmark indices were extracted in the period of time ranging from early 2006 until mid 2010. The chosen index generally represents the economy of the nation and sector in which the stock trades. The beta of the stocks listed on

the BSE was calculated by getting the BSI for the mentioned period of time and their historical prices were extracted from the BSE website. These stocks are: Blom GDR, Audi GDR, Audi Listed, Solidere A, Blom Listed, Byblos Bank listed, Holcim Liban listed shares, Rassamny Youness Motor Co. (RYMCO), Bank of Beirut Listed, BLC Bank and BEMO Bank.

The percentage changes for the stock and index was calculated using the following:

$$100 * \frac{Current\ Value - Previous\ Value}{Previous\ value} \quad (2)$$

Then, the beta was derived on the Excel spreadsheet as being the function of slope of the percentage change of the stock's price and the percentage change of the market index since the beta measures the volatility of a stock compared to a more general market. (Stock Beta and Volatility, 2007)

Among the securities held by the clients were unlisted, privately held and traded over the counter stocks. Since these stocks are not listed, and there is no reference index, another method was used to obtain their respective betas. An Excel sheet from Reuters was extracted detailing for each company, the name, description of the industry the company functions in, the income tax percentage, the levered beta, and the debt to equity ratio.

Levered and unlevered beta

It is worth to mention that there are two kinds of betas, levered and unlevered. Unlevered beta is the beta of a company after removing the effect of its debt obligations. It eliminates the influence of the use of leverage on the capital structure of a firm. Removing the debt component allows an investor to compare the base level of risk between various companies. It is calculated by:

$$\beta u = \frac{\beta l}{(1 + ((1 - Tax\ rate) * \frac{D}{E})} \quad (3)$$

Where βl is levered beta and D/E is the debt to equity ratio.

The levered beta must always be higher than the unlevered beta because the equity cash flow is riskier than Free Cash Flow. The FCF is the cash available after paying out from the net income all the expenses, including amortization, depreciation, changes in working capital and capital expenditures. Hence, it is a company that has no debt, meaning the beta of the company's stock is unlevered. The equity cash flow is a firm based on leverage. It issues debt and therefore this specific company's stock's beta is levered. Since the levered is riskier, then the levered beta is higher than the unlevered beta. On the contrary, in a world of no leverage cost, the unlevered and levered betas are equal, unless different financing strategies are used by the corresponding companies. (Fernandez, 2003)

Industry average beta

Afterwards, the industry's average beta is calculated. It is the beta of businesses with similar risk profile average beta. For instance, if there is a stock which operates in the fuel industry several stocks in the said industry is gathered with their respective levered betas. The average of these betas is then calculated. In order to find the beta of the stocks, the debt factor is to be removed from the industries' beta. Therefore the beta is unlevered by the following formula for each individual stock in the industry:

$$\beta u = \frac{Avg\ \beta l}{(1 + (1 - Tax\ rate) * \frac{D}{E})} \quad (4)$$

Where βu is the unlevered beta and $Avg\ \beta l$ is the average levered Beta of the stock.

After calculating the average of the entire unlevered beta of the business that the company operates in, there is the need to adjust for the fact that being a private company it also has firm specific risk, so the re-levered beta is calculated for each stock with its corresponding specific debt to equity ratio and corporate tax rate of the respective country in which the stocks are listed in. For the purpose of deriving the debt to equity ratio, each company's total assets and total debts from their relative financial statements from ZAWYA website were found.

$$Total\ Debt\ =\ Total\ Assets - Total\ Equity \quad (5)$$

Then, Debt to Equity ratio was derived as follows:

$$\frac{D}{E}\ ratio = \frac{Total\ Debt}{Total\ Equity} \quad (6)$$

As for some of the companies whose financial statements were not published, simply the average industry beta was used.

Portfolio beta

After collecting and calculating all securities' betas, the portfolio beta for each client's holding was derived. The portfolio beta represents the portfolio's overall market risk. To find the said beta, all stocks' beta located in the portfolio of each client is multiplied by the percentage of the total portfolio that stock represents (i.e., a stock with a beta of 1.3 that comprises 10% of your portfolio would have a weighted beta of 1.3 times 10% or .13). Later, all the weighted betas are added together to achieve the portfolio's overall beta.

Limitation

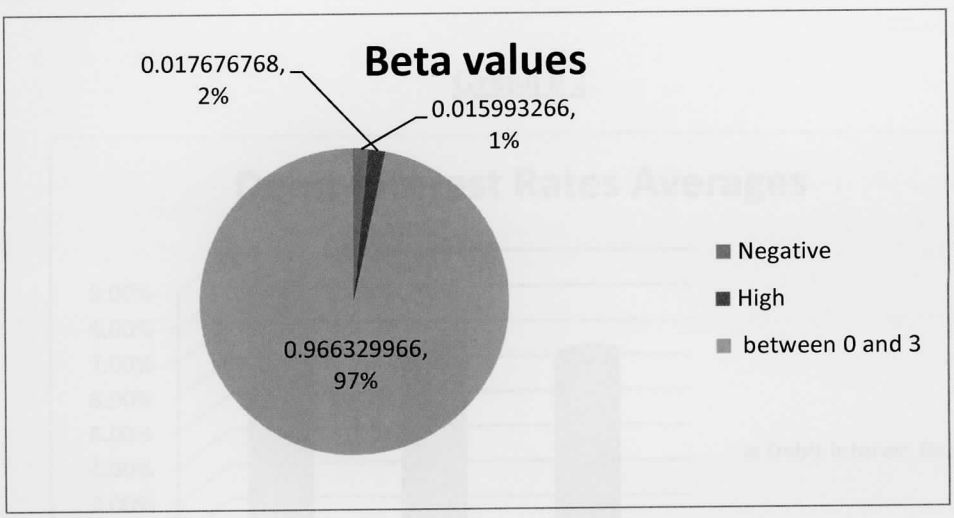
There is a sort of a limitation regarding the securities' portfolio collection. The Treasury bills and bonds, also known as risk-free bonds, have been eliminated from all clients' portfolios for the simple reason that bonds in general are considered less risky than stocks. Bond betas are very low and insignificantly different from zero. The risk of stocks and bonds vary in different ways. Bonds issuers promise to repay at maturity the face value of the security to the holder. Stocks have no such guarantee. In addition bonds pay a fixed rate of interest whereas the stock issuers have no obligations to do so. They may only distribute dividends if they are willing to. Historically the bond market has shown to be less exposed to price movements or volatility than the stock market. Bonds are considered to have no risk. Hence, when they are issued by any government's Treasury, the bonds are supported by the full trust and credit of that government. Therefore it is concluded that bonds don not have a significant beta.

Excel regression results and analysis

Test # 1: Debit interest rate and portfolio beta

Now that the statistical data collection was terminated, first the relationship between the debit interest rate charged on the clients and portfolio beta was studied. The excel sheet includes the following variables: Client account numbers, dates as at first day of each month for the period longing from 2007 till 2009, debit rates of each client and their respective portfolio betas. The average of all the portfolio betas through the three studied years is 1.2510 and its standard deviation is equal to 0.99366. The average debit interest rate for the same period is 7.35% and the standard deviation has a value of 1.03635%.

Graph # 1

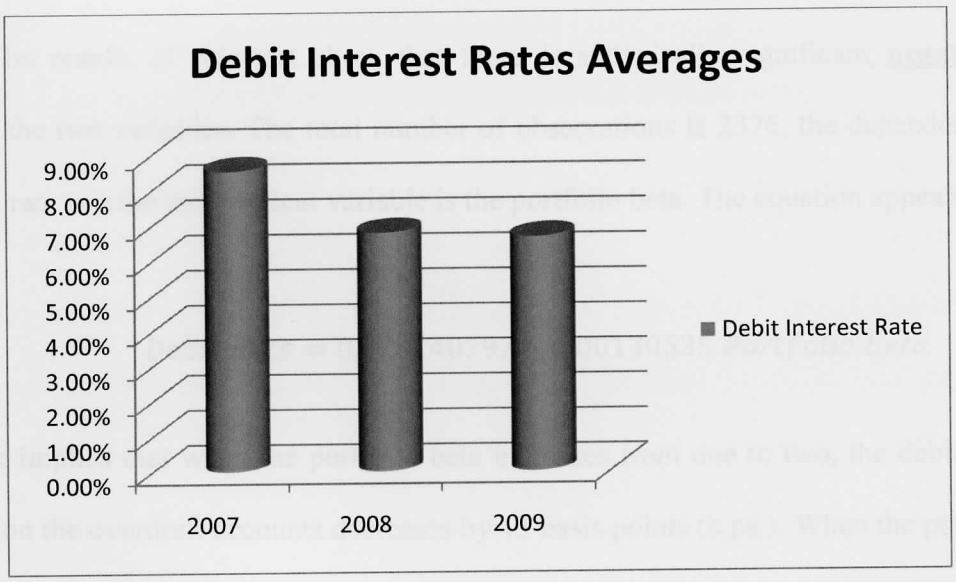


As a first glance at the observation of portfolio betas, some negative numbers and some very high valued betas normally above 3 were found. The negative betas and high pitched betas consist 1.5993% and 1.7677% of the total respectively. These two figures represent a very small proportion of the whole sample, since negative and very high betas are so rare to find (see graph # 1: Beta values). The negative betas, as illustrated before implies that the stock is in an inverse

movement with the market and the high beta stocks are very volatile shares. Volatility in finance refers to the possibility of fluctuations in a certain stock by identifying its corresponding risk.

The graph # 2, indicates that the debit interest rates were pretty high during the year 2007 having an average of 8.56%, whereas at the beginning of 2008, namely starting with the month of February till the end period of 2009, the rates' average have fallen to 6.73% which is much lower than the previous year's average. This 21% decrease will be illustrated further in the study during the analysis of some statistical tests (Quandt-Andrews unknown breakpoint test). The standard deviation of the interest rates during the year 2007 and during the period 2008 - 2009 was calculated to be 0.51 and 0.67 respectively. This means that the interest rates are clustered around the mean.

Graph # 2



As a first step, to find out whether the diversification of the portfolio in terms of risk, measured by **beta**, and **debit interest** rate are significantly related, a simple regression analysis is run on the Excel spreadsheet data analysis tool.

The summary output appears in the tables 1 and 2:

Table 1: Regression statistics

R Square	0.015664616	*Standard Error*	0.010284177
Adjusted R square	0.015249985	*Observations*	2376

Table 2: Debit interest rate and portfolio beta regression output

	Coefficient	*Standard Error*	*T-statistics*	*P-value*
Intercept	0.075140792	0.000339269	221.47881	<0.00001
Portfolio Beta	-0.00130535	0.000212373	-6.146511333	<0.00001

The results of this test show that there is statistically significant **negative relation** between the two variables. The total number of observations is 2376, the dependent variable is the debit rate and the independent variable is the portfolio beta. The equation appears as follows:

$$Debit\ Rate = 0.075140792 - 0.00130535\ Portfolio\ Beta \quad (7)$$

It implies that when the portfolio beta increases from one to two, the debit interest rate charged on the overdraft accounts decreases by 13 basis points (b.ps.). When the portfolio beta is zero the debit interest rate charged is 7.5%. The test is statistically significant first because the absolute values of t-statistics are greater than two and second the p-values are almost zero. The

smaller the value of probability, the more significant the parameter and the less likely that the actual parameter value is zero.

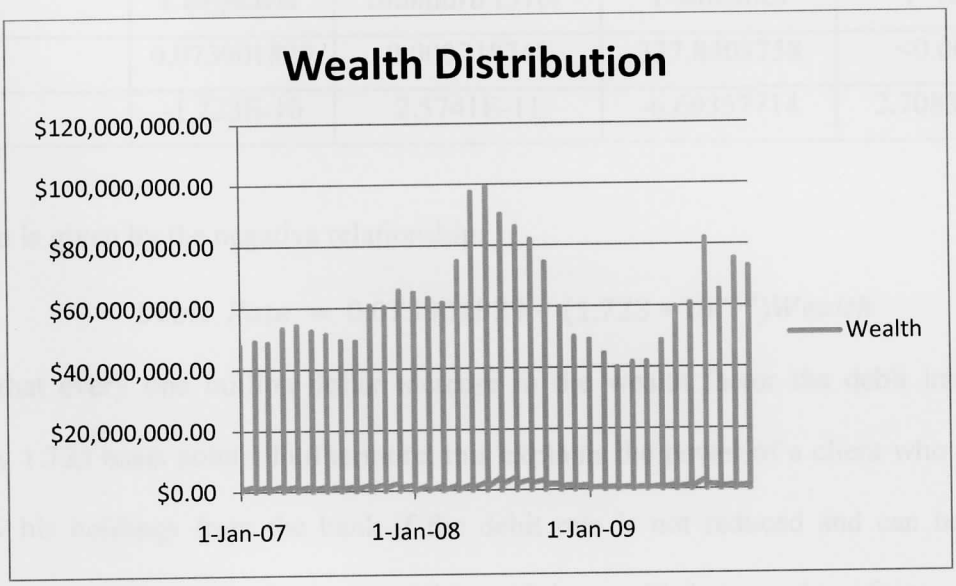
Conversely, it is noticeable in the output of table 1 that the adjusted R square is equal to 1.5249985% which is usually considered a very low indicator. This figure states that beta explains only 1.5249985% of the variations in the debit interest rate. The adjusted R^2 is a better indicator than the R^2 because as its name implies it adjusts for the degrees of freedom. The adjusted R^2 can be negative, and will always be less than or equal to R^2. Generally, a low adjusted R square might be an indication of poorly measured or excluded variables. But, this does not mean that the tested model is not fit because here the adjusted R square is of secondary interest.

Reference to all of the above, the negative relationship between the rate and beta had to be explained. Based on my personal experience as a credit officer and based on my educational background, it is of the normal sense to have the opposite relation between the debit rate and the beta, i.e.: positive relation instead of the negative relation. This positive relation is explained by the fact that the bank charges lower debit rates to less risky portfolio holders and higher rates for the riskier investments in order to shelter its revenues. Moreover, it contributes to the fact that the higher the risk the higher the return of the investor, the more the ability to cover the debit rate charged on the overdraft account. Upon having this contradictory negative relationship, other factors that might affect the debit rate independently of the riskiness of the securities portfolio, were brought forward.

Test # 2: Debit interest rate and wealth

Since wealth is an important factor based on which banks decide how much credit line to grant to the clients, it was incorporated in the regression analysis against the debit rate. Simply the wealth is each client's abundance of valuable resources or material possessions, or the control of such assets. The wealthier the client is, the higher the trust in his reimbursement sources to repay the debit interest rate. The wealthy client has more power to negotiate the rate than others. For instance, when the personal net worth form is filled out by a client and he or she has a wealth of cash in banks, list of land properties, securities portfolios held with various banks or financial institutions and a very high income, this client has mostly the power to negotiate to the lowest interest rate possible to be applied to his overdraft account. Therefore, in order to verify this statement a regression analysis is run having as dependent variable the debit interest rate and the independent variable as wealth. The wealth of each client in the 2376 observation was gathered, being their securities portfolio holdings and cash whenever available.

Graph # 3



The wealth ranged from the smallest number of $ 209 to the largest number $ 99,078,850 having a total average of $ 2,287,211 (see graph # 3). This variation is explained by the wide standard deviation of $ 3,122,000.

The regression results on excel in tables 3 and 4 show that there is a statistically significant **negative relation** between wealth and debit rate. The significance is explained by the t-statistics that have an absolute value of greater than 2 and the p-value is less than the marginal significance level of 0.05. The independent variables explain 1.8% of the variations in the debit rate which is given by the adjusted R square.

Table 3: Regression statistics

R Square	0.018523194	*Standard Error*	0.010269233
Adjusted R square	0.018109766	*Observations*	2376

Table 4: Debit interest rate and Wealth regression output

	Coefficient	*Standard Error*	*T-statistics*	*P-value*
Intercept	0.073901829	0.000218748	337.8403758	<0.00001
Wealth	-1.723E-10	2.5741E-11	-6.69357714	2.70837E-11

The equation is given by the negative relationship:

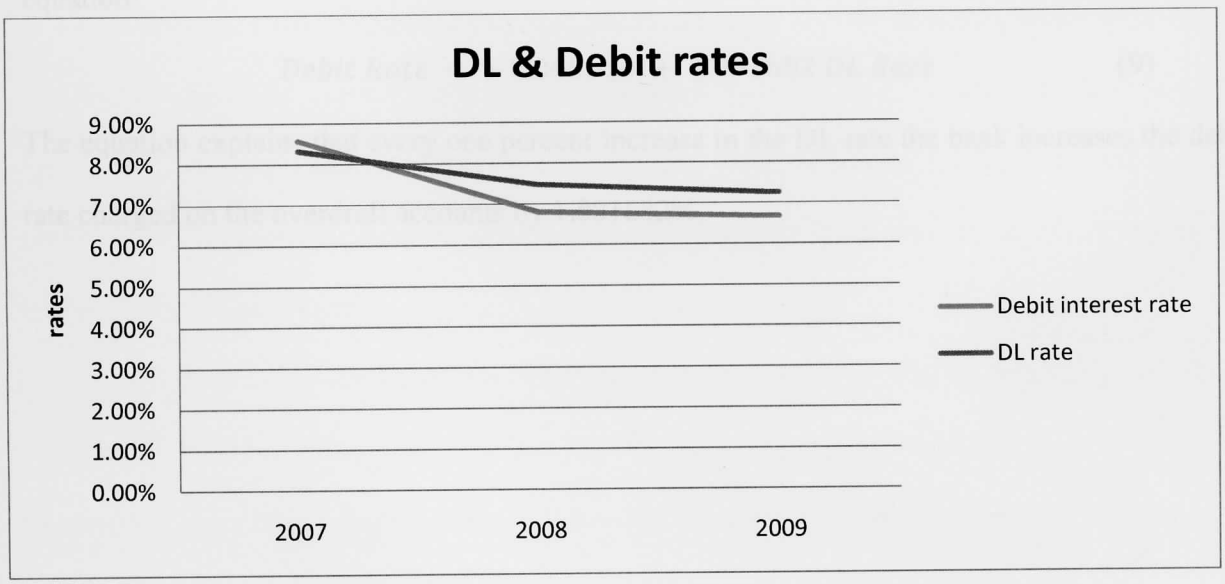
$$Debit\ Rate = 0.073901829 - (1.723 * 10^{-10})Wealth \quad (8)$$

It implies that every one million dollar increase in the wealth factor the debit interest rate decreases by 1.723 basis points. Furthermore, this explains the power of a client who is willing to withdraw his holdings from the bank if the debit rate is not reduced and can be easily a potential client to a competitor bank. In addition, if the wealth has a value of zero, the debit interest rate has a value of around 7.4%.

Test # 3: Debit interest rate and Discount and Loans rate

In the regression equation number 8 the estimated constant or intercept is around 0.074, or 7.4%. This is approximately equal to the average of the DL rate, hence the need to include this variable in the regression. The DL rate is retrieved from the web page of the Central Bank of Lebanon, under the section of the monthly rates on discount and loans in US Dollars. (Economic and Financial Data, 2011) Since the concerned margin facilities are in terms of dollar amounts, the rates from the Central Bank of Lebanon were extracted in USD. Once collected, this interest rate variable was included in the spreadsheet. Of course this variable is monthly and does not change each day. Since the data is daily, the interest rate was kept the same for each day of a given month. This new variable will show whether the customers' debit rates change proportionately with the DL rate. As a matter of fact the regression analysis of both variables shows that there is statistically significantly positive relation between the two. Hence they move together as shown in the graph below:

Graph # 4



The regression output is detailed in tables 5 and 6:

Table 5: Regression statistics

R Square	0.703719692	*Standard Error*	0.005642212
Adjusted R square	0.70359489	*Observations*	2376

Table 6: Debit interest rate and Discount and Loans rate regression output

	Coefficient	*Standard Error*	*T-statistics*	*P-value*
Intercept	-0.06501014	0.001848291	-35.17310771	1.6487E-218
DL Rate	1.801682613	0.023993272	75.09116045	<0.00001

The significance of this test is illustrated by the t-statistic absolute values of greater than 2 and the p-value of almost zero. As expected, the DL rate variable explains very well the dependent variable debit interest rate specific to the bank. This is shown by the high adjusted R square value of 70.35%, which means 70.35% of the variations in the debit interest rate, is explained by the variation in the DL rate. Their positive relation is given by the following equation:

$$Debit\ Rate = -0.065010 + 1.801682\ DL\ Rate \qquad (9)$$

The equation explains that every one percent increase in the DL rate the bank increases the debit rate charged on the overdraft accounts by 1.801682%.

Discussion

Following this sense of relating the firm specific debit rate to the DL rate, and since they move together, further investigations of the negative coefficient on beta was conducted. According to finance books, the slope of the relation between beta and the rate of return is equal to the average market risk premium. The relationship between the beta and the market return is explained by the *Security Market line*. SML is the graphical representation of the Capital Asset Pricing Model. It displays the expected rate of return of an individual security as a function of systematic, non-diversifiable risk beta. The beta is the explanatory variable and the return is the dependent variable. The slope of this relation is the expected market premium, which is the average of the return on the market portfolio from which it is deducted the average market risk free rate. This average is hence called average market premium or average excess return. It is the explanation of how much an investor is willing to take risk in order to make a certain line of profit return by investing in a stock. It is worth to mention that at equilibrium the marginal cost is equal to the marginal return and what is a cost to the investor is compensated by a return from the assets held by the investor. (Brealey, Myers, & Allen, 2006)

Finally it turns out that during the period selected for this research, 2007 – 2009, the *market risk premium was* ***negative***. It was calculated by using daily data for the Standard and Poor's 500 historical index price from yahoo finance. (S&P 500 Index, 2011) Published in 1957, the S&P 500 is a weighted index of the prices of 500 large capital companies whose stocks are traded in the United States.

It is well recognized that the volatility of the S&P 500 is usually positively correlated with the S&P 500 returns, the higher the risk the higher the return. But when there is economic uncertainty, a negative relation of return and volatility stems out of a negative price reaction.

Therefore, the preference of investors towards uncertainty affects the size of this correlation. Since volatility has a negative MRP negatively correlate with market returns, this model is not a traditional CAPM model. (Eraker, 2008). This problem occurred given the financial crisis during the period longing from 2007 to 2009 which has caused long term risk free securities yield more than the market during the same time frame. So if this situation is continued with this method then there is room for negative MRP.

This is what happened at the outburst of the **financial crisis**. With the fear of losing money, investors withdrew their money from the stock markets leading to the fall of the market itself. After withdrawing this money, people invested it in safer securities, namely in the risk free bonds. In this case, banks would cut the risk free rate due to the huge inflow of capital. This process will continue till market risk premium takes back its positive nature. Consequently, on the short run MRP can be negative but over the long run it will stay positive.

Financial Crisis outburst in the United States of America

Now in order to make sense of the negative relationship between beta and the debit interest rate, one can refer to the financial crisis of 2007 – 2009 and to the historical data trend of the LIBOR during this period. This crisis started in the United States of America by means of very high leverage in the economy. People consumed more than they actually earned. As a result, when people were using so much leverage, the lending banks in their turn faced liquidity crunch. Here came the role of the US Federal Bank.

On August 17, 2007, the Board of Governors of the Federal Reserve declared a temporary change to credit lending terms. The discount rate was cut by 50 basis points from 6.25% to 5.75% and the term of loans was extended to thirty days. This reduced the spread of the

primary credit rate over the fed funds rate from 100 basis points to 50 basis points. Later than on March 16, 2008, in order to rescue Bear Stearns from insolvency and to stop institutional bank runs, the Federal Reserve announced significant changes to primary credit lending terms by extending the term of loans from thirty days to ninety. The primary credit rate was also reduced to 3.25% from 3.50%, which cut the spread of the primary credit rate over the fed funds rate to 25 basis points from 50 basis points. (Discount window, 2011)

Impact of the Global Financial Crisis:

Europe (PIGS): It turned out that other countries accompanied the U.S. in this overleveraged economical turmoil. Especially the countries of Northern Europe: Portugal, Italy, Greece and Spain (called the PIGS). These countries are members in the European Union (EU), a political and economic organization of 27 European countries who enjoy internal free trade and common external tariffs. It was established in 1993. Sixteen out of the 27 countries use the common currency of EURO. Among the PIGS, the greatest economic downturn was that of Greece. It has the highest debt to Gross Domestic Product (GDP) ratio of around 90%. Greece extended 20% of its GDP as loans to the Balkan region. When the latter's economy was stagnant, Greece had huge losses. Consequently, in 2008 Greece's banks bailed out, budget deficit increased, stock and bond markets regressed and tourism rate declined. (Resourceful Blog, 2008)

The United Arab Emirates had also its share in the financial crisis, mainly Dubai. For the past 6 years Dubai was considered to be the most booming economy with new malls, tall buildings, high tech facilities and luxurious sites. Dubai mainly concentrated on real estate

booming because its oil resources were little. Its growth rate increased from 4% in 2006 up to 177% by December 2007. In early 2008, the real estate prices decreased 50% than the normal rate and caused a recession. The state of Dubai was no more able to pay its debts, the investments recessed and the stock market crashed decreasing by 70% from its previous index.

The Middle Eastern countries did not escape the turmoil. Lebanon is of main interest since the data collected for the research is from a Lebanese investment bank. During this time, Lebanon's stock market index decreased by a lesser margin than others, its financial market growth was positive and attracted more investors. Investors who had their money in foreign banks who were in their turn going to bankruptcy transferred their deposits to the Lebanese banks. Hence, the incoming deposits increased by 3.7% from mid 2008 till early 2009.
To avoid major lending problems, the Central Bank of Lebanon planned to lend in LBP through subsidized loans and decreased reserves requirements on deposits in Lebanese Pound in order to use the excess in lending the economy. (The World Bank Group, 2009)

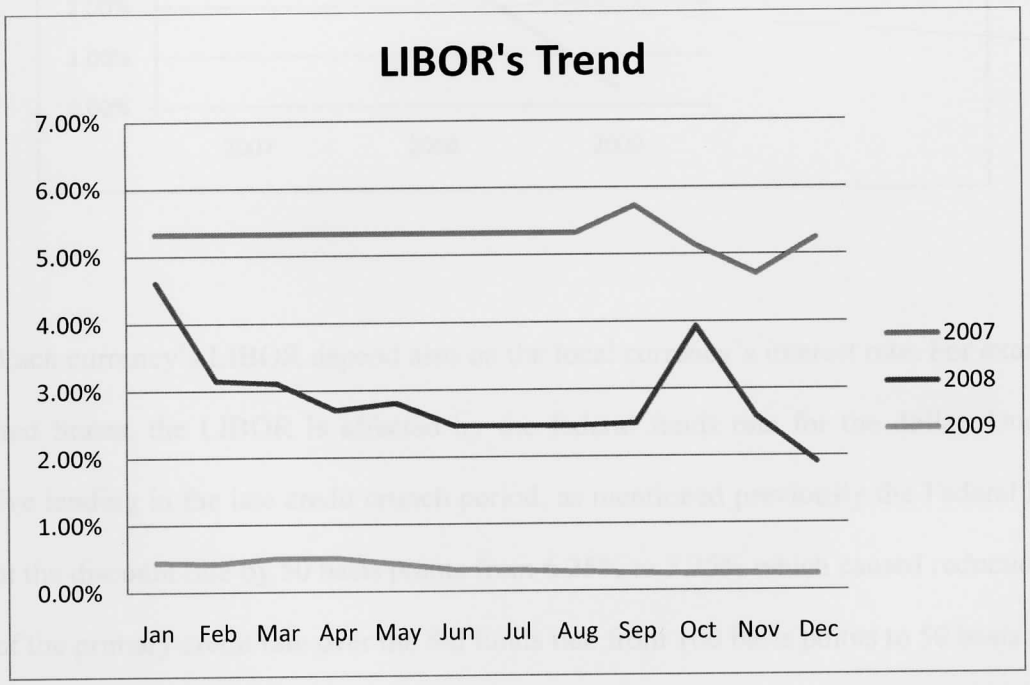
London Inter Bank Offered Rate

LIBOR is the short name for London Inter-Bank Offered Rate. It is determined by a group of large London banks which is a very common benchmark interest rate. The LIBOR is used as the borrowing rate for London interbank Money Market for short or long term loans and is published daily by the British Banker's Association and fixed on Reuters. Its maturities vary from overnight to twelve months for different currencies, Pound Sterling, United States Dollar, Japanese Yen, Swiss Franc, Canadian Dollar, Australian Dollar, Euro, Danish Kroner, Swedish Krona, and New Zealand Dollar. For instance, when lending in British Pound, the LIBOR

corresponding to this currency is used. The one month, 3 months, 6 month and one year LIBOR differ because the risk premium increases with the term-to-maturity. The LIBOR is also used by the U.S. capital markets and published in the *Wall Street Journal*. The rate is used by international banks when lending in order to adjust for economic condition changes.

The impact of the financial crisis of 2007-2009 was obvious on the LIBOR. The graph # 5 shows a decreasing trend all through the twelve months of the years. Since the 1 month LIBOR is the most used for the margin loans, its historical trend during the financial crisis mentioned previously will be observed.

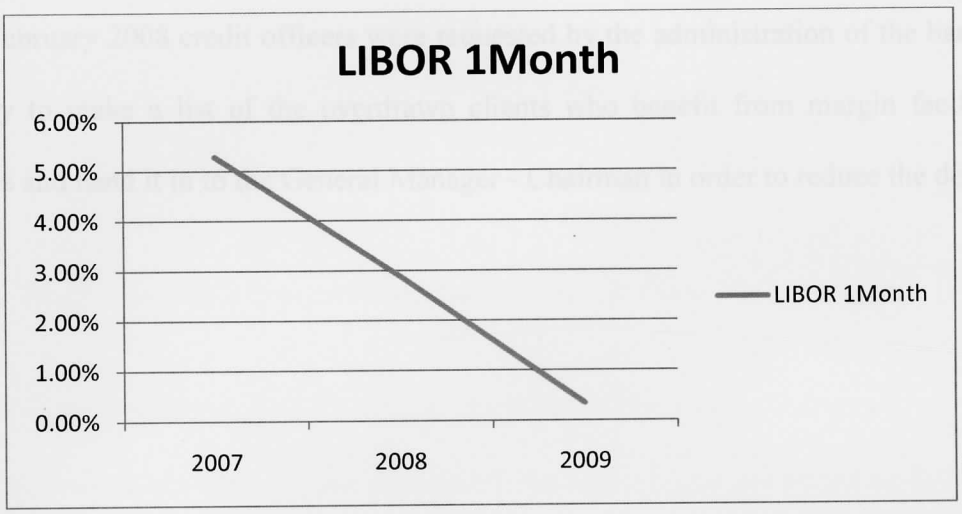
Graph # 5



It is noticeable that the LIBOR during 2007 ranged from 4.7% to around 5.7% having an average of 5.28%. The data points are not much spread given a low standard deviation of 0.226%. Both values of 4.7% and 5.7% are considered high when compared to those of the year

2009 which have a maximum value of 0.5%, with an average of 0.35%. Its standard deviation is 0.1007%, meaning that the data points are clustered around the mean. This sharp decrease in the LIBOR from the average of 5.28% to 0.35% in almost 2 years is illustrated in the graph # 6:

Graph # 6



Each currency's LIBOR depend also on the local currency's interest rate. For example, in the United States, the LIBOR is affected by the federal funds rate for the dollar. Due to the aggressive lending in the late credit crunch period, as mentioned previously the Federal Reserve Bank cut the discount rate by 50 basis points from 6.25% to 5.75% which caused reduction in the spread of the primary credit rate over the fed funds rate from 100 basis points to 50 basis points.

Since LIBOR is an international benchmark rate for short term borrowings, and given that any investment bank may have a position in foreign American stocks, Lebanese financial institutions also had to regain the interest rates charged on the borrowing accounts of the clients.

During early 2008, I have personally held a meeting with the credit senior manager at the investment bank where I work and he agreed with the argument that whenever there is financial crisis the bank supports the clients by lowering their borrowing costs because the bank wants to collect its dues and tend not to increase them. The bank will want to protect its rights and revenues and at the same time when the Central Bank reduces the rates influenced by the international rate decrease, all the local banks will lower the rates as well. In addition, I recall during February 2008 credit officers were requested by the administration of the bank subject of the study to make a list of the overdrawn clients who benefit from margin facilities against securities and hand it in to the General Manager - Chairman in order to reduce the debit rates.

Conclusion

To sum up the above mentioned discussions, it can be concluded in the following manner: If the debit interest rate charged on the overdraft accounts is R*d*, and if the hypothesis that the debit interest rate is set by the bank proportional to the systematic risk, beta (β) is maintained, then it is a positive function of:

$$Rd = f(\beta) \tag{10}$$

$$With \quad \frac{\partial(Rd)}{\partial(\beta)} = \frac{\partial(f(\beta))}{\partial(\beta)} = f'(\beta) > 0 \tag{11}$$

In simple terms, if beta (β) is higher consequently the debit rate (R*d*) is higher.

The client holds a portfolio with a given risk namely beta. The return on this portfolio (R*p*) is approximately equal to the product of the beta (β) of the portfolio by the US stock market return, which will be called R*m*. Therefore the return on the portfolio (R*p*) of the client is:

$$Rp = Rm * \beta \tag{12}$$

In simple terms, if beta (β) is higher the portfolio return of the client (R*p*) should be higher. In the long run he is making profits or just breaking even, which means that:

$$Rp \geq Rd \tag{13}$$

This implicitly assumes that the 'market return' R*m* is positive on average. This is true in the long run. However, R*m* was temporarily negative during the daily period considered which is in this research's case 2007 – 2009, because of the US credit crisis. Consequently R*p* was

negative. As a result the higher the beta (β) the more negative the portfolio return of the client Rp. Thus the client is faced with high unrealized losses. If he liquidates his position and realizes his losses, he is bankrupt and cannot repay the debit balance outstanding at the bank. In such a case, the bank has an interest to prevent default. For that purpose the bank will ease conditions on the client. This is done by lowering the debit interest rate (Rd) . Hence the channel of transmission is:

$$High\ beta \Rightarrow high\ unrealized\ losses \Rightarrow$$
$$high\ probability\ of\ default \Rightarrow lower\ debit\ interest\ rate$$

If one takes the start and end of this chain then: Higher beta (β) lower the debit interest rate (Rd). This negative relation stands only because during the period considered, Rm *was* negative. If one had taken a period of thirty years, for example, then Rm would be positive on average, and Rd and β would be positively related.

E-views 7 regression results and analysis

The data collected could be accompanied by some sort of noise. Therefore the curve fitting becomes essential. The curve fitting method fits equations of similar curves to the raw data. This is given by the method of least squares which describes the best fit in the least-squares since it minimizes the sum of squared residuals. The residual represents the difference between the observed value and the fitted value of the model. In order to find the best fitting line, several statistical tests were run using the E-views 7 program.

The program is a powerful statistical tool that manages many data varying between time series, cross-sectional, or longitudinal data. It runs econometric and statistical analysis, creates forecasts or model simulation. The output of E-Views regression is separated into three sections. The upper panel shows the input to the regression, the middle panel reveals information about each regression coefficient, and the last panel summarizes the statistics about the entire regression equation. The estimated regression coefficients and their respective statistics, such as standard errors, are the highlighted elements of the E-views output. The *t* statistic in the output shows whether or not the coefficient is statistically significant. Of course it depends on the critical value chosen based on the risk one is willing to take. The smaller the critical value, the greater the risk and the more probability to find the test significant. Regarding the p-value, the hypothesis one is testing will be rejected if the p-value is less than 0.05%, the critical value.

The last panel of the regression includes several statistics about the regression. "Sum squared residuals," "Log likelihood," "Akaike info criterion," "Schwarz criterion," and "Hannan-Quinn criterion." These are only useful to find out which model is better than the other. Therefore, they are of no particular interest in this study. The "Mean dependent var" and "S.D. dependent var," describe the sample mean and standard deviation of the left hand side variable.

"Adjusted R-squared" makes an adjustment to the R squared and shows what fraction of the variation in the independent variable is explained by the regression. The "F-statistic" and "Prob (F-statistic)" are used together to interpret the results. The F-statistic calculates the standard *F*-test of the combined hypothesis that all the coefficients, except the intercept, are equal to zero. (Startz, 2009)

Least Square: curve fitting

Using the least square method the first test is conducted on E-views. The method of least squares is a standard approach to the application of data fitting. The best fit in the least-squares sense minimizes the sum of squared residuals, a residual being the difference between an observed value and the fitted value provided by a model.

The dependent variable is the debit rate (R*d*) and reference to the table 7, the independent variables are the Wealth (W), Beta (β) and Discount and Loans rate (DL rate). In the linear model here, holding all variables constant, the coefficients measure the marginal contribution of the independent variable in relation to the dependent variable. The coefficient labeled "C" is the intercept, meaning when all other variables are zero, and the equation is equal to the left hand side. The other coefficients are interpreted as the slope of the relation between the corresponding independent variable and the dependent variable, assuming all other variables do not change.

From the regression output in table 7, it can be determine that the **first model** is statistically significant hence all the t-statistics have an absolute value of greater than 2 and the probability and the p-values are less than 5%. The independent variables explain 73.29% of the variations in the dependent variable; this figure is given by the adjusted R-square. The mean of the dependent variable is around 7.35%. The "Std. Error" column reports the estimated standard

errors of the coefficient estimates. In the regression statistics the standard errors have very low values.

Table 7: First model - Least squares method

Variable	*Coefficient*	*Std. Error*	*t-statistic*	*Prob.*
C	-0.061961	0.001754	-35.32546	<0.00001
Wealth	-1.41E-10	1.33E-11	-10.61302	<0.00001
Beta	-0.000813	0.000110	-7.417067	<0.00001
DL rate	1.779812	0.022583	78.81273	<0.00001

Table 8: Regression statistics

R- Squared	0.733278	*Mean dependent var.*	0.073535
Adjusted R-Squared	0.732940	*S.D. dependent var.*	0.010255
S.E. of regression	0.005299	*F-statistic*	2173.714
Sum Squared residual	0.066613	*Prob (F-statistic)*	<0.000001

The linear model function is given by:

$$Rd = -0.061961 - (1.41 * 10^{-10})\, W - 0.000813\beta + 1.78DL \qquad (14)$$

A one million dollar increase in the wealth factor will cause a 1.41 basis points decrease in the debit rate. A one unit increase in the beta i.e. from 1 to 2 will cause a decrease of 0.0813 basis points in the debit rate. The DL rate has a positive relation with the debit rate. Hence a one percent increase in the DL rate will lead to a 1.78 percent increase in the debit rate charged by the bank.

Adjusting for Heteroskedasticity

If there is heteroskedasticity, the t-statistics will characteristically be biased leading to the difficulty of determining whether the coefficient estimates are statistically significant or not. The forecasts from the regression will also face bias. As a result, the next step is to use the data and the residuals to test if there is a heteroskedasticity problem. Heteroskedasticity is present if the random sequences of variables have different variances. It is the disturbances of the linear model that has constant variance but conversely inefficient parameter estimates and incompatible covariance matrix estimates. These complexities can be eliminated by using appropriate linear transformation on the data. There are several methods to adjust standard errors for heteroskedasticity; one of which is the **White test**.

This test is named after the economist Halbert White who wrote "A Heteroskedasticity-Consistent Covariance Matrix Estimator and A Direct Test for Heteroskedasticity" in 1980. In the auxiliary regression, the squared residuals attained from the basic model are regressed on the original regressors with a certain interval of the residuals. White uses the Chi Square ($\chi 2$) to test whether the frequency of certain events is consistent with the distribution given K degrees of freedom. It shows a test's goodness to fit. The null hypothesis will be rejected if TR^2 (T stands for the sample size and R^2 is the coefficient of determination) has a p-value smaller than 0.05. (White, 1980)

The White Heteroskedasticity-consistent standard errors and covariance test is run for the basic model by using the E-views. The dependent and independent variables remain the same as the fundamental model.

Table 9: White heteroskedasticity-consistent standard errors and covariance test

Variable	*Coefficient*	*Std. Error*	*t-statistic*	*Prob.*
C	-0.061961	0.001844	-33.59501	<0.00001
Wealth	-1.41E-10	1.34E-11	-10.51487	<0.00001
Beta	-0.000813	9.35E-05	-8.695736	<0.00001
DL rate	1.779812	0.024450	72.79368	<0.00001

Table 10: Regression statistics

R- Squared	0.733278	*Mean dependent var.*	0.073535
Adjusted R-Squared	0.732940	*S.D. dependent var.*	0.010255
S.E. of regression	0.005299	*F-statistic*	2173.714
Sum Squared residual	0.066613	*Prob (F-statistic)*	<0.000001

All the terms in the result did not change except for the standard error and the t-statistics. All the t-statistics having an absolute value of above 2 in addition to the global test's Probability (F-statistic)'s value of less than 5% show that the test is statistically significant. The coefficients of the independent variables are constant and the change of the standard errors explains that the variances have altered.

Moreover, another correction of heteroskedasticity used is the **Newey west test**. A Newey–West estimator is used in statistics and econometrics to provide an estimate of the covariance matrix of the parameters of a regression-type model when this model is applied in situations where the standard assumptions of regression analysis do not apply. It was devised by Whitney K. Newey and Kenneth D. West in 1987. The estimator is used to overcome autocorrelation, or correlation, and heteroskedasticity in the error terms in the models.

A statistical error is the amount by which an observation differs from its expected value, and in heteroskedasticity the problem is that these error terms are correlated. (Newey & West, 1987)

After running the Newey West heteroskedasticity and autocorrelation consistent (HAC) Standard Errors and Covariance test to correct for heteroskedasticity the results in tables 11 and 12 reveal that the coefficient variables are unchanged but the standard errors are larger in comparison with the previous test and t-statistics have altered. On the other hand, the coefficients are still highly significant given the individual t-statistics' absolute values of greater than 2 and the p-values of less than 5%.

Table 11: Newey West HAC standard errors and covariance test

Variable	*Coefficient*	*Std. Error*	*t-statistic*	*Prob.*
C	-0.061961	0.003041	-20.37501	<0.00001
Wealth	-1.41E-10	1.33E-11	-10.61711	<0.00001
Beta	-0.000813	9.08E-05	-8.952460	<0.00001
DL rate	1.779812	0.040627	43.80908	<0.00001

Table 12: Regression statistics

R- Squared	0.733278	*Mean dependent var.*	0.073535
Adjusted R-Squared	0.732940	*S.D. dependent var.*	0.010255
S.E. of regression	0.005299	*F-statistic*	2173.714
Sum Squared residual	0.066613	*Prob (F-statistic)*	<0.000001

Next, the **Harvey test** is used. It is a test for heteroskedasticity based on ordinary least squares residuals. It conducts an F-test with restricted degrees of freedom on the repetitive residuals. If the relationship is not linear, the mean of the repetitive residuals should significantly differ from 0.

The dependent variable is the Log residuals squared ($LRESID^2$) of the original model and the independent variables are wealth, beta, and DL rate. Heteroskedasticity in this test is determined whenever the p-values are less than 5%.

Below is explained the mathematical derivation of determining heteroskedasticity with the Harvey test. In the linear model the function is given by:

$$Debit\ rate = \beta 0 + \beta 1 wealth + \beta 2 beta + \beta 3 DL\ rate + residual \quad (15)$$

The residual is the error term in the equation and it will be referred to it as "e". This "e" is squared and then logged. The log of the squared residual is then regressed on the variables wealth, beta and DL rate. If this regression turns out to be statistically significant, then it can be determined that there is heteroskedasticity.

Table 13: Harvey test

Variable	*Coefficient*	*Std. Error*	*t-statistic*	*Prob.*
C	-20.40683	0.730725	-27.92682	<0.00001
Wealth	5.80E-09	5.54E-09	1.047869	0.2948
Beta	0.086044	0.045679	1.883688	0.0597
DL rate	107.5963	9.408057	11.43661	<0.00001

Table 14: Regression statistics

R- Squared	0.052993	*Mean dependent var.*	-12.01364
Adjusted R-Squared	0.051796	*S.D. dependent var.*	2.267222
S.E. of regression	2.207725	*F-statistic*	44.24482
Sum Squared residual	11561.24	*Prob (F-statistic)*	<0.000001

From the regression output in tables number 13 and 14, the adjusted R square is 0.052 meaning that 5% of the variation in the dependent variable could be explained by the regression equation. The individual tests' results show that one p-value has a value of less than 5% and the remaining two have values of greater than 0.05. The t-statistics of wealth and beta have absolute values of lower than 2. But the global F-test shows a high statistical significance with a p-value of lower than 5% meaning that heteroskedasticity is present. Even if heteroskedasticity is present in the Harvey test, standard errors are already corrected by White and Newey West tests.

The results give the following equation:

$$LRESID^2 = -20.40683 + (5.8 * 10^{-9})W + 0.086044\beta + 107.5963DL \qquad \textbf{(16)}$$

Continuing with the statistical tests to adjust for heteroskedasticity, the least square method is run this time by having the dependent variable (R*d*/FIT1) the debit rate divided by the fitted model from equation number 16 and all the independent variables divided by the fitted model. The fitted variable is the square root of the exponential of $LRESID^2$. The below mentioned steps illustrate the derivation of the FIT of the first model:

1. Take the original equation and regress the log residuals squared on the variables wealth, beta and DL rate.
2. Take the fitted values of the regression
3. Take exponential of the fitted values

4. FIT1= $\sqrt{exponential(fitted\ values)}$

5. Divide all the coefficients by FIT1:

$$\frac{Debit\ Rate}{FIT1} = \frac{1}{FIT1} + \frac{wealth}{FIT1} + \frac{Beta}{FIT1} + \frac{DL\ rate}{FIT1}$$

The results of the test are shown in tables 15 and 16:

Table 15: Least squares method with FIT1

Variable	*Coefficient*	*Std. Error*	*t-statistic*	*Prob.*
1/FIT1	-0.057279	0.001882	-30.43487	<0.00001
Wealth/FIT1	-1.31E-10	1.32E-11	-9.903734	<0.00001
Beta/FIT1	-0.000646	7.27E-05	-8.897059	<0.00001
DL rate/FIT1	1.714856	0.025078	68.38203	<0.00001

Table 16: Regression statistics

R- Squared	0.841820	*Mean dependent var.*	30.02767
Adjusted R-Squared	0.841620	*S.D. dependent var.*	5.073457
S.E. of regression	2.019086		
Sum Squared residual	9669.953		

The results are statistically significant reference to the t-statistic absolute values of above 2 and the p-values of almost zero. The equation of the results appears as follow:

$$\frac{Rd}{FIT1} = -\frac{0.057279}{FIT1} - \frac{(1.31 * 10^{-10})W}{FIT1} - \frac{0.000646\beta}{FIT1} + \frac{1.714856DL}{FIT1} \qquad (17)$$

The equation is sound since there is a negative relation between the wealth and the beta coefficients and a positive one between the DL rate and the debit rate. A one million dollar increase in wealth will cause a decrease of 1.31 basis points in the debit rate. A one unit increase

in beta (i.e.: from 1 to 2) will decrease the debit rate by 0.0646%. On the other hand, when the DL rate rises by 1% the debit rate is increased by 1.714856%. When comparing with the initial first model, it is noticeable that the wealth, beta and the DL rate were close to the findings of the above equation with their values of 1.41 basis points, 8.13 basis points and 1.7798% respectively. The adjusted R square implies that the independent variables explain 84.16% of the variations in the dependent variable.

Next, heteroskedasticity is corrected by using again the White and the Newey West HAC Standard Errors and Covariance tests. The variables, dependent and independent are the same. Their coefficients remain unchanged hence the equation is the same as the equation # 17. The t-statistics and the standard errors have slightly altered as shown in the following tables:

Table 17: White heteroskedasticity-consistent standard errors and covariance test

Variable	*Coefficient*	*Std. Error*	*t-statistic*	*Prob.*
1/FIT1	-0.057279	0.001852	-30.92638	<0.00001
Wealth/FIT1	-1.31E-10	1.45E-11	-9.007549	<0.00001
Beta/FIT1	-0.000646	5.78E-05	-11.18118	<0.00001
DL rate/FIT1	1.714856	0.024790	69.17572	<0.00001

Table 18: Newey West HAC standard errors and covariance test

Variable	*Coefficient*	*Std. Error*	*t-statistic*	*Prob.*
1/FIT1	-0.057279	0.003340	-17.15033	<0.00001
Wealth/FIT1	-1.31E-10	1.41E-11	-9.256621	<0.00001
Beta/FIT1	-0.000646	6.24E-05	-10.35495	<0.00001
DL rate/FIT1	1.714856	0.044866	38.22176	<0.00001

It is worth to mention that the results of table 19 are the same for both White and Newey West correction tests.

Table 19: Regression statistics

R- Squared	0.841820	*Mean dependent var.*	30.02767
Adjusted R-Squared	0.841620	*S.D. dependent var.*	5.073457
S.E. of regression	2.019086		
Sum Squared residual	9669.953		

The t-statistics for both tests are significant having absolute values of greater than 2. All the p-values of the individual tests are statistically significant. The adjusted R square is 84.16%, meaning that 84.16% of the variations in the dependent variable could be explained by the regression equation.

The Harvey test for heteroskedasticity, or for functional misspecification in the regression analysis, show the results in table 20 with the dependent variable of $LRESID^2$, log of the residuals squared in addition to the independent variables divided by fitted value:

Table 20: Harvey test

Variable	*Coefficient*	*Std. Error*	*t-statistic*	*Prob.*
C	-2.615658	1.780001	-1.469470	0.1418
1/FIT1	-0.024002	0.014862	-1.614978	0.1064
Wealth/FIT1	1.95E-11	1.71E-11	1.140070	0.2544
Beta/FIT1	4.71E-05	0.000139	0.339260	0.7344
DL rate/FIT1	0.399004	0.249565	1.598799	0.1100

Table 21: Regression statistics

R- Squared	0.003314	*Mean dependent var.*	0.036208
Adjusted R-Squared	0.001632	*S.D. dependent var.*	2.133530
S.E. of regression	2.131789	*F-statistic*	1.970636
Sum Squared residual	10775.06	*Prob (F-statistic)*	0.096351

Table 22: Probabilities

Prob. F (4,2371)	**0.0964**
Prob. Chi-Square (4)	**0.0963**
Prob. Chi Square (4)	**0.1228**

From the first glance at the results the t-tests' absolute values are less than 2. But the individual tests' p-values and the global test's F-statistics are all above the critical significance level of 5%. **Therefore, in this model heteroskedasticity is eliminated**.

Next, a **second model** is tried by taking as the dependent variable the debit interest rate, called rate (R*d*) in the model, and the independent variables, log of wealth, beta and DL rate, called DL in the equation. Here the log of the variable wealth is used instead of the raw original value. When the dependent variable gets bigger its corresponding residuals become larger. Movements alike usually happen in the residuals, because the error in the value of an outcome variable is frequently a percent of the value instead of an absolute value. A bigger value of the variable means a bigger absolute error, so residuals are bigger as well. The percent error has a multiplicative factor in the variable. When the log of the variable is taken, the multiplicative factor transforms into an additive factor (log(y*error) = log(y) + log (Error).

In spite of the value of y, the percent error becomes equivalent to the additive error. Therefore, the residuals become uniform instead of non uniform. (Hopkins, 2000)

The output appears as in tables 23 and 24:

Table 23: Second model - Least squares method

Variable	*Coefficient*	*Std. Error*	*t-statistic*	*Prob.*
C	-0.052394	0.001854	-28.25317	<0.00001
Log(Wealth)	-0.000858	5.75E-05	-14.92203	<0.00001
Beta	-0.000659	0.000108	-6.125781	<0.00001
DL rate	1.793199	0.022088	81.18280	<0.00001

Table 24: Regression s

R- Squared	0.744588	*Mean dependent var.*	0.073535
Adjusted R-Squared	0.744265	*S.D. dependent var.*	0.010255
S.E. of regression	0.005186	*F-statistic*	2304.990
Sum Squared residual	0.063788	*Prob (F-statistic)*	<0.000001

The following equation is given by the output:

$$Rd = -0.052394 - 0.000858(log(W)) - 0.000659\beta + 1.793199DL \quad \textbf{(18)}$$

The output shows that the independent variables explain 74.42% of the variations in the dependent variable reference to the adjusted R square. The debit rate is negatively related with the log of wealth and beta variables, meaning that when the client is wealthier the debit interest rate charged on the client is lower and when the risk of the portfolio is higher, i.e.: high value beta, the interest rate is lower. Every 100% increase in log of wealth, the debit rate is decreased by 8.58 basis points and every one unit increase in the beta i.e.: from 1 to 2 the debit rate

decreases by 0.0659%. On the other hand, the debit interest rate moves positively with the DL rate, every one percent increase in the DL rate, the bank increases the debit rate charged on the overdraft accounts by 1.79%. All the t-statistics show that the test is significant, hence their absolute values are higher than 2 and the p-value is less than 5%.

Later then the White and Newey West corrections are run for the original model. The dependent and independent variables remain the same respectively debit interest rate, log of wealth, beta and DL rate. The adjusted R square and the remaining results are the same as the basic model's results.

Table 25: White heteroskedasticity-consistent standard errors and covariance test

Variable	*Coefficient*	*Std. Error*	*t-statistic*	*Prob.*
C	-0.052394	0.001869	-28.03638	<0.00001
Log(Wealth)	-0.000858	5.36E-05	-16.00002	<0.00001
Beta	-0.000659	9.35E-05	-7.047161	<0.00001
DL rate	1.793199	0.024039	74.59539	<0.00001

Table 26: Newey West HAC standard errors and covariance test

Variable	*Coefficient*	*Std. Error*	*t-statistic*	*Prob.*
C	-0.052394	0.002884	-18.16642	<0.00001
Log(Wealth)	-0.000858	5.85E-05	-14.65425	<0.00001
Beta	-0.000659	8.96E-05	-7.351515	<0.00001
DL rate	1.793199	0.039658	45.21710	<0.00001

After running the test, the results show that the coefficient variables are unchanged but the standard error and t-statistics have altered. The individual test's p-values are almost zero which indicates the significance of the test.

The following test would be the Harvey test. The dependent variable is the Log residual squared of the original model ($LRESID^2$) and the independent variables, log of wealth, beta, and DL rate.

Table 27: Harvey test

Variable	*Coefficient*	*Std. Error*	*t-statistic*	*Prob.*
C	-20.41331	0.785496	-25.98781	<0.00001
Log(Wealth)	-0.063305	0.024344	-2.600466	0.0094
Beta	0.119033	0.045558	2.612784	0.0090
DL rate	117.7717	9.356102	12.58769	<0.00001

Table 28: Regression statistics

R- Squared	0.065864	*Mean dependent var.*	-12.03010
Adjusted R-Squared	0.064683	*S.D. dependent var.*	2.271247
S.E. of regression	2.196564	*F-statistic*	55.74835
Sum Squared residual	11444.65	*Prob (F-statistic)*	<0.000001

Table 29: Probabilities

Prob. F (3,2372)	<0.00001
Prob. Chi-Square (3)	<0.00001
Prob. Chi Square (3)	<0.00001

The results show an adjusted R square of 6.5%, that is to say the independent variables explain 6.5% of the variations in the dependent variable. Observing the Chi-square probabilities with degrees of freedom of 3, there is very low probability of almost zero. Hence, proving the presence of heteroskedasticity. Even though the Harvey test produces heteroskedasticity, standard errors are previously corrected by White and Newey West.

Another trial to eliminate heteroskedasticty the least square method is run, the White Heteroskedasticity-consistent standard errors and covariance test and the HAC standard errors and covariance but with different variables. The dependent variable is R$d/FIT2$, the debit rate divided by the log of the fitted value squared and the independent variables divided by $FIT2$.

The $FIT2$ is derived as such:

1. Take the equation # 18 and regress the log residuals squared on the variables, log of wealth, beta and DL rate.
6. Take the fitted values of the regression
7. Take exponential of the logged fitted values
8. FIT2 = $\sqrt{exponential(logged\ fitted\ values)}$
9. Divide all the coefficients by $LFIT2$:

$$\frac{Debit\ Rate}{FIT2} = \frac{1}{FIT2} + \frac{\log(wealth)}{FIT2} + \frac{Beta}{FIT2} + \frac{DL\ rate}{FIT2}$$

The result of the basic model is:

Table 30: Least squares method with FIT2

Variable	*Coefficient*	*Std. Error*	*t-statistic*	*Prob.*
1/FIT2	-0.052592	0.001871	-28.10743	<0.00001
(Log(Wealth))/ FIT2	-0.000870	5.89E-05	-14.76958	<0.00001
Beta/FIT2	-0.000698	0.000115	-6.083124	<0.00001
DL rate/FIT2	1.798512	0.022074	81.47725	<0.00001

Table 31: Regression statistics

R- Squared	0.851165	*Mean dependent var.*	-0.006163
Adjusted R-Squared	0.850977	*S.D. dependent var.*	0.001146
S.E. of regression	0.000442		
Sum Squared residual	0.000464		

Reference to the results in tables number 30 and 31, there is statistically significant relationships between the dependent and independent variables. The t-statistics' absolute values are above 2 and the p-values of each test are almost zero. The coefficient estimates are given by the following equation:

$$\frac{Rd}{FIT2} = -\frac{0.052592}{FIT2} - \frac{0.000870(\log(W))}{FIT2} - \frac{0.000698\beta}{FIT2} + \frac{1.798512DL}{FIT2} \qquad (19)$$

Every 100% increase in the log of wealth of a client and every one unit increase in the portfolio riskiness (Beta), there is an 8.7 basis points and 6.98 basis points decrease respectively in the debit rate charged on the overdraft accounts. In addition, when DL rates increase by one percent the debit rates are increased by 1.8%. Originally, in the initial second model the increases in the wealth and beta factors caused a decrease in the debit rate by around the same numbers,

i.e. 8.58 and 6.59 basis points. As for the DL rate, it influenced the debit rate by the same value of 1.8%. The independent variables explain 85.09% of the variations in the dependent variable, given by the adjusted R square.

The Harvey test for heteroskedasticity is run next. The dependent variable is the log residual squared of the fitted model, the independent variables and the results are shown in tables 32, 33 and 34:

Table 32: Harvey test

Variable	*Coefficient*	*Std. Error*	*t-statistic*	*Prob.*
C	-30.45570	0.928072	-32.81610	<0.00001
1/FIT2	-161.5057	11.18012	-14.44580	<0.00001
(Log(Wealth))/ FIT2	0.034092	0.296619	0.114934	0.9085
Beta/FIT2	-0.354852	0.571748	-0.620645	0.5349

Table 33: Regression statistics

R- Squared	0.086266	*Mean dependent var.*	-16.99784
Adjusted R-Squared	0.085110	*S.D. dependent var.*	2.290367
S.E. of regression	2.190733	*F-statistic*	74.64718
Sum Squared residual	11383.97	*Prob. (F-statistic)*	<0.000001

Table 34: Probabilities

Prob. F (3,2372)	**<0.00001**
Prob. Chi-Square (3)	**<0.00001**
Prob. Chi Square (3)	**<0.00001**

The equation from the figures in table 32 is given by:

$$LRESID^2 = -30.45570 - \frac{161.5057}{FIT2} + \frac{0.034092(\log(W))}{FIT2} - \frac{0.354852\beta}{FIT2} \quad (20)$$

References to the output, two of the coefficients have their t-statistics absolute values lower than 2 and their respective p-values of greater than 5%. On the other hand, the global F-test reveals the significance of the test with a p-value of almost zero. Therefore, heteroskedasticity is still present. Conversely, this is not an issue because standard errors are robust ones and previously adjusted by White and Newey West tests.

Quandt-Andrews unknown breakpoint test

The Quandt-Andrews unknown breakpoint test is then used to test whether there is a structural break at a specific date. This test establishes whether the best fit of a series of measurements is linear or broken. The null hypothesis is "No breakpoints within trimmed data"; and the varying regressors are all equation variables. (Hansen, 2000)

Table 35: Quandt-Andrews unknown breakpoint test

Statistic	*Value*	*Probability*
Maximum LR F-statistic (Obs. 873)	120.6735	<0.00001
Maximum Wald F-statistic (Obs. 873)	120.6735	<0.00001
Exp. LR F-statistic	54.19686	<0.00001
Exp. Wald F-statistic	54.19686	<0.00001
Ave LR F-statistic	49.92016	<0.00001
Ave Wald F-statistic	49.92016	<0.00001

Breakpoint reason at the data number 873

The test results in table 35 show that in the data there is a breakpoint at data number 873. At this point, the data before 873 reveal the date before February 2008 and after 873 reveals the date after February 2008. This breakpoint makes sense because during this period of time the financial crisis was at its peak. On a personal level at the bank where I work as a credit officer, on February 2008, the General Manager – Chairman, requested to decrease all the debit interest rates charged on the accounts of the overdrawn clients due to the international rate decreases because of the crisis (previously mentioned in the above text). As previously mentioned, the Federal Bank of USA has decreased the rates charged on the credits by 50 basis points. Therefore, it is obvious that the period before February 2008 the rates are higher than the following ones. This debit rate decrease was also due to the crisis in the financial market.
In addition, if one observes the debit interest averages for the periods before February 2008 and after February 2008, it can be shown that they have decreased from 8.56% to 6.73% on average.

In 2008, the failure of a sequence of banks, financial institutions and insurance companies provoked the financial crisis that in actual fact caused the fall of global credit markets and required exceptional government intervention. For instance, Fannie Mae and Freddie Mac were both taken over by the government. Lehman Brothers, an important financial services firm, declared bankruptcy on September 14th 2008 when failed to find a purchaser. Bank of America agreed to purchase Merrill Lynch, and American International Group (AIG) was saved by an $85 billion capital injection by the Federal government. Later on September 25 2008, J P Morgan Chase acquired the assets of Washington Mutual which recorded the biggest breakdown in history. In actual fact, by September 17, 2008, more public corporations had filed for bankruptcy

in the United States of America than in all of 2007. These failures caused a crisis of confidence that made banks reluctant to lend money amongst themselves, or for that matter, to anyone.

Now to verify the significance of this breakpoint, a test is run by adding a dummy variable. A dummy variable is a numerical variable used in regression analysis to represent subgroups of the sample in this study. In research design, a dummy variable is often used to distinguish different treatment groups. In the simplest case, a 0,1 dummy variable is used where a group is given a value of 0 and a value of 1 for the remaining.

Dummy variables are useful because they enable us to use a single regression equation to represent multiple groups. This means that separate equation models are not necessary to be written for each subgroup. The dummy variables act like **'switches'** that turn various parameters on and off in an equation. Another advantage of a 0, 1 dummy-coded variable is that even though it is a nominal-level variable it can be treated it statistically like an interval-level variable.

In this study's case, the value of "0" is used for the data ranging from 874 to 2376 and the value of "1" for the data ranging from 1 to 873. Now these dummy variables are included in the **third model** and the least square method is run in order to verify its significance. The dependent variable is unchanged, the Rate (**R*d***), but the independent variables are included in the model once separately and once by being multiplied by the dummy variable, the wealth indicator is logged.

The model's results appear in tables 36 and 37:

Table 36: Third model - Least squares method with dummy variables

Variable	*Coefficient*	*Std. Error*	*t-statistic*	*Prob.*
C	0.057317	0.006145	9.327161	<0.00001
Dum	-0.042784	0.009289	-4.605672	<0.00001
Log(Wealth)	-0.000638	6.36E-05	-10.03136	<0.00001
(Log(Wealth))*Dum	-0.000583	0.000112	-5.207519	<0.00001
Beta	-0.000630	0.000108	-5.845622	<0.00001
Beta*Dum	-0.000367	0.000257	-1.426844	0.5138
DL rate	0.252702	0.083289	3.034031	0.0024
DL rate*Dum	0.804935	0.117477	6.851872	<0.00001

Table 37: Regression statistics

R- Squared	0.788996	*Mean dependent var.*	0.073535
Adjusted R-Squared	0.788372	*S.D. dependent var.*	0.010255
S.E. of regression	0.004717	*F-statistic*	1264.933
Sum Squared residual	0.052698	*Prob (F-statistic)*	<0.0000001

To illustrate, next are the variables to be interpreted in this particular case where there are dummy variables:

For the data between 0 and 873 i.e.: before the data point 873

Constant = C + Dum = 0.057317-0.042784 = 0.014533

Log(Wealth) = Log (Wealth) + (Log (Wealth))*Dum= -0.000638-0.000583 = -0.001221

Beta = Beta + (Beta*Dum) = -0.000630-0.000367 = -0.000997

DL rate = DL rate + (DL rate*Dum) = 0.252702 + 0.804935= 1.057637

The equation appears as follow:

$$Rd = 0.014533 - 0.001221Log(W) - 0.000997\beta + 1.057637DL \quad (21)$$

As observing the output results in table 36, the t-statistics values are all above 2 except for the Beta*Dum variable. All the interactive dummy variable coefficients are statistically significant given their p-value of almost zero except for the Beta*Dum variable that has a p-value of 0.5138.

For the data before 873, holding all variables constant the rate is equal to 0.014533%. The log of wealth has a negative relationship with the debit rate. Every 100% increase in log of wealth the debit rate decreases by 12.21 basis points. The beta is also negatively related with the dependent variable. Every 1 unit increase in the beta i.e.: from 1 to 2 there is a 9.97 basis points decrease in the debit rate. As for the DL rate, it is positively related with the debit rate. Every 1% increase in the DL rate the debit rate will be increased by 1.057637%. The latter indicates that the DL rate and the debit interest rate move together because their positive relationship in the equation 21 is approximately equal to 1.

<u>For the data between 874 and 2376 i.e.: after the data point 873</u>

Constant = 0.057317

Log (Wealth) = -0.000638

Beta = -0.000630

DL rate = 0.252702

The equation is given by:

$$Rd = 0.057317 - 0.000638Log(W) - 0.000630\beta + 0.252702DL \qquad (22)$$

Reference to the equation 22, the rate has a value of 5.7317% holding all other variables constant. The log of wealth and beta variables are negatively related with the debit rate. Every 100% increase in the log of wealth the debit rate decreases by 6.38 basis points. The rate decreases by 6.3 basis points whenever the beta is increased by a unit i.e.: from 1 to 2. The DL rate moves positively with the debit rate, hence every 1% increase in the DL rate; debit rate is increased by 0.252702%. The independent variables explain 78.83% of the variations in the dependent variable. The global test for observations after 873 is significant given the probability of F-statistic of almost zero.

The White and Newey west tests, as explained previously show a change in the standard errors and t-statistics in the outputs exposed below, the variables' coefficient estimates remain the same:

Table 38: White heteroskedasticity-consistent standard errors and covariance test

Variable	*Coefficient*	*Std. Error*	*t-statistic*	*Prob.*
C	0.057317	0.005062	11.32244	<0.00001
Dum	-0.042784	0.010547	-4.056586	<0.0001
Log(Wealth)	-0.000638	4.40E-05	-14.47715	<0.00001
(Log(Wealth))*Dum	-0.000583	0.000138	-4.235676	<0.00001
Beta	-0.000630	8.13E-05	-7.750553	<0.00001
Beta*Dum	-0.000367	0.000297	-1.236922	0.2162
DL rate	0.252702	0.068503	3.688903	0.0002
DL rate*Dum	0.804935	0.128164	6.280487	<0.00001

Table 39: Newey West HAC standard errors and covariance test

Variable	Coefficient	Std. Error	t-statistic	Prob.
C	0.057317	0.005667	10.11361	<0.00001
Dum	-0.042784	0.013909	-3.076029	0.0021
Log(Wealth)	-0.000638	5.04E-05	-12.65675	<0.00001
(Log(Wealth))*Dum	-0.000583	0.000138	-4.239183	<0.00001
Beta	-0.000630	8.42E-05	-7.486994	<0.00001
Beta*Dum	-0.000367	0.000246	-1.493995	0.1353
DL rate	0.252702	0.077934	3.242501	0.0012
DL rate*Dum	0.804935	0.168770	4.769417	<0.00001

The majority of the interactive coefficients have a p-value of less than 5% which illustrates the significance of the test.

Now to test for heteroskedasticity, the Harvey test is run. The dependent variable is $LRESD^2$ and the independent variables appear in the results of table 40:

Table 40: Harvey test

Variable	*Coefficient*	*Std. Error*	*t-statistic*	*Prob.*
C	-26.28220	2.771888	-9.481699	<0.00001
Dum	17.55203	4.190151	4.188878	<0.00001
Log(Wealth)	-0.114688	0.028671	-4.000134	<0.0001
(Log(Wealth))*Dum	-0.038891	0.050495	-0.770204	0.4413
Beta	-0.063165	0.048645	-1.298482	0.1942
Beta*Dum	0.8323325	0.115950	7.178304	<0.00001
DL rate	207.8948	37.56901	5.533678	<0.00001
DL rate*Dum	-228.8467	52.98978	-4.318695	<0.00001

Table 41: Regression statistics

R- Squared	0.092895	*Mean dependent var.*	-12.20222
Adjusted R-Squared	0.090214	*S.D. dependent var.*	2.230879
S.E. of regression	2.127872	*F-statistic*	34.64340
Sum Squared residual	10721.93	*Prob (F-statistic)*	<0.0000001

Table 42: Probabilities

Prob. F (7,2368)	<0.00001
Prob. Chi-Square (7)	<0.00001
Prob. Chi Square (7)	<0.00001

The independent variables explain approximately 9% of the fluctuations in the dependent variables. The standard errors have large values. There are two t-statistics that have an absolute value of less than two with respective p-values of lower than the critical one. But the majority p-values of the individual tests are less than 5% and the global F-test is statistically significant. Therefore, heteroskedasticity is present. However, the presence of heteroskedasticity is not an issue because the standard errors were corrected by the Newey West and White tests.

The least square method is run, but this time having a dependent variable as RATE/*FIT*3 and the independent variables as shown in table 43. The below mentioned steps illustrate the derivation of the FIT of the original model:

1. Take the equation number 22 and regress the log residuals squared on the variables wealth, beta and DL rate.
2. Take the fitted values of the regression
3. Take exponential of the fitted values

4. FIT3= $\sqrt{exponential(fitted\ values)}$

5. Divide all the coefficients by FIT3:

$$\frac{Debitrate}{FIT3} = \frac{1}{FIT3} + \frac{Dum}{FIT3} + \frac{Log(wealth)}{FIT3} + \frac{Log(wealth) * Dum}{FIT3} + \frac{Beta}{FIT3} + \frac{Beta * Dum}{FIT3} + \frac{DL\ rate}{FIT3} + \frac{DL\ rate * Dum}{FIT3}$$

Table 43: Least squares method with FIT3

Variable	*Coefficient*	*Std. Error*	*t-statistic*	*Prob.*
1/FIT3	0.067854	0.004972	13.64709	<0.00001
Dum/FIT3	-0.044512	0.009513	-4.678894	<0.00001
Log(Wealth)/ FIT3	-0.000646	4.80E-05	-13.45059	<0.00001
(Log(Wealth))*Dum/FIT3	-0.000848	0.000123	-6.903292	<0.00001
Beta/FIT3	-0.000590	8.53E-05	-6.912680	<0.00001
Beta*Dum/FIT3	-0.000216	0.000172	-1.256403	0.2091
DL rate FIT3	0.109551	0.067646	1.619468	0.1055
DL rate*Dum/FIT3	0.882069	0.117726	7.492538	<0.00001

Table 44: Regression statistics

R- Squared	0.955352	*Mean dependent var.*	33.65333
Adjusted R-Squared	0.955220	*S.D. dependent var.*	9.237094
S.E. of regression	1.954684		
Sum Squared residual	9047.630		

The FIT3 is the fitted value of the third model. The adjusted R square shows that the independent variables explain 95.52% of the variations in the dependent variable. Out of all the coefficients only two have t-statistics' absolute values of less than 2 and their respective p-values of above 5%. The equation of the result is given by the equation 23:

$$\frac{Rd}{FIT3} = \frac{0.068}{FIT3} - \frac{0.045Dum}{FIT3} - \frac{0.000646\log(W)}{FIT3} - \frac{0.00848\log(W) * Dum}{FIT3} - \frac{0.000590\beta}{FIT3}$$
$$- \frac{0.000216\beta * Dum}{FIT3} + \frac{0.109551DL}{FIT3} + \frac{(0.882069DL * Dum)}{FIT3} \quad (23)$$

Log of wealth, and beta and their respective interactive coefficients are negatively related with the dependent variable. On the contrary, the DL rate coefficient is positively related with the dependent variable. When comparing the equation number 23 with the original third model it is encountered that every 100% increase in the log of wealth in both models the debit rate decreases by 6.38 b.ps. in the original model and 6.46 b.ps in the current. The beta variable of the current model differs slightly from the original model's value by 0.4b.ps. The DL rate of the initial equation has a wider value than the current one respectively, 0.252702% and 0.109551%.

With the **Harvey** test below to ensure whether heteroskedasticity is eliminated or not, an improvement in the p-values is observed. Some have a value above 5%. (Dependent variable:$LRESID^2$).

Table 45: Harvey test

Variable	*Coefficient*	*Std. Error*	*t-statistic*	*Prob.*
C	-2.495700	0.817268	-3.053709	0.0023
1/FIT3	-0.022026	0.010266	-2.145589	0.0320
Dum/FIT3	0.038596	0.017795	2.168889	0.0302
Log(Wealth)/ FIT3	-0.000404	9.78E-05	-4.126840	<0.00001
(Log(Wealth))*Dum/FIT3	-0.000120	0.000167	-0.721412	0.4707
Beta/ FIT3	-0.000184	0.000103	-1.781155	0.0750
Beta*Dum/FIT3	-0.001984	0.000673	2.946551	0.0032
DL rate/FIT3	0.438785	0.171860	2.553159	0.0107
DL rate*Dum/FIT3	-0.486865	0.215564	-2.258568	0.0240

Table 46: Regression statistics

R- Squared	0.007868	*Mean dependent var.*	0.005539
Adjusted R-Squared	0.004515	*S.D. dependent var.*	2.114401
S.E. of regression	2.109623	*F-statistic*	2.346431
Sum Squared residual	10534.35	*Prob (F-statistic)*	0.016425

Table 47: Probabilities

Prob. F (8,2367)	**0.0164**
Prob. Chi-Square (8)	**0.0166**
Prob. Chi Square (8)	**0.0309**

Reference to the output, the global test is significant. This is given by the probabilities of the F-tests, and the Chi-Square tests which have values of less than 5%. Even though this test produces heteroskedasticity, the standard errors are robust, they are corrected by the White and Newey West tests.

The next regressions will be with the variables of wealth, beta and DL rate along with being multiplied by the dummy variables, a **fourth model**. The least square method with the dependent variable Rate and the coefficients produce the results in tables 48 and 49:

Table 48: Fourth model - Least squares method

Variable	*Coefficient*	*Std. Error*	*t-statistic*	*Prob.*
C	0.051795	0.006274	8.254856	<0.00001
Dum	-0.050905	0.009433	-5.396397	<0.00001
Wealth	-1.12E-10	1.40E-11	-7.976702	<0.00001
Wealth*Dum	-1.10E-10	2.80E-11	-3.909189	<0.0001
Beta	-0.000727	0.000110	-6.591374	<0.00001
Beta*Dum	-0.000680	0.000263	-2.586977	0.0097
DL rate	0.220938	0.085332	2.589161	0.0097
DL rate*Dum	0.821354	0.120420	6.820723	<0.00001

Table 49: Regression statistics

R- Squared	0.778155	*Mean dependent var.*	0.073535
Adjusted R-Squared	0.777499	*S.D. dependent var.*	0.010255
S.E. of regression	0.004837	*F-statistic*	1186.587
Sum Squared residual	0.055405	*Prob (F-statistic)*	<0.000001

As per the results above, there is statistically significant relationship between the variables. The t-statistics show absolute values of above 2 and the p-value less than 5%. The independent variables explain 77.74% of the variations in the rate. These outcomes reveal that there is significantly a breakpoint in the selected data.

For the data between 0 and 873 i.e.: before the data point 873

Constant = C + Dum = 0.051795-0.050905 = 0.00089

Wealth = Wealth + (Wealth*Dum) = $(-1.12*10^{-10}) - (1.1*10^{-10}) = -2.22*10^{-10}$

Beta = Beta + (Beta*Dum) = -0.000727-0.000680 = -0.001407

DL rate = DL rate + (DL rate*Dum) = 0.220938 + 0.821354= 1.042292

For the data before 873, holding all variables constant the rate is equal to 0.00089%. The wealth variable has a negative relationship with the debit rate. Every one million dollar increase in wealth the debit rate decreases by 2.22 basis points. The beta is also negatively related with the dependent variable. Every 1 unit increase in the beta i.e.: from 1 to 2 there is a 14.07 basis points decrease in the debit rate. Regarding the DL rate, it is positively related with the debit rate. Every 1% increase in the DL rate the debit rate will be increased by 1.042292%.

The equation is given by the following:

$$Rd = 0.00089 - (2.22 * 10^{-10})W - 0.001407\beta + 1.042292DL \quad \textbf{(24)}$$

For the data between 874 and 2376 i.e.: after the data point 873

Constant = 0.051795

Wealth = $-1.12*10^{-10}$

Beta = -0.000727

DL = 0.220938

The equation is given by:

$$Rd = 0.51795 - (1.12 * 10^{-10})W - 0.000727\beta + 0.220938DL \quad \textbf{(25)}$$

As per the equation 25, the rate has a value of 5.1795% when all other variables are held constant. The wealth and beta variables are negatively related with the debit rate. Every one

million dollar increase in wealth the debit rate decreases by 1.12 basis points. The rate decreases by 7.27 basis points whenever the beta is increased by a unit i.e.: from 1 to 2. The DL rate moves positively with the debit rate. Every 1% increase in the DL rate, debit rate is increased by 0.220938%.

Later, the same tests are run as before for correction of heteroskedasticity, such as White and Newey West. Both of these tests, in which the same variables were used, i.e.: with the dummy variables, show that the coefficients remain the same, but the t-statistics and standard errors have changed. These tests are significant; the p-values are less than the critical value of 5%.

Table 50: White heteroskedasticity-consistent standard errors and covariance test

Variable	*Coefficient*	*Std. Error*	*t-statistic*	*Prob.*
C	0.051795	0.005201	9.957853	<0.00001
Dum	-0.050905	0.010656	-4.777214	<0.00001
Wealth	-1.12E-10	1.30E-11	-8.589428	<0.00001
Wealth*Dum	-1.10E-10	2.39E-11	-4.583549	<0.00001
Beta	-0.000727	8.06E-05	-9.027449	<0.00001
Beta*Dum	-0.000680	0.000289	-2.349790	0.0189
DL rate	0.220938	0.070997	3.111950	0.0019
DL rate*Dum	0.821354	0.132791	6.185314	<0.00001

Table 51: Newey West HAC standard errors and covariance test

Variable	*Coefficient*	*Std. Error*	*t-statistic*	*Prob.*
C	0.051795	0.005879	8.809667	<0.00001
Dum	-0.050905	0.014318	-3.555313	0.0004
Wealth	-1.12E-10	1.29E-11	-8.642763	<0.00001
Wealth*Dum	-1.10E-10	2.36E-11	-4.635255	<0.00001
Beta	-0.000727	8.52E-05	-8.531306	<0.00001
Beta*Dum	-0.000680	0.000239	-2.841921	0.0045
DL rate	0.220938	0.080650	2.739461	0.0062
DL rate*Dum	0.821354	0.177018	4.639942	<0.00001

On another level the Harvey test was used to remove heteroskedasticity. The Log of the residual square of the basic model is taken as dependent variable ($LRESID^2$) and the independent variables as being the constant, the dummy variable, the wealth, beta, DL rate and respectively multiplied by their dummy variables. But still the results show the presence of heteroskedasticity since the probability values still have a percentage below the 5%, though the wealth variable has a p-value of above 5%.

Table 52: Harvey test

Variable	*Coefficient*	*Std. Error*	*t-statistic*	*Prob.*
C	-22.33419	2.254201	-9.907809	<0.00001
Dum	14.52949	3.389012	4.287235	0.0004
Wealth	-5.02E-10	5.04E-09	-0.099574	0.9207
Wealth*Dum	-7.99E-09	1.01E-08	-0.794047	0.4272
Beta	-0.162713	0.039636	-4.105218	<0.00001
Beta*Dum	0.776877	0.094416	8.228218	<0.00001
DL rate	141.4447	30.65676	4.613819	<0.00001
DL rate*Dum	-193.2978	43.26283	-4.467988	<0.00001

Table 53: Regression statistics

R- Squared	0.079444	*Mean dependent var.*	-11.87585
Adjusted R-Squared	0.076723	*S.D. dependent var.*	1.808563
S.E. of regression	1.737800	*F-statistic*	29.19409
Sum Squared residual	7151.239	*Prob (F-statistic)*	<0.0000001

Table 54: Probabilities

Prob. F (7,2368)	**<0.00001**
Prob. Chi-Square (7)	**<0.00001**
Prob. Chi Square (7)	**<0.00001**

The global F-statistics test of almost zero shows that the test is significant. The presence of heteroskedasticity is not an issue because the standard errors are corrected by the White and Newey West tests.

Then, the least square method is run with the dependent variable: $Rd/FIT4$ and divide each of the independent variables by the $FIT4$. The $FIT4$ is the fitted value of the fourth model mentioned previously. It is derived as follows:

1. Take the initial equation of the fourth model and regress the log residual squared on the variables, wealth, beta and DL rate.
2. Take the fitted values of the regression
3. Take exponential of the logged fitted values
4. FIT4 = $\sqrt{exponential(logged\ fitted\ values)}$
5. Divide all the coefficients by $FIT4$:

$$\frac{Debitrate}{FIT4} = \frac{1}{FIT4} + \frac{Dum}{FIT4} + \frac{log\ of\ wealth}{FIT4} + \frac{Dum(logwealth)}{FIT4} + \frac{Beta}{FIT4}$$
$$+ \frac{Beta * Dum}{FIT4} + \frac{DL\ rate}{FIT4} + \frac{DL\ rate * Dum}{FIT4}$$

The output reveals the following:

Table 55: Least squares method with FIT4

Variable	*Coefficient*	*Std. Error*	*t-statistic*	*Prob.*
1/FIT4	0.059513	0.005287	11.25575	<0.00001
Dum/ FIT4	-0.049398	0.009486	-5.207618	<0.00001
Wealth/ FIT4	-1.06E-10	1.12E-11	-9.442521	<0.00001
Wealth*DUM/ FIT4	-8.88E-11	2.37E-11	-3.746353	0.0002
Beta/ FIT4	-0.000853	9.50E-05	-8.981949	<0.00001
Beta*Dum/ FIT4	-0.000267	0.000184	-1.450098	0.1472
DL rate/ FIT4	0.117768	0.072109	1.633190	0.1026
DL rate*Dum/ FIT4	0.808547	0.119166	6.785038	<0.00001

Table 56: Regression statistics

R- Squared	0.917476	*Mean dependent var.*	28.16672
Adjusted R-Squared	0.917232	*S.D. dependent var.*	5.896982
S.E. of regression	1.696532		
Sum Squared residual	6815.624		

As per the test results, the independent variables explain 91.72% of the variations of the dependent variable. All the p-values are almost zero except for two interactive coefficients, beta and DL rate. The equation of the results in table 55 is presented as follows:

$$\frac{Rd}{FIT4} = \frac{0.06}{FIT4} - \frac{0.049Dum}{FIT4} - \frac{1.06 * 10^{-10}W}{FIT4} - \frac{8.88 * 10^{-11}W * Dum}{FIT4} - \frac{0.000853\beta}{FIT4}$$
$$- \frac{0.000267\beta * Dum}{FIT4} + \frac{0.1178DL}{FIT4} + \frac{0.8DL * Dum}{FIT4} \quad (26)$$

For the data between 0 and 873 i.e.: before the data point 873

$$Constant = \frac{1}{FIT4} + \frac{Dum}{FIT4} = 0.059513 - 0.049398 = 0.010115$$

$$Wealth = \frac{Wealth}{FIT4} + \frac{Wealth * Dum}{FIT4} = -1.06 * 10^{-10} - 8.88 * 10^{-11} = -1.948 * 10^{-10}$$

$$Beta = \frac{beta}{FIT4} + \frac{beta * Dum}{FIT4} = -0.000853 - 0.000267 = -0.00112$$

$$DL\ rate = \frac{DL\ rate}{FIT4} + \frac{Dum * DL\ rate}{FIT4} = 0.117768 + 0.808547 = 0.926315$$

The equation appears as follows:

$$Rd = 0.010115 - (1.948 * 10^{-10})W - 0.00112\beta + 0.926315DL \quad (27)$$

For the data before 873, holding all variables constant the rate is equal to 0.010115%. The wealth variable shows a negative relationship with the debit interest rate. Every one million dollar increase in wealth the debit rate decreases by 1.95 basis points. Compared to the original fourth model, the wealth caused a decrease of 2.22 basis points in the debit rate. The beta reveals a negative relation with the dependent variable. Every 1 unit increase in the beta i.e. from 1 to 2 there is a 11.2 basis points decrease in the debit rate. The initial model's beta had a value of 14.07 basis point. Regarding the DL rate, it is positively related with the debit rate. Every 1% increase in the DL rate the debit rate will be increased by 0.93% which is approximately equal to

one. The DL rate of the original model of 1.04% and this equation's market value indicate that the DL rate moves along with the debit interest rate.

For the data between 874 and 2376 i.e.: after the data point 873

$Constant = 0.059513$

$Wealth = -1.06 * 10^{-10}$

$Beta = -0.000853$

$DL\ rate = 0.117768$

The equation is given by:

$$Rd = 0.059513 - (1.06 * 10^{-10})W - 0.000853\beta + 0.117768DL \qquad \textbf{(28)}$$

As per the above, the rate has a value of 5.95% when all other variables are held constant. The wealth and beta variables are negatively related with the debit rate. Every one million dollar increase in wealth the debit rate decreases by 1.06 basis points. The rate decreases by 8.53 basis points whenever the beta is increased by a unit i.e.: from 1 to 2. The DL rate moves positively with the debit rate. Every 1% increase in the DL rate, debit rate is increased by 0.117768%.

Consequently, the Harvey test is run. In this test the dependent variable is the log of the residual squared with the same independent variables as in the basic fourth model mentioned in the least square method.

Table 57: Harvey test

Variable	*Coefficient*	*Std. Error*	*t-statistic*	*Prob.*
C	-1.907152	0.903721	-2.110332	0.0349
1/ FIT4	-0.018317	0.010206	-1.794741	0.0728
Dum/ FIT4	0.037173	0.019512	1.905088	0.0569
Wealth/ FIT4	-8.8EE-12	1.20E-11	-0.738445	0.4603
Wealth*Dum/ FIT4	-7.76E-11	2.82E-11	-2.751831	0.0060
Beta/ FIT4	-0.000508	0.000191	-2.659885	0.0079
Beta*DUM/ FIT4	0.002255	0.000800	2.817411	0.0049
DL rate/ FIT4	0.318404	0.165942	1.918766	0.0551
DL rate*Dum/ FIT4	-0.489326	0.251752	-1.943684	0.0521

Table 58: Regression statistics

R- Squared	0.008979	*Mean dependent var.*	-0.008232
Adjusted R-Squared	0.005629	*S.D. dependent var.*	1.826863
S.E. of regression	1.821714	*F-statistic*	2.680642
Sum Squared residual	7855.226	*Prob.*	0.006214

Table 59: Probabilities

Prob. F (8,2367)	**0.0062**
Prob. Chi-Square (8)	**0.0063**
Prob. Chi Square (8)	**0.0714**

Reference to the output, the majority of the t-statistics have absolute values of less than 2. The p-values in the Chi square tests and in the F-test are less than the critical value of 5%, hence heteroskedasticity is always present. But the standard errors were already adjusted with the White and Newey West tests, therefore in the Harvey test heteroskedasticity is not an issue.

CONCLUSION

In conclusion, after conducting empirical and theoretical studies, the factors that influence the debit interest rates charged on the overdraft accounts of the clients benefitting from margin loans in a particular Lebanese investment bank were identified.

The theoretical research revealed that due to the financial crisis of 2007-2009 there was an international rate decrease by the Federal Reserve System and many foreign and local central banks in order to save some institutions and banks from bankruptcy. In addition, the London Inter Bank offered rate played its role in the decreasing trend of the debit rates.

The statistical tests and analysis showed the relationships between the debit interest rate and the factors namely: wealth, beta and DL rate which affect the rate's variations. The following two negative relations were concluded: the wealthier the client the lower the rate and exceptionally with a negative risk premium during the credit crunch, the higher the risk of a portfolio (beta) the lower the debit rate. On the other hand the positive bond between the debit rate and the DL rate proved that these two variables move together. Exceptionally the Harvey test of the first original model with the FIT1 model indicated the elimination of heteroskedasticity with the global test reflecting values of above the critical number of 5%.

The most significant statistical test results were the outputs of the coefficients where the dummy variables were included. After conducting the Quandt Andrews unknown breakpoint test, a breakpoint at the data number 873 was encountered. This point in time referred to the beginning of the year 2008 when the financial crisis was at its peak. After this period the debit interest rates decreased enormously. The third test model in this study, the rate was the

dependent variable and the independent variables were the *log of wealth*, beta and the DL rate along with their interactive dummy variables.

Table 60: Summary Table of Model 3

Coefficients	Before data point 873	After data point 873
Constant	0.014533	0.057317
Log(Wealth)	-0.001221	-0.000638
Beta	-0.000997	-0.000630
DL rate	1.057637	0.252702

Reference to the results in table 60, the log of wealth and the beta presented a negative relation with the debit interest rate in the observations of data points ***before 873***. Every 100% increase in the log of wealth caused a decrease of 12.21 basis points. A one unit increase in beta from 1 to 2 decreased the debit interest rate by 9.97 basis points. On the other hand the DL rate had a positive bond with the debit interest rate. The DL rate's value of approximately 1% indicated that it moves proportionately with the debit interest rate. The global test of the third model for the observations ***after 873*** is statistically significant given its F-statistic value of almost zero. The wealth and beta variables as well showed a negative relation with the debit interest rate and the DL rate a positive relation. Every 100% increase in the log of wealth the debit interest rate decreased by 6.38 basis points. The beta coefficient's increase from 1 to 2 caused a decrease of 6.3 basis points in the debit interest rate. As for the DL rate, every 1% increase in the DL rate variable the debit interest charged on the overdraft accounts increased by around 0.25%. The R squared of this model had a value of around 79%. This indicates that the

independent variables explain 79% of the variations in the dependent variable, the Rate. The standard errors were adjusted by both tests White and Newey West even though the Harvey test could not eliminate heteroskedasticity.

The next regression was the fourth model which had as dependent variable the rate and the independent variables listed in the table 61.

Table 61: Summary Table of Model 4

Coefficients	Before data point 873	After data point 873
Constant	0.00089	0.051795
Wealth	$-2.22*10^{-10}$	$-1.12*10^{-10}$
Beta	-0.001407	-0.000727
DL rate	1.042292	0.220938

Regarding the output table, the wealth and the beta presented a negative relation with the debit interest rate in the observations of data points ***before 873***. Every one million dollar increase in the wealth resulted in a decrease of 2.22 basis points in the debit interest rate. A one unit increase in beta from 1 to 2 decreased the debit interest rate by 14.07 basis points. Conversely, the DL rate had a positive tie with the debit interest rate. The DL rate's value of about 1% showed that it moves uniformly with the debit interest rate.

The test conducted for the observations of after data point 873 revealed that the wealth and beta variables are negatively related with the debit interest rate. Every one million dollar increase in the wealth the debit interest rate decreased by 1.12 basis points. When the beta coefficient increased from 1 to 2, the debit interest rate decreased by 7.27 basis points. The DL

rate is positively related with the debit interest rate. Hence a one percent increase in the DL rate caused a 0.22% increase in the debit interest rate. The standard errors in this test were robust, since they were adjusted with the White and Newey West tests. The Harvey test for correction did not eliminate heteroskedasticity, but this was not an issue since the errors were corrected by White and Newey West tests as previously mentioned.

To conclude, this thesis utilized theoretical as well as empirical approaches. A literature study was conducted regarding the subject by assembling information from different sources. The statistical data of 2376 client account information was collected from a well known investment bank for the period of 2007-2009. As a result, the findings pinpoint to the factors that influence the debit interest rates charged on overdraft accounts of individuals benefitting from margin facilities. The wealth and beta affected the debit rate by a negative relationship and the DL rate moved along with the debit rate. Exceptionally during the chosen period the MRP had a negative value due to the financial crisis at that time.

RECOMMENDATIONS

Based on the empirical findings and conclusions drawn, the following recommendations are offered:

1. This research study suggests that there are several factors effecting debit interest rates charged on overdraft accounts of margin loan clients. The factors studied in this paper are the wealth, beta as being the portfolio riskiness and discount and loans rate. It is recommended to take into consideration other factors, such as *competition* which plays a great role in the investment banking sector in the region and particularly in Lebanon. Specifically, competition must be an intriguing component in the debit rate charging procedure; hence currently there are very highly competitive firms.
2. In order to provide further confirmation and to verify the hypothesis that the market risk premium will stay positive on the long run, this study recommends for further research about the negative MRP on the short run which was due to the financial crisis of 2007-2009. Therefore, it is preferable to gather further data for the upcoming years, 2010 and on, to observe whether MRP will turn back to its positive nature.
3. Choose other leading investment banks in Lebanon and study whether the same case is applicable. In addition, verify whether the same factors affect the debit interest rates in the same manner.

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