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Probability of Return under CAMP: An Empirical Study of the Interest Margin

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Abstract

Capital Asset Pricing Model (CAPM) holds predominant position in finance for the determination of expected rate of return from an investment. Probability of loss plays significant role for investment decision making but previous studies in Pakistan have not taken up this concept in the CAPM. Scope of the previous studies encompasses mere testing of the validity of CAPM in Pakistan using the time inconsistent methods of finding risk and returns. This study applies probability of getting the required rate of return calculated through CAPM at par with the some standard rate defined by the system in Pakistan. Evidence of market imperfection in the context of negative risk premium has also been discovered. Predictive aspect of the CAPM has been put to test in order to find gap between the monetary and the real sector with increasing rate of interest margin in the banking sector of Pakistan.

Keywords

Probability of default, Time consistent measures, Karachi Stock Exchange, Capital Asset Pricing Model

1. Introduction

Capital Asset Pricing Model (Sharpe, 1964), shortly known as CAPM, stands tall since its inception, among the other models of asset valuation, even after more than half century. The model serves as bedrock for subsequent studies (Lintner, 1965; Mossin, 1966 and Black, 1972).

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Sharpe (1964) postulates that the expected return of an asset is determined by the risk free rate and product of Beta and market risk premium. Beta in CAPM serves as a standard measure of systematic risk. Sharpe (1964) believes that the systematic risk can be diversified. Beta is covariance of the i^{th} asset with market and shows how the required return of security will react to the change in overall market. Pakistani studies related to the CAPM apply time inconsistent methods of calculating returns on securities and market index. Financial time series are time based and their per cent change should be time consistent, rather than time inconsistent (Jorion, 1999). Probability of loss is another important concept representing the probability that the outcome of investment decision will fall short of expectations. Such a concept of probability may be considered as one of the risk criteria in investment related decisions. This concept was presented by Roy (1952) in context of safety-first objective function. His work was further extended by different researchers (Kataoka, 1963 and Telser, 1956) in the same domain of safety-first with different contexts. Avramov (2004) and Avramov and Chordia (2006) show that the predictability of return from the conditional asset pricing models outperforms the other models. Probabilities of return under the head of CAPM have been left alone in previous studies, especially in the context of Pakistan.

There is little evidence in the literature as to the probability of getting the required rate of return calculated through CAPM. There are intuitively three main objectives of the present study. The first one is estimation of CAPM and thereby calculation of the probability of returns. At the second stage efforts are made to show some misspecifications while estimating CAPM in the context of Pakistan. Finally, the present study attempts to provide evidence that market imperfection in the context of negative risk premium leads us to equate CAPM-based returns to the accruals offered by the banking sector in Pakistan. This way the present study also aims at comparing CAPM-based estimated required rate of return with the probability of not getting the actual return from the financial system. An application side of CAPM has been put to test instead of deciding whether or not the CAPM applies to Pakistani stock exchange systems. The paper progresses through estimation of CAPM in traditional way as proposed by Sharpe (1964) while considering the time consistent returns. Nonlinear mathematical methods have been applied to capture the probability of return equal to the banking system. On account of the fact that there is gap between monetary policy and the real sector of Pakistan (Siddiqui, 2012), the present study highlights some problems while estimating probability of returns.

The issue has also been deliberated that the system of stock market (KSE) with the capacity to generate at least as much as the interest margin of the banking sector should have tendency to link with monetary policy of Pakistan. For this purpose, advanced statistical methods such as Probitand Logit models (types of Regression models) have been employed to look into the dynamics of CAPM with its capability in predicting probability of return. The study may be considered as an academic contribution in the literature of financial economics in many ways. At the first stage it incorporates time consistent methods of estimating CAPM in the context of Pakistan. Secondly, probability of returns is calculated and the study provides insight as to the separation of the monetary policy from the stock market. Finally, for the first time Logit and Probit models are employed to see application of the required rate of return calculated through CAPM in comparing risk premium with the rate earned by banking sector. Following this Section of introduction, the literature review is given in the second Section. Then methodology, estimation of models and final results are discussed in detail.

2. Literature review

In the early 1960s, investors were perplexed in finding the benchmark for systematic measurement of risk (see Perold, 2004). Markowitz (1959) made breakthrough in estimating expected return from the Portfolio of assets and measurement of expected risk. Variance and the rate of return, for the first time in Markowitz's terms, serve as proxy of risk for the Portfolio. The quote goes, "*a single asset or a Portfolio of asset is considered to be efficient if no other asset offers higher expected return with the same risk or lower risk with the same (of higher) expected return"* (Reilly and Browne, 2011).

These phenomena are proposed as efficient frontier and an investor who maximizes his utility based on mean-variance approach is called Markowitz efficient investor. However, one very important concept of 'risk free investment' was missing from Markowitz Portfolio Theory. It is not always the case that investor is going for a risky investment, but he can choose investment at risk free rate with no variance or risk (Investment in treasury bills is considered as risk free investment as the probability of default is minimum). This gap leads to the concept which is known as Capital Market Theory. The credit of idea related to the risk free asset, goes to Sharpe (1964) who derived a general theory of capital asset pricing under the condition of uncertainty from Markowitz Portfolio Theory. After the inclusion of proposed risk free asset in Markowitz Portfolio by Sharpe (1964), a transformation took place in the form of Capital Market Line (CML) for relevant measurement of risk. In this landmark contribution, an asset covariance with market Portfolio set a standard measure of efficiency. After the yardstick for relevant measurement of risk is determined, the investors can determine the expected (required) rate of return of an asset or Portfolio of assets.

2.1 The Capital Asset Pricing Model (CAPM): Covariance based Beta of market with itself can be written as $\text{Cov}_{m,m} / \sigma_m^2$ which must be equal to 1. As proposed by Sharpe (1964), the relevant risk measure of risky asset is its covariance with the market Portfolio, then above mentioned formula can be written as $\text{Cov}_{i,m}/\sigma_m^2$ which is well known Beta (β). Beta is considered as the standard measure of systematic risk. It states that the risk of security is the covariance to the variance of market Portfolio. After the development of Beta, the investors can calculate the Required Rate of Return (RRR) with the help of the following equation:

$$R_i = RFR + \beta(R_m - RFR) \tag{2.1.1}$$

where

R_i= return of i^{th} security.

R_m = market return

RFR = risk free rate

β = Beta of a security

(R_m – RFR) is the risk premium which can be calculated by taking the difference between return of market and the risk free rate. This model is called CAPM, it simply states that investor's required rate of return from investment is equal to risk free rate plus Beta times market risk premium. Market Portfolio in the model is the benchmark Portfolio and has a Beta equal to 1. Therefore, if Beta of an asset is above 1 it means it is more risky than the market and investor will require a higher rate of return on the asset.

Immediately after the development of CAPM, its abilities to measure required rate of return was put to test. Numerous empirical and conceptual studies show dynamics of CAPM where the model at times, fall short of expectation while in some other cases it provides solution for unresolved puzzle of required rate of return. The components of CAPM in overall empirical test of the models reveal mixed results. Sheila, et al. (1974) conducted a study on Tokyo Stock Exchange (TSE) covering the period from 1964 to 1969, using the time series cross-sectional data. They employed traditional CAPM model proposed by Sharpe (1964) and found applicability of the CAPM model to the data of TSE. Arbel, et al. (1977) checks the validity of CAPM under the domain of capital budgeting decisions. Specifically they check the impact of default risk on the value of equity based securities. According to this study, the required return is the calculated return of the project in the same sense as in CAPM. However, expected return of the project must exceed the hurdle rate which is composite of riskless rate of interest plus a premium of riskiness of the project. The study concludes that CAPM can be used in making capital budgeting decisions. Perold (2004) and Laughhunn and Sprecher (1977) also vindicate the decisions of Arbel, et al. (1977) and appreciate CAPM by arguing that the model has changed the investor's decision making regarding the risk and return and capital budgeting. French (2006) tests the CAPM and its capability to identify the value premiums which means higher return from the value stocks than the return from growth stocks. French (2006) found that the model is capable to explain the value premiums from 1926 to 1963 for the US economy. Fama and French (2004) also highlight some problems while estimating CAPM. They argue that the model is never an empirical success. Rather the model has oversimplified assumptions when it comes to the market Portfolio, risk free rate and a constant Beta. Bekaert and Ang (2004) criticized CAPM on its linear relation with market Portfolio, in a study related to the data from US, UK and German stock markets for the period of 1975-2000. They discuss the model under regime switching framework with different correlations and expected returns existing among different regimes. The study proves that CAPM fails to explain the regime switching framework using Beta. Hanif and Bhatti (2010) test traditional CAPM on Karachi Stock Exchange and provide evidence that the model is incapable of explaining the required rate of return. Black (1995) also criticizes the concept of risk free rate and argues that this assumption of the model is against the psychology of rational investor.

In Regression Analysis, β measures the sensitivity of one series to another. Taking this concept to CAPM Beta in the model explains the sensitivity of an i^{th} asset to variation in the market Portfolio. More specifically Beta is the covariance of an i^{th} asset with market Portfolio and can be written as $\mathrm{Cov}_{i,m}/\sigma_m^2$. Testing of CAPM based on this Beta falls under the range of tradition and unconditional approach. However, many studies show scepticism on this static version of Beta. To them conditional version of Beta, where Beta is the ratio of conditional covariance of an asset i with conditional variance of the market holds true (Avramov, 2004). Nelson (1991) in a study covering the period from 1926 to 1985 on US market proves that conditional models outperform the unconditional ones on the US stock market, as the mean and variance varies over time. The study incorporated Auto-Regressive Conditional Heteroskedasticity (ARCH) process in the component of an asset-Beta and proves that the conditional version of Beta proves more meaningful in explaining the expected return. Consistent with this methodology, Javid (2009) in a study on Pakistan stock market also comes up with similar findings.

Other studies covering the conditional version of CAPM include Castillo-Spindola (2006) on Mexican economy with significant results, Shum, et al. (2004) on Singapore stock market covering the period of 1986-1998 also reveal significant findings regarding explanatory power CAPM with conditional version. In another study, on New York Stock Exchange (NYSE) and AMIX for the period of 1962-1990, Jagannathan and Wang (1996) show that conditional version performs substantially better than unconditional one. In a similar study on New York Stock Exchange (NYSE), The American Stock Exchange and National Association of Securities Dealers Automated Quotations System (NASDAQ) for the period of 1964-2001, Avramov and Chordia (2006) reveal significant results. Huang (2001) and Sweeney (1982) also support the same methodologies as followed by the similar studies. However, Handa and Tiwari (2006) reveal that conditional version does not perform better than the unconditional version of CAPM.

Most of the previous studies on CAPM focus on the specification of data instead of its application on various sectors of the economy. Especially in Pakistan almost all the studies overburden CAPM by testing whether or not CAPM is valid for Karachi Stock Exchange. All the macroeconomic factors, especially interest rate, have relevance to the financial models, as per findings of these studies. The dynamics of macroeconomic factors are totally different from stock’s volatility despite the facts that performance of macroeconomic factors does affect volatility of stocks through speculations.

The previous studies have ignored application of CAPM risk return relations to the economic activities. The required rate of return using the CAPM equation can be very useful in the illustration of many economic concepts. Application side of the CAPM with reference to Pakistan is specially missing from the existing literature. The present study is an effort to explore significance of the CAPM for the determination of the phenomenon whether or not the investors are earning at competitive rates. Although some of the previous studies (Na et al., 1995) show failure to the model which can be attributed to the market imperfection; nevertheless, market anomalies do not constitute the fact that model is incapable of performing in accordance with running economic context. It can also be inferred that failure to get the required rate of return through CAPM, may lead investors to see what required return is up to in the economy.

3. Methodology and Analysis of findings

Estimating CAPM in the context of Pakistan is prone to data misspecification. The basic input in CAPM is calculation of returns of assets and the return of benchmark Portfolio. In case of Pakistan the benchmark is represented by KSE-100 index (Most of the papers in Pakistan are based on KSE 100. This is considered as a benchmark Portfolio). While estimating CAPM in Pakistan, most of the studies (Abbas et al., 2011; Hanif and Bhatti, 2010; Hanif and Shah, 2011; and Khan et al., 2012) calculate returns on security as well as market index by using a simple formula that is, $R_i = (\mathrm{p_t}/\mathrm{p_{t-1}}) - 1$. Where R_i is return on i^{th} security and $\mathrm{p_t} - \mathrm{p_{t-1}}$ is price differential of security at time t and $t - 1$. Returns calculated through this method are time inconsistent. Moreover, when it comes to continuous compounding effect, the formula fails to capture the continuous change in prices or returns Avramov(2004). Returns calculated through the above formula will be inflated, causing covariance to be overestimated and consequently Beta will provide erroneous results related to the systematic risk in the neighborhood of SML. The present study is based on time consistent returns. The security as well as market returns are captured by the formula given below:

$$R_i = \ln\left(\frac{P_t}{P_{t-1}}\right)$$

This formula captures the time addictiveness of data and also incorporates the compounding effect in returns. In the present study panel data models are employed using the returns of the stock prices of 22 banks for the period of June 3-2008 to May 16-2012 on the daily basis. The data set has been structured using banks as identifiers for the period under consideration. This way, there are 22 cross-sectional units with 925 observations each, for the period ranging from June 03, 2008 to May 16, 2012. Some of the descriptive statistics are presented in Table 1.

The time consistent returns of some of the banks are negative for the period of 2008 to 2012. In this sample period, KSE has gone through a bad patch and even the market crashed in the mid-2008 shedding 1500 points in a single day Khan and Mahmood (2013). Out of 22 banks, returns of 12 banks are negatively skewed which reveals most of the values of returns falling below the average values. Moreover Kurtosis for all the banks is greater than 3 indicating the data set following Leptokurtic Distribution whose central peaks are higher and steeper and the tails are longer and flatter.

After calculating descriptive statistics the target is to estimate CAPM using equation (2.1.1). Karachi Interbank Offer Rate (KIBOR; Karachi interbank offer rate at which schedule bank can borrow from central bank) is used as a proxy for the risk free rate which is used as a benchmark by the banking sector in borrowing and lending to the investors. Table 1 column H shows 12% average KIBOR rate for the sample period. Column E shows the Beta calculated using standard formula (such as $\mathrm{Cov}_{i,m}/\sigma_m^2$). Our sample Beta ranges from -0.021 for SNB to 0.725 for UBL. The value of Beta being equal to 1 shows that a security is as risky as the market and should accrue the return equal to the market return. Interestingly the present study shows that none of our selected banks has Beta above one which means all the securities are less risky than the market as per criterion of the CAPM. Therefore, we should expect less required rate of return from these securities as a whole. Required rate of return calculated through CAPM shows a great variability whereas return on the UBL's securities is the lowest at 3.33 % and maximum return is 12.31% of SNB.

It is assumed that the risk free rate is less than market rate on the argument that taking risk must attribute more profit to the investor. However, in the context of Pakistan, most of the studies on CAPM employ T-bill rate (Javid, 2009 and Raza, et al., 2011) or the rate specified by national saving certificate (Hanif and Bhatti, 2010 and Khan, et al., 2012) as a proxy for risk free rate. The risk premium calculated by employing such type of risk free rate will always be negative in Pakistani perspective. The required rate of return calculated from CAPM using risk free proxies is pointless unless viewed in a practical setting. The significance of CAPM for the determination of required rate of return for the investors in the event of risk taking environment has always been main objective. This objective of the investors goes unachieved in the event of negative risk premium. There is no rationale of taking risk but accepting return much less than risk free rate. The previous studies failed to provide any justification for such an irrational rate of return in the Pakistani context. Yet studies related to Pakistani KSE stocks have given many more different types of applications of CAPM. The difference between required rate of return calculated from the CAPM and the risk free rate is shown in column J of the Table 1. None of the figure for any bank is positive. It means investor is better off by not taking the risk of investment in the security market. Rather, risk free rate is better option for him to invest. Different other very important meanings can be drawn from this very fact of risk free rate exceeding the required rate of return. The scenario can be elaborated with the help of the formula which is generally used to measure probability of default. The formula is shown in equation (3.1) given below.

$$P = \frac{(1 + RFR)}{(1 + RRR)} \quad (3.1)$$

where
P = probability of default of risk based assets.
RFR = interest rate (KIBOR) or the risk free rate.
RRR = expected return or the required rate of return using traditional CAPM equation.

In Pakistani perspective, most of the cases have RFR > RRR. That is why there is least probability of getting return above the risk free rate. There is need to revert the existing inequality between risk free rate and the required rate of return in order to establish positive scenario for investment in the real sector of Pakistan economy. Until and unless this inequality is reverted the productive capacity of the economy of Pakistan cannot be enhanced. Banking sector of the economy is the focus of the present study. This sector seems to have played little role in the expansion of real sector of the economy despite significant growth of financial sector of Pakistan. The results also reveal that Pakistani monetary sector is highly protected in terms of high interest rate and the high interest spread.

In order to reiterate the findings of the study, another test as per hypothesis stated below has been considered.
H_0 = there is no difference between RFR and RRR in Pakistan.
H_1 = there is significant difference between RFR and RRR.

The present study applies various nonparametric tests of equality on the hypothesis stated above. The results are reported in the Table 2 given below. All the nonparametric test results indicate significant difference between the risk free rate and the required rate of return calculated from the CAPM. All the measures of central tendency, measures of dispersion reveal significant difference between the two rates (RFR and RRR). Not only the distribution pattern of the two rates is different but also statistically they are different. Every rate is running on its own pattern, therefore, the economic link between the monetary policy and the stock market is missing. Since stock market represents the real sector of the economy, therefore it may be concluded from the findings that monetary and the real sector seem to have developed either very weak relation or out-rightly there is no relationship between the real and the monetary policies of the economy of Pakistan. Further studies are recommended in the connection to explore the missing link between the monetary and the real sectors of the economy of Pakistan.

3.1 The Causality test: As discussed earlier, all the descriptive statistics reveal missing link between the real and the monetary policies of the economy of Pakistan. The present study employs advanced statistical techniques such as Probit and the Logit models in order to check causality between the real and the monetary variables. The variable of monetary policy has been slightly modified in this section. Risk premium is considered as the variable representing the real sector's performance. The interest margin is assumed as representative of the monetary policy of the country. After the construction of these two very important variables the present study tests whether or not the risk premium determine as much required rate of return as the interest margin earned by the banking sector of the country.

Assuming different rates of the interest margin it has been tested whether or not there is probability of determination of an equal amount of required rate of return by the risk premium which is determined by the stock market with the help of traditional CAPM equation. Since the dependent variable is the response measured in qualitative form, which is why the Logit models are tested. The capacity of CAPM to determine as much required rate of return as the interest margin has been tested in the present study. Pakistani banks are making hefty profit margins on account of very high interest spread in the South Asian region (Daily times "banking spread up 32 bps" Wednesday March 02,2011, Financial stability review, first half 2011 State Bank of Pakistan.) which seems at the cost of real sector growth of the economy. The models have been tested for the interest margin ranging from 6% to 9% assuming that real sector of the economy will come to real halt if the trend of the banking sector to earn ever rising interest margin continues to exist. Four dummy variables are constructed based on the four possible rates of interest margin. These qualitative response variables are defined in the following lines.

Probability of earning RRR at least equal to 6% interest margin carries value 1, otherwise 0.
Probability of earning RRR at least equal to 7% interest margin carries value 1, otherwise 0.

Probability of earning RRR at least equal to 8% interest margin carries value 1, otherwise 0.
Probability of earning RRR at least equal to 9% interest margin carries value 1, otherwise 0.

This definition of the dichotomous dependent variable paves the way to apply Logit and Probit models assuming the nonlinear relationship. When the dependent variable is qualitative in nature, the simple OLS and GLS fail to determine the relationship between dependent and independent variables (Gujarati and Sangeetha, 2007). Our dependent variable is probability of return equal to the interest margin determined by monetary system of the country. The independent variable is market risk premium (R_m – RFR). The Logit model is stated in the equation (3.1.1).

$$L_i = \ln\left(\frac{P_i}{1-P_i}\right) = \beta_1 + \beta_2(R_m - RFR) \qquad (3.1.1)$$

where
L_i = log of Odds Ratio of the probabilities
P_i = probability of bank interest spread at least equal to the RRR falls between 0 and 1.
($R_m – RFR$) = risk premium of the banking stocks

This model specification also provides evidence whether or not interest margin of the Pakistani banking sector is at par with the market rate of return. The market risk premium being greater than the interest margin encourages investors to invest in the real sector rather than investing their monetary assets in the passive modes of bank deposits.

The results are presented in the Tables 1 through 4 given below. The coefficients of risk premiums are significant when log of the Odd Ratio of the probability of having 6% rate of interest margin is assumed to be equal to the required rate of return. The results are significant for both the Probit and the Logit models. It means if the risk premium increases, it is likely to raise the required rate of return at par with interest margin of the banking sector of the Pakistan economy when the interest margin in the economy is only 6%. The other results are calculated assuming the interest margin greater than 6%. The results clearly depict no significant impact of the risk premium on the log of the Odd Ratio of probability of interest margin at par with the required rate of return. If the interest margin continues to expand, the risk premium is least likely to have any possible impact on the log of the Odd Ratio. Thus it can be concluded that rising trend of the interest margin creates possibility of delink between the real and the monetary sector of the economy of Pakistan.

The negative value of the coefficients of risk premium at the higher rate of interest margin means that the system of stock market in terms of KSE is unable to catch up as much profit as the bank margin, such as greater than 6%. In order to promote real sector of the economy, banking sector has to rationalize their interest margin. An excessive interest margin is never rationalized in the best interest of the real sector of the economy.

4. Conclusion

Most of the previous studies related to the CAPM estimation in Pakistan employed time inconsistent methods of calculating returns of securities and the market index. The present study avoids this error and calculates time consistent continuous series of returns. The previous studies focused on estimation and validity of the CAPM in Pakistan. The present study opens the doors for the application of CAPM conceptual relationship in terms of risk and return to different sectors of the economy. The study employs qualitative response variable to apply nonlinear method of estimation and finds delink between the interest margin and the risk premium in Pakistan. There is unequivocal delink between the real sector and the monetary policy at the point where banking sector of the country enjoys high rate of interest margin. The descriptive analysis of the study based on nonparametric test revealed significantly different distribution patterns of the risk free rates and the required rate of return. At the second stage when advanced statistical methods of nonlinear causal relationships are estimated, the relationship seems to have existed when the banking sector of the country is charging reasonable interest margin. As the banking sector starts charging higher rate of interest margin, not only CAPM equation fails to build relationship of risk premium but also monetary policy of the country fails to play its expansionary role for the real sector of the economy of Pakistan.

Based on findings of the study, expansionary monetary policy in Pakistan is recommended in order to build link between the monetary and real sector of the economy. Interest cut policy is likely to encourage investors of the real sector to increase bank borrowings for the expansion of their business activities. Furthermore, useful applications of the CAPM, instead of testing its validity, might be explored with time consistent estimation of returns.

Table 1: Descriptive statistics, capital asset pricing model, risk free frat and risk premium

	Return of individual security $Ri = \ln(p_t - p_{t-1})$					Required rate of return $Ri = RFR + \beta\,(Rm - RFR)$		Risk free Rate KIBOR	Risk premium $(Rm - RFR)$	RRR-RFR
	A	**B**	**C**	**D**	**E**	***F***	**G**	**H**	**I**	**J**
BANKS	Mean	Std. Dev.	Skew.	Kurt.	beta	*Ri*	Std. Dev.			
ABL	-0.000249	0.046017	-1.233358	235.8202	0.291	8.55%	0.024170	0.120587	-0.120442	-0.035041
ACB	-0.001065	0.051401	-1.072298	221.9421	0.255	8.98%	0.025272	0.120587	-0.120442	-0.030703
BAF	0.000411	0.205871	-0.472432	45.6315	0.375	7.54%	0.021655	0.120587	-0.120442	-0.045158
BAH	-0.001053	0.027776	0.208622	4.1244	0.338	7.98%	0.022759	0.120587	-0.120442	-0.040714
BIP	-0.00027	0.021770	-3.899947	45.6767	0.020	11.81%	0.032897	0.120587	-0.120442	-0.002347
BOK	-0.000485	0.041775	0.705045	8.2555	0.316	8.25%	0.023403	0.120587	-0.120442	-0.038050
BOP	-0.000597	0.038017	0.588267	6.1602	0.699	3.64%	0.014239	0.120587	-0.120442	-0.084143
FAB	-0.001179	0.031267	0.059837	4.9949	0.496	6.08%	0.018351	0.120587	-0.120442	-0.059708
HBL	-0.000303	0.023647	-0.649137	9.1030	0.204	9.60%	0.026881	0.120587	-0.120442	-0.024558
HMB	-0.000974	0.024153	-1.331507	13.1040	0.068	11.23%	0.031317	0.120587	-0.120442	-0.008191
JSB	-0.001226	0.046059	0.829646	8.9640	0.501	6.02%	0.018239	0.120587	-0.120442	-0.060302
KAS	-0.002269	0.046397	0.119656	6.7763	0.304	8.39%	0.023748	0.120587	-0.120442	-0.036577
MCB	-0.000155	0.024335	-0.114875	4.0182	0.751	3.01%	0.013651	0.120587	-0.120442	-0.090401
MEB	-0.000252	0.026194	-0.160913	5.5367	0.091	10.96%	0.030545	0.120587	-0.120442	-0.010958
NBP	-0.000604	0.027672	-1.792690	20.2746	0.341	7.95%	0.022657	0.120587	-0.120442	-0.041049
NIB	-0.001766	0.042758	1.470768	16.6078	0.221	9.39%	0.026348	0.120587	-0.120442	-0.026597
SAM	-0.001809	0.046659	-6.209236	117.7752	0.067	11.25%	0.031345	0.120587	-0.120442	-0.008080
SCB	-0.002258	0.044406	0.728239	13.0932	0.481	6.26%	0.018749	0.120587	-0.120442	-0.057916
SIL	-0.001334	0.033387	-0.012969	9.6515	0.558	5.34%	0.016857	0.120587	-0.120442	-0.067186
SNB	-0.000961	0.031457	0.069766	4.9636	-0.021	12.31%	0.034280	0.120587	-0.120442	-0.002472
SUM	-0.001932	0.047651	0.981744	8.7933	0.235	9.22%	0.025889	0.120587	-0.120442	-0.028301
UBL	-0.000224	0.028761	-6.176592	110.5924	0.725	3.33%	0.013934	0.120587	-0.120442	-0.087284
KSE	0.000145	0.014373	-0.095871	5.7268						

Table 2: Test for equality between series

Included observations: 20350

Method	Equality of Variances Between Series	Equality of Medians Between Series	Equality of Means Between Series
F-test	1.143215 (0.0000)	-	-
Siegel-Tukey	28.59052 (0.0000)	-	-
Bartlett	91.06419 (0.0000)	-	-
Levene	2566.397 (0.0000)	-	-
Brown-Forsythe	2539.634 (0.0000)	-	-
Wilcoxon/Mann-Whitney	-	147.7015 (0.0000)	-
Wilcoxon/Mann-Whitney (tie-adj.)	-	147.7415 (0.0000)	-
Med. Chi-square	-	21395.38 (0.0000)	-
Adj. Med. Chi-square	-	21392.48 (0.0000)	-
Kruskal-Wallis	-	21815.75 (0.0000)	-
Kruskal-Wallis (tie-adj.)	-	21827.54 (0.0000)	-
van der Waerden	-	18889.72 (0.0000)	-
t-test	-	-	116.3511 (0.0000)
Satterthwaite-Welch t-test*	-	-	116.3511 (0.0000)
Anova F-test	-	-	13537.58 (0.0000)
Welch F-test*	-	-	13537.58 (0.0000)

Table 3a: Results for Logit and Probit Models at 6%

Dependent Variable: Bank Interest Spread	Binary Logit (Quadratic hill climbing) 9%	Binary Probit (Quadratic hill climbing) 9%
Constant	-0.777795	-0.488101
	(0.0000)	(0.0000)
Risk Premium (Rm-RFR)	-2.039656	-1.298787
	(0.0000)	(0.0000)
LR statistic	23.73994	23.9842
Prob(LR statistic)	0.0000011	0.000000971
S.D. dependent var	0.482823	0.482823
McFadden R-squared	0.000885	0.000894
Schwarz criterion	1.317746	1.316955
Hannan-Quinn criter.	1.317222	1.317734

Table 3b: Results for Logit and Probit Models at 7%

Dependent Variable: Bank Interest Spread	Binary Logit (Quadratic hill climbing) 9%	Binary Probit (Quadratic hill climbing) 9%
Constant	-0.777795	-0.488101
	(0.0000)	(0.0000)
Risk Premium (Rm-RFR)	-2.039656	-1.298787
	(0.0000)	(0.0000)
LR statistic	23.73994	23.9842
Prob(LR statistic)	0.0000011	0.000000971
S.D. dependent var	0.482823	0.482823
McFadden R-squared	0.000885	0.000894
Schwarz criterion	1.317746	1.316955
Hannan-Quinn criter.	1.317222	1.317734

Table 3c: Results of Logit and Probit Models at 8%

Dependent Variable: Bank Interest Spread	Binary Logit (Quadratic hill climbing) 8%	Binary Probit (Quadratic hill climbing) 8%
Constant	0.119549	0.072421
	(0.0199)	(0.0279)
Risk Premium (Rm-RFR)	-0.640134	-0.4212882
	(0.1190)	(0.1105)
LR statistic	2.56711	2.690662
Prob(LR statistic)	0.109107	0.100938
S.D. dependent var	0.497606	0.497606
McFadden R-squared	0.0000916	0.000096
Schwarz criterion	1.377527	1.377521
Hannan-Quinn criter.	1.377003	1.376997

Table 3d: Results of Logit and Probit Models at 9%

Dependent Variable: Bank Interest Spread	Binary Logit (Quadratic hill climbing) 9%	Binary Probit (Quadratic hill climbing) 9%
Constant	-0.777795	-0.488101
	(0.0000)	(0.0000)
Risk Premium (Rm-RFR)	-2.039656	-1.298787
	(0.0000)	(0.0000)
LR statistic	23.73994	23.9842
Prob(LR statistic)	0.0000011	0.000000971
S.D. dependent var	0.482823	0.482823
McFadden R-squared	0.000885	0.000894
Schwarz criterion	1.317746	1.316955
Hannan-Quinn criter.	1.317222	1.317734

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