Value-at-risk and the market-to-book equity ratio:

Evidence from the Israeli banking system

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1. Introduction

VaR (Value at Risk) is the maximum expected loss on a given financial position over a given time horizon and at a defined statistical confidence level. For instance, a bank disclosing a daily VaR of 10 million dollars at 99% level means that there is only 1% chance that the bank will incur a loss of more than 10 million dollars over the next day. One of the most important developments in portfolio risk management is the increased use of VaR by banks (Dowd, 2000). VaR aggregates all of the risks in a portfolio into a single number suitable for use in the boardroom, reporting to regulators, or disclosure in an annual report (Rogachev, 2007)

Banks in Israel must manage market risks through a VaR system, for calculating capital adequacy (Supervisor of the Banks, Directive 339 and Directive 341). A detailed disclosure of VaR can be found in the banks' financial statements.

The ME/BE ratio is the ratio between a firm's market value of equity (ME) and its book value of equity (BE). An ME/BE ratio higher than 1 indicates a situation in which investors estimate the value of a firm to be higher than its book value, which is indicative of a higher inherent potential value, as they see it (low risk or high yield).

Ruthenberg and Pearl (2005) develop an ME/BE ratio equation of a bank and estimate it empirically for 1993-2003 for each of the five largest banks in the Israeli banking system. Ruthenberg and Pearl's conclusion is that two main factors have a

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significant effect on the ME/BE ratio; credit risk impacts it negatively, while return on equity impacts positively.

The objective of this study is to examine the relevance of Value-at-Risk in the Israeli banking system. We will examine the market risk as reflected in VaR on the ME/BE ratio of the five largest banks in Israel in 2004-2008. The banks are: Bank Hapoalim, Bank Leumi, Israel Discount Bank, Mizrahi Tefahot Bank and First International Bank. According to the bank of Israel annual review of 2008 (page 11), as of December 31, 2008, the five largest banks hold 94% of the assets of the banking industry. The empirical study will be conducted using a multi-variable regression, where in addition to the market risk variable, we also control for profitability, credit risk, macroeconomic and capital market conditions, banking structure (competition) and regulation.

Our study focuses on a developing country, Israel, which like other developing countries is marked by a centralized capital market and significant government intervention. These characteristics may impact the way banks are managed which, in turn, may influence the financial ratios and the market value of said banks. Additionally, in light of the globalization and integration process in the capital markets, many foreign investors invest in the Israeli capital market, and thus, of 25 Israeli companies listed on the TA-25 Index, six of them were dual listed. Four of the five largest banks in Israel are traded in the TA-25 list. These banks have branches and subsidiaries overseas, and their shares are commonly held by foreign investors. As a reflection of this reality, foreign investors' interest in the Israeli capital market has increased in recent years, as has the analysis of the condition of publicly traded banks. For these reasons, it is important to examine the effect of market risk exposure of banks on the market value of banks' equity in Israel.

The results of this study may well prove themselves to be essential for regulators of banks, since they can also monitor the stability of the banking system through the banks' ME/BE ratios. Additionally, the findings may influence analysts and investors who analyze the performance of banks over time.

The structure of the article is as follows. The second section provides a literature review. The third section develops the forecasted quarterly standard deviation of trading revenues implied in the VaR as a risk variable and formulates the hypothesis for it. Section 4 describes the methodology and the database. Section 5 presents the empirical results. The last section concludes and provides limitations as well as recommendations for further research.

2. Literature Review

Damodaran (2002) shows that the ME/BE ratio is positively related to the return on equity (*ROE*). Saunders and Wilson (2001) note the negative significant correlation between the exposure of the banks to credit and market risks and the ME/BE ratio and. The exposure to risk is reflected in the increase in the rate of return required by the investor or in the rise in the cost of capital for the firm.

Ruthenberg and Pearl (2005) demonstrate that two variables significantly influence the ME/BE ratio of the Israeli banks. **Return on equity** has a positive impact, while **the risk** has a negative impact. They use two approaches to estimate risk. The first approach was to calculate the credit risk variables from the banks' financial statements. The second used the Capital Assets Pricing Model (CAPM), where the cost of capital could be derived from this model. According to the study, these findings show that it is possible to estimate the return and risks of banks over time through ongoing monitoring of the development of the ME/BE ratios.

Many studies find that the stock returns of financial institutions are sensitive to interest rate changes (Lloyd and Shick, 1977; Chance and Lane, 1980; Flannery and James, 1984; Booth and Officer, 1985; Scott and Peterson, 1986; Kane and Unal, 1988; Kwan, 1991; Choi et al., 1992). Schrand (1997) examines whether the reports on derivatives provide information that is useful in estimating the exposure to interest among savings and loan institutions. The researcher studies this by measuring the sensitivity of stock price relative to fluctuations in the interest rate. The findings of the study show that activity in derivatives reduces exposure to interest rate fluctuations. In addition, Harris et al. (1991) find that stock returns of commercial banks were sensitive to exchange rate movements.

Other studies report that the use of derivatives reduced the sensitivity of the equity returns of financial institutions to interest rates (Choi and Elyasiani, 1997; Chamberlain et al., 1997; Carter and Sinkey, 1997; Hirtle, 1997; Brewer et al., 2001).

Similarly, Rajgopal (1999) studies whether information on derivatives presented in a table or in sensitivity analysis is useful when assessing exposure to changes in price. The researcher finds that share prices of companies that used derivatives as a hedge were less impacted by changes in the prices of gas and oil.

Linsley and Shrives (2000, 2005) suggest that the forward-looking risk information would be especially useful to investors. Hirtle (2003) shows that US banks' quarterly market risk data contain valuable information about future risk exposures. The results of other researchers also demonstrate the usefulness of the market risk and VaR information (see also Hirtle, 2007; Bali et al., 2007; Taylor, 2005; Alexander and Sheedy, 2008).

Jorion (2002) studies the relationship between the VaR measurements and the subsequent variability of the trading revenue in a group of eight large commercial

banks in the US over the course of six years. Jorion finds a positive and significant correlation between the VaR-based volatility and future market risk, concluding that the VaR measurements published by the banks effectively predict the bank's market risks from trading activities. Therefore, they can be used by analysts to compare risk profiles of different banks.

Liu et al. (2004) examine the correlation between VaR disclosures and the trading margins among 17 commercial banks between 1997 and 2002. The researchers find that banks' trading VaRs have predictive power for trading income variability that increases with bank technical sophistication and over time. They find that trading VaRs have predictive power for different measures of risk.

The annual reviews of the Supervisor of the Banks contain analysis of the development of the aggregate ME/BE ratios of the five large banks in Israel. The reviews show that since the beginning of 2003, investors changed their assessments and expected significant improvement in the performance of the banking groups. These expectations were, indeed, met with the publication of positive results by the banks in 2003, 2004 and 2005, which were reflected in the ongoing rise of the ME/BE ratio in all of the groups during those years. In December 2003, the aggregate ratio was an average of 0.87; in December 2004, it crossed 1 and was 1.11, and in December 2005, it reached 1.55. Despite the improved performance by the banks in the first half of 2006, this ratio worsened due to the ongoing improvement in the book value of the banks, concurrently with the decline in their market value, as happened throughout the market. According to the Supervisor of the Bank's annual reviews, the decline in the value of the ME/BE ratio in 2006 reflects the skepticism of the market regarding the ability of the large banks to repeat the impressive performance of the previous years. The decline in the ratio in 2006 at all the large banks - despite the

difference in their characteristics and business results - shows that in the minds of investors, the expected negative impact on the performance of the banks is attributable to their need to grapple with shared future challenges, beginning with the anticipated decline in operating revenues from implementation of the Bachar Reform (decline in fees due to the forced sale of mutual funds by the banks) and through legislation that limits the ability of the banks to raise fees.

The ME/BE ratio continued to decline in 2007, despite the positive background conditions. The average value of the ME/BE ratio was 1.21 at the end of 2007, compared to 1.33 at the end of 2006. However, it remained higher than 1 and the average over the past five years was 1.05. This decline can be explained as the response of investors to the new developments with future negative effects on the profits of the banks mainly due to the beginning of the subprime mortgage crisis in the US and its implications for global capital markets. This crisis impacted negatively on the value of Israeli bank shares in the present, particularly because the investors feared the banks' exposure to risks involved in their activity with mortgage-backed securities and from the failure of the banks to meet their future profitability targets.

In 2008, these trends intensified as the financial crisis expanded throughout the world after the collapse of Lehman Brothers in the US in the second half of September 2008, the recession that began developing at the end of 2008 and the high leverage of companies increased the credit risk in the economy and also led to lower prices on the capital market. These had a negative impact on the business results of the banking system in the fourth quarter of 2008. This impact was reflected in the banks' provisions for loan losses and in the decline in the value of their securities, and as a result, losses in the Israeli banking system. At the end of 2008, the average value of the ME/BE ratio reached a low of 0.57.

Diagram 1 presents the development over time of the ME/BE ratio at the five large banks.

Diagram 1 here

3. Using VaR to a measure of risk and developing an hypothesis

In this study, we extract the forecasted quarterly standard deviation of trading revenues from the VaR data, using a methodology similar to that used by Jorion (2002).

We assume that the changes in the trading revenue have a conditional normal distribution, and the average of the changes is zero (a reasonable assumption for large commercial banks whose trading portfolios include a wide variety of financial instruments exposed to risk factors). At a one-tailed confidence level of 99%, in other words $\alpha = 2.33$, the equation will be written as follows:

$$R_{t+1} \sim N(0 , S_t^2)$$

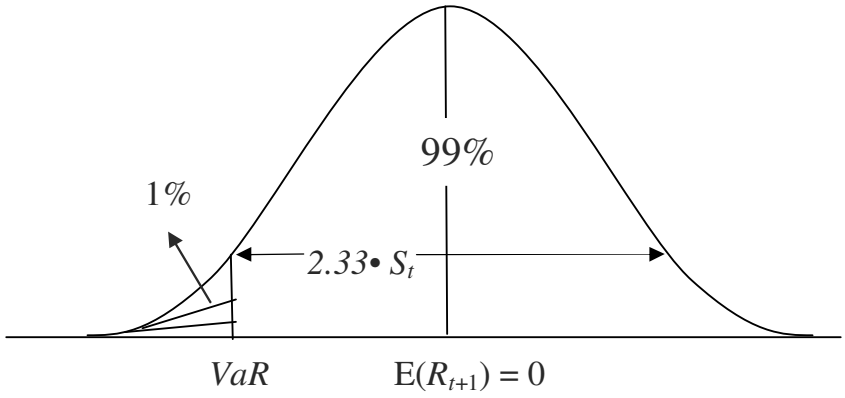
$$VaR_t = 2.33 \cdot P \cdot \sigma_t \qquad (1)$$

Where:

2.33 - the number of standard deviations for a confidence level of 99%, which is 2.33.

P- the size of the position of the revalued portfolio in NIS millions.

σ_t - standard deviation of the revalued portfolio.



The following are the steps in calculation of the forecasted quarterly standard deviation of the VaR relative to equity (implied standard deviation in VaR divided by equity, *ISDE)*

Step 1:

Transformation, in order to standardize the reported VaR to daily by dividing the reported VaR by $\sqrt{n}$, as described in Equation (2):

$$\text{VaR(daily, 99\%)} = \frac{\text{VaR(n days ,99\%)}}{\sqrt{n}} \qquad (2)$$

Where:

n - time horizon according to which the VaR was calculated.

Let us stress that Bank Hapoalim, Bank Leumi, Israel Discount Bank and First International Bank of Israel calculate VaR for two weeks forward (10 trading days), while Mizrahi Tefahot Bank calculates VaR for one month (21 trade days). Therefore the VaR for Bank Hapoalim, Bank Leumi, Israel Discount Bank and First International Bank of Israel is divided by the square root 10, while the VaR for Mizrahi Tefahot Bank is divided by the square root 21.

Step 2:

Placement of the daily VaR in Equation (3) to extract the forecasted quarterly standard deviation of revenues implied in the daily VaR (in NIS).

$$\text{VaR(daily, 99\%)} = P \cdot \alpha \cdot \sigma_{\text{daily}} \tag{3}$$

Where:

P- size of the position in NIS millions.

α - the number of standard deviations for a confidence level of 99%, which is 2.33.

σ_{daily} - the implied daily standard deviation (in percentage) derived from the VaR.

Step 3:

Placement of $P \cdot \sigma_{\text{daily}}$, extracted from Equation (3), in Equation (4) to calculate the quarterly implied standard deviation, $S_{\text{quarterly}}$.

$$S_{\text{quarterly}} = P \cdot \sigma_{\text{daily}} \cdot \sqrt{N} \tag{4}$$

Where:

N - 63 trade days in the quarter.

Step 4:

Division of the implied quarterly standard deviation, $S_{\text{quarterly}}$, of the bank by its equity as described in Equation (5):

$$ISDE = \frac{S_{\text{quarterly}}}{BV} \tag{5}$$

Where:

BV- book value of equity.

VaR (Value at Risk) estimates the maximum expected loss a bank can incur due to realization of market risks on a financial position during a given time horizon and at a defined statistical level (confidence level).

A high VaR value (in given parameters of confidence level and time horizon) indicates a high market risk. Therefore, if the measurement is relevant, we would expect it to also be reflected in the value of the bank and its ME/BE ratio.

Therefore:

H1: A negative correlation is expected between ISDE and the ME/BE ratio.

4. Methodology and data

Like Ruthenberg and Pearl (2005), we also estimate the variables that determine the ME/BE ratio using multivariable regression.

$$\begin{aligned}(ME/BE)_t^i &= \beta_0 + \beta_1(market\ \ risk)_t^i + \beta_2(profitability)_t^i + \beta_3(credit\ \ risk)_t^i \\ &+ \beta_4(capital\ \ market\ \ conditions)_t + \beta_5(macroeconomic\ \ conditions)_t \\ &+ \beta_6(banking\ \ structure\ \ factors)_t + \beta_7(regulation\ \ policy)_t \\ &+ \beta_8(bank\ \ size)_t^i + \varepsilon_{it}\end{aligned}$$

The dependent variable

ME/BE is the ratio between the market value of equity and the book value of equity of bank *i* in quarter *t*. Because there is a lag of approximately three months in the publication of the financial statements which are related to *BV*, we calculated the ratio:

$$\left[\frac{ME_{t+3}}{BE_t}\right]^i .$$

Independent variables

The independent variables and the hypotheses regarding their impact on the ME/BE ratios are set out below:

For **market risk**, we use the forecasted quarterly standard deviation of trading revenues implied in the VaR divided (deflated) by equity, $(ISDE)_t^i$. This is the main variable in our study, and it is expected to have a negative impact on the ME/BE ratio.

Control variables:

Profitability is presented by the dependent variable ROE_t^i, the average return on equity. The variable is comprised of the bank's net profit *i* in quarter *t*, divided by the average of the equity in quarter *t* and the previous quarter, *t-1* (in annual terms). In light of similar studies, we expect a positive relationship between *ROE* and the ME/BE ratio of the bank.

For **credit risk**, we use the ratio between the aggregate loan loss provisions (LLP) of bank *i* over quarter *t* and the three previous quarters (*t-1, t-2, t-3*) divided by total credit to the public, $(LLP / L)_t^i$. This variable estimates the quality of the bank's credit. The quality of credit declines as the LLP ratio increases and vice versa. Therefore, we expect the variable to have a negative impact on the ME/BE ratio.

To measure the **capital market condition**, we use the quarterly rate of change (in annual terms) of the Tel-Aviv 100 Index, $(TA100)_t$ between quarter *t*+ 1 and quarter *t*. This variable is used as an estimate for the market portfolio. The hypothesis with respect to the aforementioned variable is that an increase in the market portfolio (TA 100 index) represents optimism and positive momentum in the stock market, and will thus lead to an increase in the price of the banks' shares and an increase in their ME/BE ratio. Consequently, we expect a positive association between the TA 100 Index and the dependent variable.

Macroeconomic conditions are represented by the quarterly rate of change (in annual terms) in the Combined State of the Economy Index, $(CSOEI)_t$ in quarter *t*.

We hypothesize that in times of economic growth, the economic value of the bank increases with the scope of the economic activity, and therefore we expect a positive relationship between this variable and the ME/BE ratio.

Regarding the **structure of the banking system**, we select a variable that measures the degree of concentration in the banking system, the Herfindahl-Hirschman Index, $(HA)_t$, where the index is measured using the total assets of all five banks in quarter *t*. The hypothesis is that maintaining a high-level of concentration will lead to less competition, an increase in the economic value of the bank due to its monopolistic strength, and therefore to an increase in its ME/BE ratio. In other words, we expect a positive relationship between the Herfindahl-Hirschman Index and the dependent variable.

To estimate the effect of **regulation**, we use a dummy variable for the privatization of Israel Discount Bank, D_{2005}, with a value of 1 for the periods after privatization (in January 2005) and 0 otherwise. We select Israel Discount Bank, because it was the only bank to be privatized during the period examined. The hypothesis is that the market views privatization as a move that will improve performance of the bank in the future, following improvement in its operational efficiency and investments or due to better risk management than in the past. In light of the above, we expect a positive correlation between this variable and the ME/BE ratio.

In order to control for the **size of the bank**, we use a natural logarithm of the bank's total assets *i* in quarter *t*, $(LTA)_t^i$

As aforementioned, we analyze panel data that include a combination of a cross-section of data on the five major banks with time series data that cover the 20 quarters between 2004 and 2008. The data was taken from the quarterly financial statements of

the five largest banks that were published publicly (Bank Hapoalim, Bank Leumi, Israel Discount Bank, Mizrahi Tefahot Bank and First International Bank). In other words, there are 20 observations for each of the five banks and a total of 100 observations of the panel data. The period - the past five years - was selected due to the availability of the VaR data. According to the Bank of Israel's 2008 Annual Review 2008 (page 11), on December 31, 2008, the five largest banks hold a 94% share of total assets of the banking industry, and they therefore represent the banking sector in Israel.

Table 1 presents the descriptive statistics of the sample. The table shows that the average ME/BE ratio is greater than 1 (1.05). Furthermore, the period is characterized by high average profitability (approximately 12%), differing between the banks.

Table 1 here

5. Empirical results

Table 2 presents the regression results for the bank data. The adjusted R^2 reached 62% in the regression, and the overall model is significant (F=21.45).

Table 2 here

With respect to market risk, the main variable that is based on VaR (*ISDE*) has a negative and statistically significant impact on the ME/BE ratio ($\beta_{1=}$ -8.08, p<0.05). This finding is very important and is in line with studies that indicated the relevance of the VaR measurements (Jorion, 2002; Liu et. al., 2004). This finding supports our hypothesis.

With respect to the control variable, the following are the results:

ROE has a positive and significant effect on the ME/BE ratio at banks. This indicates that an increase in the bank's profitability enhances the attractiveness of the

shares of that bank to the investors and, as a result, its market value and ME/BE ratio also improve.

For credit risk, considered to be the main risk in banking activity, we use a variable that estimates the percentage of loan loss provision divided by credit to the public (*LLP/L*). The impact of the variable is negative and statistically significant on the ratio (*ME/BE*), and this finding is in line with expectations. In other words, the greater the bank's exposure to credit risk, the more investors will decrease their holdings of the shares, leading to a decline in its market value and the ME/BE ratio.

As expected, we find a positive and statistically significant association between the condition of the capital market, as estimated by the variable *TA 100* and the ratio (*ME/BE*) of the banks.

Our research shows that the economic environment affects the banks' ME/BE ratio. The macroeconomic conditions, as expressed in the rate of change in the Combined State of the Economy Index for economic activity show, as expected, a positive and significant statistical relationship with the banks' ME/BE ratio.

Concentration (structure of the system) and regulation have an impact on the ME/BE in the Israeli banking system. The concentration, as estimated by the Herfindahl-Hirschman (*HA*) Index, has a positive and significant impact on the ME/BE ratio. Regulation is represented here by a dummy variable that is supposed to capture the impact of government policy on privatization of Israel Discount Bank in January 2005. As expected, the coefficient of the variable for regulation is positive and statistically significant.

6. Summary and Conclusions

In this study, we examine the relevance of VaR. This examination is done by an empirical investigation of the risk inherent in VaR on the ME/BE ratios of the five largest banks in Israel between 2004 and 2008. The innovation in our study relates to the examination of the issue during the recent period (when changes in bank operations began as did their exposure to risks, particularly due to the global financial crisis) and with the addition of a new variable that captures the market risk exposure (VaR).

Based on our hypothesis, we find a negative and statistically significant relationship between the forecasted quarterly standard deviation of revenues implied in the VaR and the ME/BE ratio of the banks. The findings show that investors in these bank shares estimate that market risk has a negative and significant impact on the value of the banking premium. In other words, **the VaR measure has a negative effect on the ME/BE ratio of the banks**. This finding extends previous studies on the issue.

The following are the other findings of our study:

1. A positive and statistically significant correlation between the return on equity and the ME/BE ratio of the banks, similar to the findings of Ruthenberg and Pearl (2005).
2. A negative and statistically significant relationship between credit risk and ME/BE ratio of the banks as was found in Ruthenberg and Pearl.
3. A positive and statistically significant relationship between macroeconomic factors and the ME/BE ratio of the banks. The positive correlation found bolsters the perception that the banks are a "spitting image" of the economy.

4. A positive and statistically significant association between the structure of the banking system and the ME/BE ratio. This finding demonstrates that the more concentrated the banking sector, the higher investors expect yields in the banking sector to be.

However, there are two main limitations in this preliminary research on the VaR relevance in Israel. Firstly, the small sample covers five years of data from large banks, and the results may not be generalized over different time periods and small banks. Secondly, only two types of risk were tested (market risk and credit risk). Other risk variables that represent different types of risk can be considered in future research. Such a study could enhance our understanding of the association between the risk profile of banks and their ME/BE ratio.

The results of our study can be used by analysts and investors when analyzing the performance of the banking system over time. Additionally, the study may help the Banking Supervision Authorities, which follow the developments of the risk adjusted returns in banks.

In the coming years, the Israeli banks will implement the Basel II Accord. We believe that this implementation will lead them to more focused and precise risk management and increased transparency and full disclosure. This is a clear indication to the market that there is an improvement in the banks' decision-making and in risk management and thus increased "market discipline" as an additional supervision mechanism to the institutional one. This process is expected to lead to a more precise estimation of market value and the ME/BE ratio. Therefore, it would be interesting to revisit the issue at banks after implementation of the directives of the Basel II Committee and while including new variables that represent more accurate

measurement of credit risks and for the first time measures of operational risks as well.

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Table 1
Descriptive Statistics

	Characteristic	Mean	Median	S.D.	Min	Max
ME/BE	Performance	1.05	1.08	0.28	0.35	1.68
ISDE	Market risk	1.11%	0.95%	0.83%	0.12%	3.45%
ROE	Profitability	11.96%	12.81%	9.48%	-30.46%	32.71%
LLP/L	Credit risk	0.62%	0.53%	0.29%	0.17%	1.35%
TA100	Capital market conditions	14.74%	21.19%	43.77%	-75.75%	94.48%
CSOEI	Macroeconomic conditions	5.73%	7.31%	5.60%	-9.10%	14.65%
HA	Banking structure (concentration)	0.249	0.249	0.004	0.241	0.254
D_{2005}	Regulatory Policy	0.96	1.00	0.19	0.00	1.00
LTA	Bank Size	11.95	11.98	0.55	11.05	12.65

Where:

ME/BE - market-value to book-value equity ratio

ISDE - implied standard deviation in VaR divided by equity

ROE - return on equity (compounded annually)

LLP/L -loan loss provision/total loans

TA100 - return on the TASE 100 Index (compounded annually)

CSOEI -change in Composite State-of the-Economy Index (compounded annually)

HA - Herfindahl- Hirschman Index (using total assets)

D_{2005} - dummy variable for the privatization of Israel Discount Bank (1 for the periods after the privatization (January 2005) and 0 otherwise.

LTA - natural log of total assets

Table 2
OLS Regression for the Relationship between the ME/BE Ratio and the Independent Variables

Independent variables	*Coefficient*
C	-7.17 (-3.48)*
ISDE	-8.08 (-2.18)*
ROE	0.66 (3.34)**
LLP/L	-31.36 (-3.69)**
TA100	0.23 (5.72)**
CSOEI	1.07 (2.44)*
HA	29.66 (3.97)**
D_{2005}	0.21 (2.31)*
LTA	0.06 (1.12)
Adj. R^2	0.62
F Value	21.45

For variable definitions see table 1.

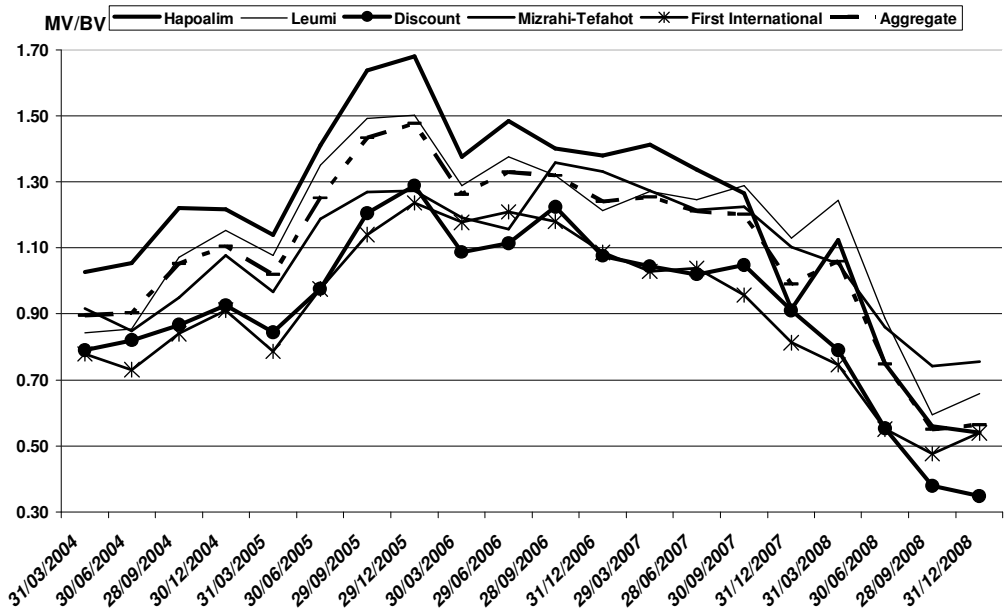
t values appear in parentheses.

** significant at 1 percent

* significant at 5 percent

Diagram 1

ME/BE of the Largest Five Commercial Banks, 3/2004-12/2008



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