Value-at-Risk Disclosures of Banks: The Case of Israel

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1. Introduction

Banks in Israel are mandated to manage market risks and calculate their capital adequacy through a Value–at-Risk (VaR) system (Supervisor of the Banks, Directive 339 and Directive 341). A detailed disclosure on VaR can be found in the banks' financial statements.

VaR is the maximum expected loss on a given financial position over a given time horizon and at a defined statistical confidence level. Regulators in Israel proliferated the implementation of VaR to other industries as well. As of the end of 2007, under the Israeli Securities Regulations, companies whose main business is in the area of finance must report according to the VaR model. It should be noted that other than these companies, since 2008, provident funds and insurance companies must also calculate VaR.

In this paper, we examine the relationship between the VaR measurements reported by the five largest banks in Israel and the subsequent variability of their trading revenues. The research question is: **Does the VaR reported by banks over time predict the variability of the trading revenues in the Israeli banking system?**

A high VaR value (in given parameters of confidence interval and time horizon) indicates a larger standard deviation of the changes in the prices of the risk factors. Therefore, if the measurement has informative value, we would expect this to also be

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reflected in the changes in future trading revenues, which the VaR attempts to capture. In other words, we expect to find a positive correlation between the VaR data of the banks and the subsequent variability of their trading revenues.

Barth (2007) argues that accounting researchers can help the accounting standards setters both at the theoretical and practical level. Research is exact, unbiased and based on economic theory; it can therefore assist in measurement and disclosure decisions, and can indicate the extent to which these methods provide useful information to users of the financial statements. In a previous article written by the author (Barth, 2006), she relates to this when discussing IFRS 7: "Information about the variance of estimates of the future can be important to users in assessing the riskiness of expected benefits" (page 283).

We believe that examining this issue is essential for several reasons:

- Israel is characterized by: (1) high concentration of control by controlling shareholders in publicly traded companies, (2) strong centralization of the banking system, (3) the 5 largest banks in Israel hold a 94% market segment. These characteristics may impact the way banks are managed and the level of information derived from the financial statements. Furthermore, over the past decade, Israel has become a popular target for foreign investments and is widely covered by analysts. Consequently, it is important to examine informativeness in the Israeli context.
- As previously mentioned, use of the VaR measurement in Israel has increased over the years, and it is implemented in banks, insurance companies, provident funds and other publicly traded companies whose primary business is in the financial area. IFRS 7 (IASB, 2005) has mandated publicly traded companies in

Israel to report on sensitivity analysis (or alternatively on VaR) since 2008. It is important for the regulatory authorities and accounting standards institutions to understand whether the new information is informative and whether it can forecast the variance of profits in the future.

- The VaR included in the financial statements of banks may be used by investors and analysts - when analyzing the banks' risk-return profile. This also explains why it is important to examine the informativeness of the VaR information.

The structure of the study is as follows: In Section 2, we review the relevant literature: we describe the regulation with respect to the issue of VaR at the banks and also review articles that have examined the relevance of risk management in general, with specific attention to VaR data. In Section 3, we present the research hypothesis**,** methodology and sample. In Section 4, we describe the data and descriptive statistics. In Section 5, we present the empirical results, and in the last section we conclude and provide limitations as well as recommendations for further research.

2. Review of Relevant Literature

2.1 Definition of VaR

VaR 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.

Three methods are used to calculate VaR: The normal distribution, historical simulation and Monte Carlo simulation. The VaR model has become a standard tool

used by banks to control risk (Dowd, 2000) and as a control and reporting tool used by managers, traders and directors. VaR is reported to the regulatory agencies and investors in the financial statements (Rogachev, 2007).

When VaR is compared to the other method of risk control - sensitivity analysis, we find that the sensitivity analysis method is simpler and more transparent than VaR. However, sensitivity analysis has its shortcomings. It takes each risk into account separately neither considering the correlation between the risk factors, nor offsetting risks attributable to the diversification and existence of negative correlations between the risk factors. Additionally, sensitivity analysis uses a fixed change, 5% for example, and does not consider past scenarios.

The VaR model takes into account the past standard deviation and correlation between risk factors. It can be improved by back-testing, which examines the gap between the loss forecast under the VaR model and the actual loss. Additionally, a stress-test can be applied to capture the risk of the model with extreme conditions and heavy-tailed distributions. However, implementing VaR systems is costly in terms of software, interfaces, recruitment of skilled employees, etc.

2.2 VaR-related Regulation in Israel

In 1997, Directive 339 to the Proper Conduct of Banking Business Regulations (risk management) was published. It relates to implementation of the VaR model. Later, Directive 341 to the Proper Conduct of Banking Business Regulations, (capital allocation for market risk exposure) relating to calculation of capital adequacy in respect of the exposure to market risks, was issued.

According to Directive 339, all banks (excluding mortgage banks) which take positions in foreign currency and interest, invest in their own account in securities (nostro) or are market makers in derivative financial instruments, must manage the market risks by means of a VaR system. The Directive emphasizes the following requirements:

- An internal model for measuring market risks, based on statistical techniques such as variancecovariance (normal distribution), historical simulations and Monte Carlo simulations
- Ongoing measurement of the bank's exposure to market risks by estimates of VaR based on the corporation's internal model
- Stress-test analyses of market risks
- A model for assessing the profitability of positions
- A separate risk-control unit

Directive 339 marked a revision at the banks in matters related to organizational and IT preparedness from the various aspects of risk management. The Directive defined new functions in the organizations (including a risk manager and a risk-control unit) and increased the involvement of management and the board of directors in all matters related to risk management and control. The Directive also served to be an inspiration for regulators in other fields, as it motivated them to tighten regulation in terms of financial risks. We are now seeing a process in which banking regulations trickle down to other financial companies and from them to publicly traded companies, thus strengthening corporate governance guidelines.

Directive 341 defines, *inter alia* qualitative and quantitative standards for approving an internal model used to calculate capital adequacy of market risks. The **qualitative**

standards stress the following parameters: 1) Involvement of the risk-control unit and responsibility of the management and board of directors, 2) independence of the risk control officer, 3) existence of an internal model that is part of risk management, 4) performance of monitoring and full control of the database and the possible changes to the models. The **quantitative** standards emphasize the various parameters and particularly the following: 1) VaR must be computed on a daily basis with a confidence interval of 99% and for a time horizon of 10 days, 2) the database is to be updated every three months, 3) recognition of correlations, 4) special estimation of the risk in options, 5) performance of stress tests on the parameters in the model.

2.3 Relevance of Information on Risk Management

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 (and VaR is forward looking), would be especially useful to investors. Hirtle (2003) shows that US banks' quarterly market risk data contains 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.

3. Research hypothesis, methodology and sample

3.1 Research hypothesis

In light of the literature review in the previous section, we would expect that the VaR data published by the banks would have informative value. The higher the VaR value (in given parameters of confidence interval and time horizon) the larger standard deviation of the changes in the prices of the risk factors that constitute the financial position. Therefore, if the VaR measurement has informative value, we would expect it to be reflected in the changes of the future trading revenues, which the VaR attempts to estimate. We test this with the following hypothesis:

H_1: The VaR measurement of a bank is positively related to the subsequent variability of its trading revenues.

3.2 Methodology

To examine the research hypothesis, we ill use the methodology proposed by Jorion (2002).

First, let us define:

VaR_t – *VaR* at the end of a day t

R_{t+1} – trading revenue during day $t+1$

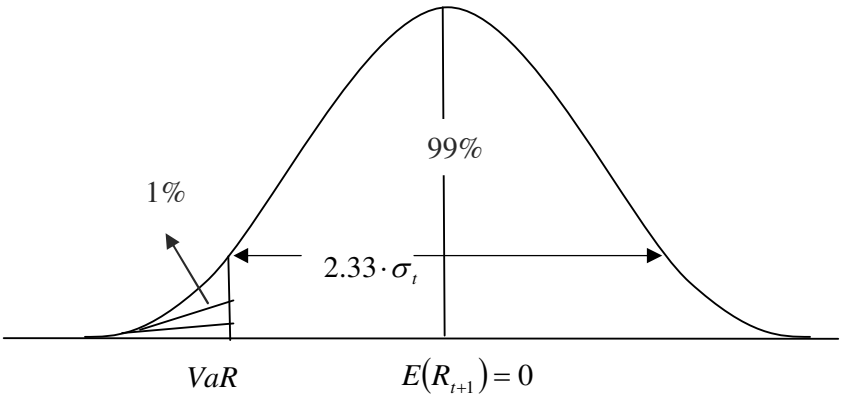
$(1-C)$ – 1 minus the confidence level (e.g., 1% when $C = 99\%$)

$$P\left[R_{t+1} - E\left(R_{t+1}\right) < \text{-VaR}_t\right] = 1 - C = 1\% \qquad (1)$$

3.2.1. Transforming VaR into a Risk Measurement:

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

$$VaR_t = \alpha \cdot S_t = 2.33 \cdot S_t \tag{2}$$



The expected absolute value of the trading revenue is a linear function of the standard deviation, and the standard deviation is a proportionate to the VaR, as shown in Equation (3):

$$E\left(\left|R_{t+1}\right|\right) = \sqrt{\frac{2}{\pi}} \cdot S_t = 0.80 \cdot S_t \tag{3}$$

From this we can see that a linear link exists between VaR and the absolute value of the trading revenue and therefore the predictive power of the *VaR*, can be examined using the following equation:

$$\left|R_{t+1}\right| = \alpha + \beta \cdot \sigma_t + \varepsilon_{t+1} \tag{4}$$

Where:

$$\sigma_t = S_t \cdot \sqrt{N} \tag{5}$$

N = 63 trade days in a quarter

One of the assumptions is that R_{t+1} is distributed normally with a mean of 0. However, because it is not actually so, Jorion (2002) measures the unexpected trading revenues as the difference between the quarterly trading revenue and its moving average over the previous four quarters.

$$R_{t+1} - E\left[R_{t+1}\right] = R_{t+1} - \frac{1}{4} \cdot \sum R_{t+1-i} \tag{6}$$

Thus, Equation (4) was implemented as follows

$$\left|R_{t+1} - E\left[R_{t+1}\right]\right| = \alpha + \beta \cdot \sigma_t + \varepsilon_{t+1} \tag{7}$$

In this paper, we estimate Equation (7) through the OLS regression model. If β is positive and significant, we will conclude that VaR is informative for the risk of future trading revenues

3.2.2. Calculating the Standard Deviation of Trading Revenues (σ_t):

The following are the stages in calculation of the quarterly standard deviation (σ_t):

Step 1:

Transformation, in order to standardize the reported VaR to daily by dividing the reported VaR by $\sqrt{n}$, as described in Equation (8):

$$\text{VaR(daily, 99\%)} = \frac{\text{VaR(n days ,99\%)}}{\sqrt{n}} \tag{8}$$

Where:

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

Step 2:

Placement of the daily VaR in Equation (8) to compute the daily standard deviation of revenues implied in the daily VaR (in NIS).

$$\text{VaR}_t = \alpha \cdot S_t \tag{9}$$

where:

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

Step 3:

Substituting St from Equation (9) into Equation (10) to compute the quarterly standard deviation.

$$\sigma_t = S_t \cdot \sqrt{N} \tag{10}$$

Where:

N = 63 trade days in a quarter

3.2.3. Calculation of the Unexpected Trading Revenues:

The **unexpected trading revenues** will be calculated using Equation (6):

$$R_{t+1} - E[R_{t+1}] = R_{t+1} - \frac{1}{4} \cdot \sum R_{t+1-i}$$

Where:

R_t will be calculated as the total of the following quarterly items taken from the income statements of the five banks:

- Shares: quarterly profit (loss) from investment in shares, net.
- Derivatives: quarterly profit from derivative instruments, ineffective part of ALM and others.
- Bonds: quarterly cumulative revenues from trading bonds and unrealized profit and loss on trading bonds, net.

In this study we examine the relation between the VaR-based quarterly volatility and the absolute value of the unexpected trading revenue in the subsequent quarter using Ordinary Least Squares (OLS) regression analysis. Equation (7) is estimated for the period December 31, 2003 to December 31, 2007 and for each of the five banks separately (17 quarterly observations for each bank).

The regression model is:

$$\left|R_{t+1} - E[R_{t+1}]\right| = \alpha + \beta \cdot \sigma_t + \varepsilon_{t+1}$$

3.3 The sample

The sample will include the VaR data reported by the five largest banks in Israel:

- Bank Hapoalim Ltd.
- Bank Leumi Le-Israel Ltd.

- Israel Discount Bank Ltd.
- Bank Mizrahi Tefahot Ltd.
- First International Bank Ltd.

Other banks are not included in the sample, as complete data was not available. 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.

4. The data and Descriptive Statistics

As aforementioned, the data was taken from the financial statements of the five largest banks for the period December 31, 2003 to December 31, 2007, where the data on trading revenues was taken from the financial statements for the period December 31, 2002 to December 31, 2007, given that the dependent variable also uses the four quarters preceding December 2003.

Table 1 presents an example of Bank Leumi's VaR reporting for 2007, extracted from the bank's financial statements.

Table 1: Sample of VaR reporting by Bank Leumi, December 2007

	Limitation	**December 31, 2007**	**2007 average**	**December 31, 2006**	**2006 average**
Total at group level	500	290	256	206	231
Total at group level for revalued portfolios by market value	300	141	85	29	38

Source: Bank Leumi, 2007 annual financial statements

Bank Leumi uses the normal distribution method to calculate VaR. The following are the parameters it uses: 99% confidence level and two-week time horizon. The table distinguishes between total banking activity and the revalued portfolios according to market value and between year-end VaR and average VaR.

The table also shows a very interesting process. The VaR system has become an integral part of risk control. The board of directors defined risk policy and limits in terms of VaR, inferring that VaR is used for risk control by the board and not only as a regulatory and risk management tool.

Table 2 specifies how VaR was calculated by the five banks. It can be seen that three banks (Leumi, Discount and First International) used the parametric approach that is based on the assumption of normal distribution. At two banks (Hapoalim and Mizrahi) the calculation was done using the historical simulation method and at times also using several methods.

Table 2: Information about VaR methods at the five large banking groups

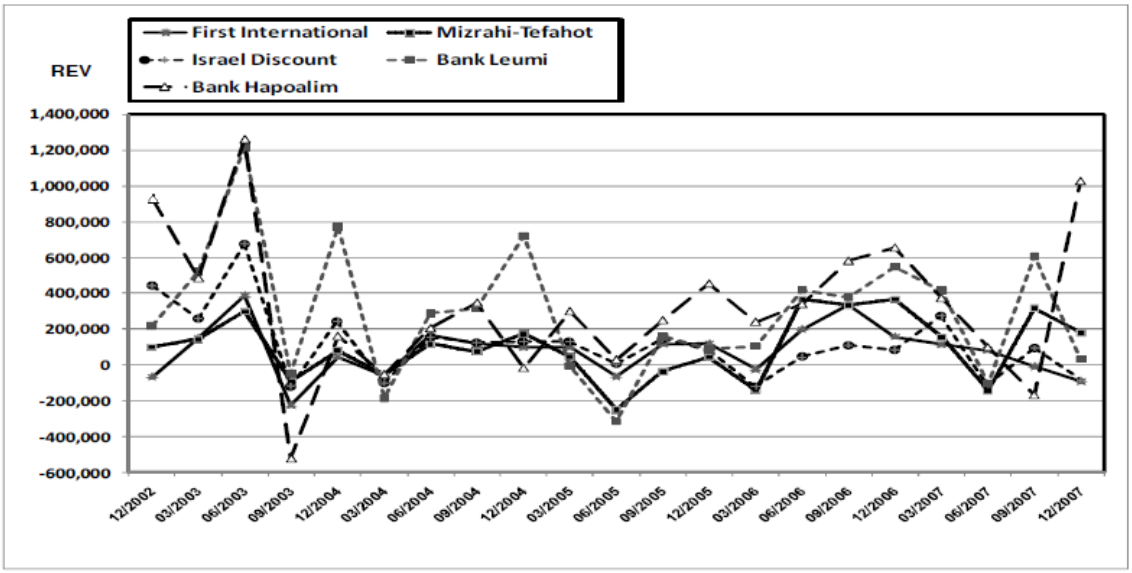
Bank	Time horizon	Confidence level	Calculation method
Bank Hapoalim	10 business days	99%	The high result from the historical simulation calculation and the calculation according to the Monte Carlo simulation (on total trade in Israel)
Bank Leumi	Two weeks	99%	The parametric method (for MTM revalued portfolios)
Israel Discount	10	99%	The parametric method (for the Group's total

	business days		risk)
Mizrahi-Tefahot	Month	99%	Historical simulation on Group's total assets (on the Group's total risk)
First International	10 business days	99%	The parametric method (for the Group's total risk)

Source: Financial statements of the five large banks

Figure 1 illustrates the development of the quarterly trading revenues for the five banks. The figure shows how over most of the period, there is a positive correlation between the trading revenues of the five banks.

Figure 1: Development of the quarterly trading revenues of the five large banks - December 31, 2002 - December 31, 2007



Source: Financial statements of the five large banks and the authors' processing.

Table 3 provides additional information on the variables in the regression.

Table 3: Average, standard deviation, maximum value and minimum value of the variables in the regression (NIS, thousands)

	Bank	Maximum	Minimum	Standard Deviation	Average
S_t	Bank Hapoalim	67,436	14,004	16,551	33,027
	Bank Leumi	297,320	31,240	65,858	69,831
	Israel Discount	184,209	29,732	35,167	63,665
	Mizrahi-Tefahot	150,904	87,718	15,327	105,121
	First International	133,578	33,395	25,143	77,055
$\lvert R_{t+1} - E[R_{t+1}] \rvert$	Bank Hapoalim	787,688	6,125	208,324	270,771
	Bank Leumi	800,000	18,375	218,535	295,898
	Israel Discount	366,500	4,875	103,131	107,471
	Mizrahi-Tefahot	461,438	6,375	145,895	155,776
	First International	232,125	688	71,235	105,496

5. Empirical results

We test the association between the VaR based standard deviation and the absolute value of unexpected trading revenues in the subsequent quarter. The OLS regression results are reported in Table 4.

As expected, the impact of the standard deviation based on VaR is positive and significant for three of the five large banks (Bank Leumi, Israel Discount Bank, First International Bank). This finding indicates that the VaR disclosures are positively related to the variability of the subsequent trading revenues of three banks. It is interesting to note that these three banks used the parametric approach for calculating VaR. This is also the approach used to develop our methodology in section 3.2 above.

Table 4: Results of the regressions of Equation 7 for each of the five large commercial banks, quarterly data for December 31, 2002 - December 31, 2007

Bank	Intercept	Slope	R^2
Bank Hapoalim	214,647 (0.56)	3.62 (0.73)	16.5%
Bank Leumi	147,467 (1.89)*	2.53 (2.11)**	27.9%
Israel Discount Bank	79,076 (2.08)**	0.49 (1.84)*	44.3%
Mizrahi-Tefahot Bank	403,711 (1.42)	-1.82 (-0.69)	73.8%
First International Bank	-593 (-0.01)	1.56 (2.33)**	84.2%

t values in the second line.

* Significant at 0.10 level; **significant at 0.05 level.

We also performed a regression analysis based on panel data (polled sample) of the five banks over time (untabulated). The coefficient based on the VaR was found to be positive, but not statistically significant.

If we summarize the results of the regressions for the five large Israeli banks, we find that in most cases they support our hypothesis that there is a positive association between the VaR based standard deviation and the absolute value of unexpected trading revenues in the subsequent quarter. In other words, the VaR data generally have an informative value.

A similar study upon which we relied was conducted in the US by Jorion (2002). His test was conducted on a quarterly basis for 1995 - 2000, a total of 23 observations for each bank. Jorion showed that VaR has an informative value for some of the banks

and for the system as a whole. The relation was found to be positive and statistically significant for four of the eight banks in his study. Additionally, Jorion analyzed the pooled data of the eight banks and found a positive and significant relation.

Similarly, we usually find a positive and significant association between the VaR based measure of volatility and the absolute value of unexpected trading revenues in the subsequent quarter. For three of the five banks, a positive and significant relation is found between the variables, supporting our hypothesis. However, in contrast with Jorion's study, we do not find a significant relation for the pooled sample.

6. Summary and Conclusions

In this paper, we present the Value-at-Risk, VaR, which is an advanced tool for estimating market risks at banks, insurance companies and other companies primarily engaged in the finance sector. We then use a regression analysis to examine the association between the VaR data reported and the subsequent unexpected trading revenues for the five large banks in Israel, from 2003 - 2007. We assume that in light of the fact that VaR is forward-looking and is an accepted indicator of exposure to market risks, we can expect a positive relation between the standard deviation based on VaR reported by the Israeli banks and the variability of their trading revenues. The results indicate that there is a positive and significant association between the standard deviation based on VaR and the future volatility of the trading revenues at three of the five large banks examined.

However, we should practice a cautious approach in order not to generalize the results. First of all, the results are sensitive to the sample and period. Second, it is important to note that the methodology we used to examine the research hypothesis

is based on the parametric approach (normal distribution), while banks sometimes use other methods to calculate VaR, leading to results that differ from those through the parametric approach (e.g. Bank Hapoalim and Mizrahi Bank in our sample). Third, it is important to remember that the methodology we used includes an assumption of stability of the position during the coming future quarter. In fact, changes can certainly occur in a position that will impact on the quarterly results.

The results of the study may have several implications. We noted that the provident funds and insurance companies have started using VaR. The reporting on VaR may be helpful to the users of the financial statements. Thus, for example, lenders can use this measurement when deciding on whether to deposit in an insurance company and at what rate. Furthermore, the study may be important for regulators and accounting standards institutions when setting banking regulation and financial reporting standards.

We believe it is important to continue to research the issue at banks, after expanding the information on public financial statements. Thus, for example, expanding the reporting so that it include a breakdown of the VaR reported for each of the market risks (CPI, exchange rate and interest) and with a quantitative description of the impact of diversification could contribute to improving the informativeness of the VaR data. This type of reporting can indicate the contribution of exposure of each of the types of market risks to the overall measurement and show the offsetting impact attributable to the diversification among the risk factors. Additionally, full disclosure regarding the changes in the fair value of the banking portfolio as a result of the exposures may also be helpful to users of the financial statements. Finally, this research should be expanded in the future to insurance companies and companies

primarily engaged in the financial sector after they adopt the VaR model and report on it in their financial statements.

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Autobiographical note

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Mr. Polanitzer had successfully passed all the Portfolio Manager License Exams administered by the Israel Securities Authority (ISA), holds a B.A. (cum laude) in Economics specializing in Finance and a M.B.A. (cum laude) in Business Administration specializing in Finance, both from the Ben-Gurion University of the Negev. Mr. Polanitzer has considerable experience as risk manager, founder and head of the Fair Value Department of the consulting firm of Ogen Ltd. - Actuarial, Financial and Business Consulting, research assistant for the Dr. Shilo Lifschutz, CPA, in the field of Risk Management in the Israeli Banking System (participation and leading empirical studies about the VaR Model and the Market-to-Book Value Ratio in the Israeli Banking System, as well as writing academic articles for publication in professional journals), teaching assistant for the Dr. Shilo Lifschutz, CPA, for Finance (using Excel's advanced tools in finance) and Banking (Risk Management Regulations in public companies and financial institutions) courses, risk manager and chief modelist of an Investment Committee at Ben-Gurion University of the Negev, adjunct lecturer in the Management Department at Achva Academic College for Derivatives and Risk Management courses, adjunct lecturer in the School of Economics at Ashkelon Academic College for Financial Statement Analysis and Valuations courses, and lecturer in a privet preparation course for the professional exams administered by the Israel Securities Authority (ISA) for a Portfolio Manager License.