Properties of the Value at Risk Estimate Using the Historical Simulation Methodology

A Research Project Submitted for the Degree of Master of Business

Confidential to Department

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1. Introduction

In its most general form, risk can be defined as the possibility an outcome will differ from expectations. This project is concerned with the quantification of market risk which results from the inherent volatility in the prices of financial assets and is of concern to banks and other financial institutions for two principal reasons. Firstly, a large proportion of the assets and liabilities of these types of firms are sensitive to changes in market prices. Secondly, there have been a number of high profile cases[1] of significant losses caused by an inadequate appreciation of market risk. These factors have driven recent advances in quantifying and understanding Market Risk and one increasingly popular technique is known as Value-at-Risk (VaR).

Value-at-Risk is a relatively new concept originally developed for exchanges in their settlement operations and has advanced quickly since the late 1980's to become the leading measure of Market Risk in a majority of large banks and trading organizations. JP Morgan produced a standardized framework for the VaR calculation known as RiskMetrics in 1994 prompting an explosion in use by making the methodology and data freely available. A number of regulators, including the Reserve Bank of New Zealand, have advocated VaR as an appropriate risk measure.

A principle advantage of a VaR methodology lies in its simplicity. VaR is capable of providing a single number to express the market risk of a portfolio of financial instruments, a property that makes communication of such a complex exposure relatively simple. However, the greatest benefit of the technique lies in the structured analysis of exposures. It is this process of generating the VaR that delivers the benefit to an organization.

WestpacTrust have used the VaR technique since its earliest conception constantly changing and updating the methodology to reflect best practice in the industry. The bank currently perform this calculation but realize that there can be significant variation in the estimate depending on the various assumptions and underlying data used in the calculation. At present the bank relies on an intuitive understanding of how these various factors can influence the calculation but would prefer a quantitative solution. The principle aim of this project is to provide a framework enabling the Bank to gain a better understanding of the properties of the VaR estimate based on quantitative tools. Specifically, this process will involve an estimation of the error in VaR, an understanding of how the VaR estimate is affected by the underlying assumptions made and how other measures of market risk can be used to provide the trading risk management team with additional insights to the banks exposure.

Firstly, this research project will describe the different VaR techniques, their strengths and their weaknesses. One of these models will then be developed to calculate the VaR for WestpacTrust Financial Markets in Wellington. Finally, the properties of this VaR will be examined to understand the estimate and gain an

appreciation of the subjectivity in its calculation. Some recommendations to the Bank regarding their VaR methodology will form the conclusion to this report.

10 References

1. Anders, Ulrich. *Value At Risk. Course Material – Finc407 Quantitative Methods* University of Otago (1998).
2. Barone-Adesi, Giovanni., Bourgoin, Frederick., Giannopoulos. "Don't Look Back" *Risk* (August 1998) P100-103.
3. Basle Committee on Banking Supervision. *An Internal Model Based Approach to Market Risk Capital Requirements.* Basle Committee on Banking Supervision (1995)
4. Basle Committee on Banking Supervision. *Planned Supplement to the Capital Accord to Incorporate Market Risks.* Basle Committee on Banking Supervision (1995)
5. Beder, Tanya Styblo. "VaR: Seductive but Dangerous." *Financial Analysts Journal.* (September-October 1995) P12-24.
6. Bernstein, Peter. *Against The Gods – The Remarkable Story of Risk* John Wiley & Sons, Inc. (1996).
7. Culp, C., Miller, M. and Neves, A. "Value at Risk: Uses and Abuses." *Journal of Applied Corporate Finance.* (1998) No. 10 P27-38.
8. Cardenas, J., Fruchard, E., Koehler, E., Michel, C. and Thomazeau, I. "VaR: One Step Beyond." *Risk Magazine.* (1998) No. 10.
9. Elton, Edwin. and Gruber, Martin. *Modern Portfolio Theory and Investment Analysis.* John Wiley & Sons, Inc. (1995).
10. Fong, Gifford. and Vasicek, Oldrich. "A Multidimensional Framework for Risk Analysis" *Financial Analysts Journal.* (July/August 1997) P51-57.
11. Gizycki, Marianne., Hereford, Neil. "Differences of Opinion" *Risk* (August 1998) P42-47.
12. Godfrey, Stephen., Espinosa, Ramon. "Value-at-Risk and Corporate Valuation" *Journal of Applied Corporate Finance.* (1998) Vol.10 No.4 P108-115.
13. Greene, William. *Econometric Analysis.* Prentice-Hall Inc. (1997).
14. Hanselman, Duane. and Littlefield, Bruce. *The Student Edition of MATLAB.* Prentice-Hall, Inc (1997).
15. Hawkins, Ian. "Risk Analysis Techniques – 1998 GARP FRM Exam Review Class Notes" http://www.EuclidResearch.com/current.htm (1999).
16. Hoppe, Richard. "VaR and the Unreal World" *Risk* (July 1998) P45-50.
17. Hull, John. *Options, Futures, and Other Derivatives.* Prentice-Hall Inc. (1997).
18. Jorion, P. *Value at Risk: The New Benchmark for Controlling Market Risk.* McGraw-Hill (1997).
19. Jorion, P. "Risk^2:Measuring the Risk in Value at Risk" *Financial Analysts Journal* November/December (1996).
20. Longerstacy, Jacques. *Riskmetrics Technical Document – Fourth Edition.* JP Morgan http://www.jpmorgan.com/RiskManagement/RiskMetrics/pubs.html (1995)
21. Morokoff, William., Lagnado, Ron., Owen, Art. "Tolerance for Risk" *Risk* (June 1998) P78-83.
22. Roth, Benedict., Layng, Alan. "Tools for Trading" *Risk* (June 1998) P51-55.
23. Shimko, David., Humphreys, Brett., Pant, Vijay. "*Hysterical Simulation*" Risk (June 1998) P47.

24. Walkenbach, John. *Excel for Windows 95 – Power Programming With VBA*. IDG Books (1996).
25. WestpacTrust Banking Corporation. *Trading Risk Management Framework* (August 1997).
26. Zangari, Peter. "A VaR Methodology for Portfolios That Include Options" *RiskMetrics Monitor – First Quarter 1996*. JP Morgan (1996)