

Collateralized Debt Obligation Approach for Newsboy Problem

~Would the notorious CDO be a genuine financial tool for managing risks?~

Rina Isogai

200720759

(Master's Program in Business Administration and Public Policy)

Adviser

Professor Ushio Sumita

Submitted to the Graduate School of
Systems and Information Engineering
in Partial Fulfillment of the Requirements
for the Degree of Master of Business Administration
The University of Tsukuba

March 2009

Abstract

It is widely believed that the Collateralized Debt Obligations (CDOs) played a major role in the ongoing worldwide financial crisis triggered by collapse of the subprime loan market in the United States. However, the fact that the misuse of the CDO resulted in collapse of the world economy does not necessarily imply that the CDO itself would be hazardous. The purpose of this thesis is to explore the potential of the CDO approach for controlling general risks. We largely focus on one-term CDO because of its simplicity, which enables one to investigate explicitly the stochastic structure of the CDO between the protection buyer and the protection seller. In particular, we apply the idea of the CDO to the classical Newsboy Problem (NBP). The classical NBP is concerned with how to determine the optimal order quantity of a product, whose value diminishes over one period, so as to maximize the expected profit, given the distribution of the stochastic demand. In our analysis, the underlying loss function replaces the credit risk in the original CDO context. The risk-neutral unit premium is formally introduced so as to assure no-arbitrage. A value at risk problem is then formulated without or with CDO. By comparing the respective optimal solutions, the effect of the CDO for controlling general risks is examined. Extensive numerical experiments reveal that the overall effect of CDO is rather limited. It could be effective, however, if (i) the underlying risk is high in that the variance of the stochastic demand is large; (ii) the expected profit should be held above a high level; and (iii) the probability of having a huge loss should be contained. Furthermore, if the CDO approach is effective, then both the optimal order quantity and the resulting expected profit are larger with CDO than those values without CDO.

Contents

1	Introduction	1
2	CDO Model Description	7
2.1	Multi-Term CDO Model	8
2.2	One-Term CDO Model and Its Basic Properties	13
3	Classical Newsboy Problem	21
3.1	Newsboy Problem: Expected Profit Approach	21
3.2	Newsboy Problem: Value at Risk Approach	26
4	Application of CDO Approach to Classical Newsboy Problem	28
4.1	CDO Formulation for Classical Newsboy Problem	29
4.2	Value at Risk Approach for Classical Newsboy Problem with CDO	30
4.3	Maximizing the Effect of CDO for Classical Newsboy Problem with CDO	37
4.4	Numerical Examples	38
5	Concluding Remarks	58
	Acknowledgements	60
	Bibliography	60