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# AN INSURANCE MODEL FOR THE PROTECTION OF CORPORATIONS AGAINST THE BANKRUPTCY OF SUPPLIERS BY USING THE BLACK-SCHOLES-MERTON MODEL

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## ABSTRACT

Many banks provide supply-chain finance solutions that might include insurance services that further mitigate trade risk such as the default of suppliers. This study proposes the development of an insurance model that uses the Black-Scholes-Merton Model (BSM) for default prediction and risk pooling management techniques as a way to reduce the risk due to supplier bankruptcy and estimate an insurance premium that banks can use to charge this service to their customers. In order to demonstrate the use of the proposed insurance model, a sample of companies is selected from the New York Stock exchange and data for historical stock prices from the CRSP database (Center for Research in Security Prices) is collected in order to calculate the probability of bankruptcy of a sample of suppliers from different industries by using the BSM model. Twelve pools of companies of different sizes are created and a VBA program for Excel is developed in order to calculate probability of bankruptcy tables of companies belonging to the different pools. A Monte Carlo simulation to simulate the impact on risk and expected losses on the number of insurance policies sold is implemented with the use of simulation software. The results show that the simulation is useful to estimate the number of sold policies required in order to reduce the risk to a minimum level and predict with a high level of certainty the losses due to bankruptcy of suppliers. The expected losses for a risk pool can be used by a financial institution in order to price an insurance contract that hedges a company against the risk of default of suppliers.

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## . INTRODUCTION

Companies are increasingly forming global supply chains and favouring global sourcing practices to lower the purchase prices. Although supply chain management has been used in practice during several decades, a new trend of developing financial services for the supply chain has emerged in the last ten years (Popa 2013); this has originated the concept of Supply Chain Finance (SCF). There are several definitions of SCF. According to Killen and Associates (2002), SCF represents all transaction activities that go from the flow of cash from the customer's initial order through reconciliation and payment to the seller. Lamoureux and Evans (2011) define SCF as the sequence of financial events and processes that take place as commercial transactions are executed. Popa (2013) also recognizes that SCF is different from the physical supply chain as it deals with the flow of cash instead of goods (Popa 2013). SCF has been recognized as an important issue in the supply chain mainly because its bad management can cause late delivery, negative cash positions and poor working capital management. SCF deals with many aspects of the supply chain including Supplier Risk Management, Supply Chain Financing, Tax Optimization, working capital optimization (including inventory) and the Impact of purchasing

and supply chain management on key financial performance ratios. SCF, in general, will translate into cost reduction, service improvement, better risk management and richer management information from a buyer and supplier perspective (Popa 2013).

Although the concept of supply chain finance is still expanding in scope, banks have initially understood SCF as a marketing umbrella to repackage traditional products such as trade, insurance, payments and cash management (Popa 2013). Since many banks provide supply-chain finance solutions, this includes insurance services that further mitigate trade risk. A supply chain insurance can be a possible way to hedge a company against the risk of bankruptcy of suppliers. This event can generate losses and extra costs that include (a) losses due to supply chain disruption, (b) delayed or stopped finished goods shipments, (c) difficulty in finding cost-effective alternate suppliers and sourcing contracts, (d) emergency procurements, (e) loss of reputation and market share loss, among others. In summary, If a supplier goes bankrupt, that firm may not be able to meet all of its customer requirements in the short-term, and will not meet any customer requirements if it eventually goes out of business (Valverde & Talla 2013).

This study proposes the development of an insurance model with the help of bankruptcy models and risk pooling management techniques. The proposed model uses pooling arrangements and the BSM bankruptcy model as a way to reduce the risk due to suppliers' bankruptcy and estimate an insurance premium that banks can charge to their customers for this service. First, a sample of companies are selected from the New York Stock exchange and data for historical stock prices from the CRSP database (Center for Research in Security Prices) are collected in order to calculate the probability of bankruptcy of a sample of suppliers from different industries by using the Black-Scholes-Merton (BSM) model. The data collected for this research is collected by using a judgment sampling method. A VBA program for Excel is developed in order to calculate the probability of bankruptcy with the help of the BSM model for the sample of selected companies. Risk pools are then created from the sample of companies and Monte Carlo simulations is conducted in order to estimate expected losses and risk.

The research questions are:

- i) Can the propose supply chain risk management insurance model reduce the risk of bankruptcy of suppliers in a corporate setting?
- ii) Is the model appropriate to calculate an insurance premium that could be used to implement the insurance model by insurance and financial institutions?

### 1.1. Supply Chain Risk Management

Risk management is a critical part of supply chain management (SCM) as the risk of bottlenecks, disruptions and incurring unforeseen costs are greater in cross continent and global supply chains. Supply chains are surrounded by potential risks including natural disasters, fraud, economic issues, changes in tax laws, disruptions caused by suppliers' bankruptcy, interest rates and foreign exchange rates fluctuations among other things. Supply Chain Risk Management (SCRM) includes strategies to manage risks along the supply chain (Shi 2004). The growing incidence of natural disasters caused by climate change, terrorist acts, embargoes, fraud, money laundering and economic volatility adds to the risk profile of a global supply chain.

Issues associated with risk and continuity in the supply chain have received considerable attention from both the practitioner and academic communities (Zsidisin 2010). Supply chain risks can generate losses that can be at times quite large due to the disruption of the supply chain. Losses can include loss of reputation, emergency procurement, delays in the production among others.

Research has shown that current principles used in supply chains have resulted in very vulnerable chains (Stephens and Valverde 2013). For example, the drive towards efficient supply networks has amounted into those networks becoming more vulnerable to business disruptions. Some supply chains aim at reducing vulnerability, but there remain chances that can result into disruption escalation. Therefore, it is easy to

deal with the internal sources more than the external ones. This is true because despite all the security measures that are put in place, chances of a terrorist attack to take place are still there. Human factors can also cause vulnerabilities in the supply chain. For example, cargo can be stolen despite all the security measures set aside.

There are different ways that have been adopted by companies in reducing vulnerabilities, for example reengineering or decreasing vulnerability by adjusting the structure and design within supply chains (Talla and Valverde 2012). Introduction of analysis tools can act as answers to the drastic supply chain disruption. The analysis application can help in handling incidents in an adequate manner in the future. Kraus & Valverde (2014) developed a tool for the detection of fraud in supply chain, this tool analyzes supply chain transactions in order to reduce the risk of fraud in the supply chains. Vulnerabilities in the supply chain can be mitigated with the help of supply chain tools.

SCF has been used for the risk management of supply chains. SCF includes risk mitigation instruments such as trade credit insurance that protect suppliers against the risk of non-payment by foreign buyers (Lamoureux 2011). Supplier risks can also be reduced by financial risk management strategies such as attenuating price volatility of supplier pricing for goods and services through negotiation of long term contracts and consolidation of requirements with other firms/organizations, minimization of currency risk on contracts denominated in foreign currencies through the various forms of hedging (e.g. forward contracts, futures contracts), minimizing the risk of potential supplier bankruptcy through financial analysis and surveillance and minimizing the cost of supplier financing in developing and emerging markets by providing advanced payments (Lamoureux 2011). A firm is obliged to evaluate the financial viability of suppliers in order to avoid the consequences of suppliers' default, insolvency, or bankruptcy (Milne, 2010; Wagner et al, 2004).

Consulting firms such as Deloitte and PriceWaterhouseCoopers (PWC) and insurance companies such as Zurich Insurance provide consulting services on assessing and mitigating supply chain risks arising from product development to outsourcing and from finance to logistics (Manmohan 2012). Zurich's supply chain risk management practice provides consulting services to reduce supply chain failures and insurance coverage including supplier defaults and supply delay so that the insurer can reduce financial risk exposure (Manmohan 2012).

## 2. Materials and methods

This section outlines the research methodology and design for this study. It covers the data collection techniques, mathematical models used, simulation techniques and the limitations for this research.

### 2.1. Data Collection

The research will use the Black-Scholes-Merton (BSM) (1973) option pricing model for estimating the probability of bankruptcy of suppliers based on the financial data collected

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