Transportation Research Part E 106 (2017) 276–293

Contents lists available at ScienceDirect

Transportation Research Part E

journal homepage: www.elsevier.com/locate/tre

Managing default risk under trade credit: Who should implement Big-Data analytics in supply chains?

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ARTICLE INFO

Article history:
Received 20 January 2017
Received in revised form 25 August 2017
Accepted 26 August 2017

Keywords:
Trade credit
Default risk
Supply chain
Big-Data analytics
Demand uncertainty

ABSTRACT

This paper considers a supplier–retailer channel in which providing trade credit to customers incurs default risk. Big-data analytics (BD-A) could be used to mitigate default risk. The aim is to identify the party that should implement BD-A in the supply chain. Our results indicate that when the retailer (supplier) is dominant in determining the credit period, the retailer (supplier) prefers to implement BD-A unilaterally if the optimal BD-A effort is higher than a threshold. The credit period, quantities ordered, and BD-A effort increase when BD-A effort cost is shared.

1. Introduction

Trade credit represents an agreement in which a customer is permitted to purchase goods by using an account (without paying cash), thereby paying the vendor at a later date. This type of credit enables customers to "buy now and pay later." Approximately 80% of companies in the United States offer trade credit (Tirole, 2006), rendering it the single most crucial source of short-term external financing for firms in the United States (Peterson and Rajan, 1997). The trade credit of Wal-Mart, the largest retailer in the world, exceeds the amount it borrows from banks. In March 2013, the trade credit owed by Australian businesses was estimated at over 80 billion dollars (Fitzpatrick and Lien, 2013). Severe competition in the market is increasingly driving entrepreneurs to use trade credit in promoting commodities.

Delaying payment enables customers to more effectively manage their short-term cash flow, and it can be used as an instrument of price discrimination to stimulate sales. Peterson and Rajan (1997) found evidence consistent with the use of trade credit as a means of price discrimination. Given that trade credit is usually extended to buyers on the same basis, regardless of the buyer's underlying credit quality, financially weaker firms typically pay a lower effective price than financially stronger firms do (Fitzpatrick and Lien, 2013). Nonetheless, trade credit commonly creates situations in which companies or people are unable to meet their debt obligations. When payment is delayed, the risk of default must be taken into account (Zhang et al., 2014), and extending credit terms increases the risk of default (Wang et al., 2014). In the case of default, the financial health of the seller depends on the size of the default with respect to profits (Raddatz, 2010). The provision of long credit periods to customers presenting bad-will would be impetuous. Trade credit can also function as a screening mechanism by which sellers can evaluate the default risk of customers (Smith, 1987).

Big-data analytics (BD-A) refers to the process of collecting, organizing, and analyzing large quantities of data to discover patterns and useful information. In a business setting, BD-A can be applied to operations and sales as well as

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http://dx.doi.org/10.1016/j.tre.2017.08.013
1366-5545/

relations with customers, suppliers, and any other business-related entities (Manyika et al., 2011). This can help managers make favorable decisions or gain managerial insight. For example, companies selling consumer products commonly monitor social media such as Facebook and Twitter to gain a perspective on customer behavior, preferences, and perception regarding existing products. Web-based businesses are currently developing information products to use customer-related data in developing recommendations that are more appealing and establishing promotion programs that are more likely to succeed.

BD-A also enables anticipating and managing counterparty risk to avoid the risk of default (Kural and Billens, 2013). The bankruptcy of the US investment bank Lehman Brothers in September 2008 is an example of risk management without the benefits of BD-A. Banks are increasing their reliance on BD-A for risk management (i.e., default risk and liquidity risk). Moreover, BD-A software solutions have been developed. The big data technology of IBM provides a scalable, secure, and cost-effective integrated platform to facilitate the detection and mitigation of fraud. Dell EMC's BD-A for financial services is used to detect fraudulent activity in real time, predict buyer behavior, and reduce the risk of default. Companies can mitigate the risk of default by monitoring buyer behavior to anticipate the risk of default or by implementing predictive models to differentiate between legitimate and fraudulent transactions. Then a company can demand a deposit to mitigate risk in cases in which the likelihood of default is high. An example is that the Beijing Iron Ore Trading Center considered deposits to reduce the risk inherent in that industry in 2015 (South China Morning Post, 2015).

In any supply chain, the retailer must assume the risk in cases in which the payment on goods is not received from a customer on time. In this situation, neither the supplier nor retailer can receive the account owed for a given batch of goods. The strong correlation between defaults in steel companies and construction companies in China is a prime example of how the risk of default is present in the same channel. Therefore, when clients are provided trade credit in a supplier–retailer channel, the retailer and supplier must assume the burden of default risk. BD-A can be implemented by the member of a trade channel to mitigate the risk of default; however, this raises several notable questions: *Which member should implement BD-A? Should a retailer implement BD-A unilaterally? Should the supplier implement BD-A and the retailer merely share the point of sale (POS) data to the supplier? Does BD-A cost sharing benefit channel members? Under BD-A cost sharing, which party should be responsible for implementing BD-A? How is the behavior of channel members affected by the implementation of BD-A by different members?*

In this study, we aim to answer the aforementioned questions by considering a supplier–retailer channel in which the provision of trade credit to customers imposes the risk of default. The supplier sells to a retailer, who in turn sells on a market with uncertain demand and a dependence on the credit period. In such a channel, BD-A can be used to mitigate the risk of default. Our study considers BD-A as a single tool to manage risk of default. The objective is to discuss who should implement BD-A when the supplier–retailer channel decides to use BD-A to manage risk of default. Our model assumes that the supplier can access retailer sales data. This may occur when the supplier and retailer form a strategic alliance, or when the supplier and retailer belong to the same corporation. In the provision of trade credit, the trade-off between increased sales and the risks associated with the granting of credit must be considered, particularly when BD-A is used to mitigate the risk of default. Moreover, this study proposes models in which the credit period, effort to implement BD-A, and quantities ordered serve as decision variables. The quantities ordered are determined by the retailer, whereas the credit period and BD-A effort can be determined by the retailer or supplier. In this study, we consider both situations: (1) when the retailer determines the credit period (retailer dominant in determining credit period) and (2) when the supplier determines the credit period (supplier dominant in determining credit period). For each situation, we compare the profits and decisions made when BD-A is implemented by the supplier with those made when it is implemented by the retailer. We also consider the cases in which (1) the costs assumed by the supplier in implementing BD-A are shared by the retailer and (2) the costs assumed by the retailer in implementing BD-A are shared by the supplier. We compare the profits and decisions made with and without BD-A cost sharing. We also compare the profits and decisions made under cost sharing measures when BD-A is implemented by suppliers or retailers. Other policies (revenue sharing and centralized determining credit period) and normal demand distribution are also discussed.

The remainder of this paper is organized as follows. In Section 2, we present a review of related studies. Section 3 introduces the notations and assumptions. In Sections 4 and 5, we respectively present the models used when the retailer dominates the channel and when the supplier dominates the channel. Numerical analysis is conducted in Section 6. Section 7 presents our conclusions, implications for managers, and directions for future research.

2. Literature review

2.1. Trade credit

Trade credit is the credit extended to a company by vendors who allow a company to "buy now and pay later". In academics, Goyal (1985) was the first to examine the effect of trade credit on optimal inventory policies. Teng (2002) amended Goyal's model by considering the difference between unit price and unit cost. Numerous studies (based on Goyal and Teng's studies) dealing with inventory problems under trade credit have been published. For examples, some considered the deteriorating items (Ouyang et al., 2009; Chang et al., 2010; Liao et al., 2012; Chung et al., 2010; Yang et al., 2015), some consider channel coordination (Sheen and Tsao, 2007; Chen and Kang, 2010; Tsao and Sheen, 2012; Zhang et al., 2014), some consid-