Essays at the Interface of Supply Chain Finance and E-commerce

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Abstract

With the rapid development of mobile technologies, online retailing has achieved tremendous growth in the last few decades. In the last decade only, global e-commerce sales increased by 5 times. It stood at 4.9 trillion USD in 2021. It is forecasted to grow by 50% in the next three years. Third-party sellers are one of the main contributors to online retailing growth. For instance, on Amazon, 56% of total paid-up units are sold by third-party sellers. The third-party sellers (mostly small and medium businesses, SMBs) get access to a large customer base and technological and operational support from the online platforms. In return, they give referral fee or commission fee to the platforms. Both the online sellers and the platforms are benefited from this collaboration. However, this can be jeopardized by the working capital shortage faced by online sellers. A report by World Bank states that 50% of the businesses need business loans, whereas only 28.4% got loans from banks in 2021. The banks reject most loan applications due to insufficient collateral, credit history, and lack of business transparency.

The shortage of working capital can affect the whole online supply chain. Therefore, the platforms have started providing loans to the SMBs selling on their platforms, which is called platform credit financing (PCF). For instance, Amazon started providing unsecured loans to online sellers in 2011 through the Amazon Lending program. Similarly, other platform giants like JD.com, Alibaba, and Flipkart have their own lending modes. Using the rich history of transactional data, customer feedback, and reviews, the platforms can evaluate the operational efficiency of the capital-constrained seller and check their eligibility for availing of a loan. The platform does not demand collateral from the borrower to provide the loan, making it suitable for

SMBs. Unsecured loans such as PCF are very appealing to a capital-constrained seller because the platform would not liquidate the seller's assets to recover the loan amount in case of bankruptcy. The risk becomes limited for the seller in case of default, even if the seller's operational risk causes it. However, PCF becomes risky for the platform due to this same arrangement. Besides Platform, the seller can also get a working capital loan from upstream supply chain partners such as a manufacturer.

In this thesis, I aim to explore critical issues related to PCF, such as determining the optimal interest rate and analysing its interaction with traditional financing modes like bank credit financing (BCF) and manufacturer credit financing (MCF). My thesis comprises three essays at the interface of supply chain finance (SCF) and E-commerce. In essay-1, I compare PCF and BCF in the presence of online sellers' performance risk. In essay-2, I compare manufacturer credit financing (MCF) with platform credit financing (PCF) and find an optimal financing strategy for the capital-constrained seller in a three-echelon supply chain. In essay-3, I incorporate the market cannibalization effect in the analysis of the online financing models. I analyse the interaction between the seller's financing decision and the platform's store brand introduction decisions in a two-echelon online supply chain. I summarize the methodology and findings of each essay below.

In Essay 1, I develop a series of game-theoretic models to analyse and compare BCF and PCF for a cash-constrained third-party seller on an e-commerce marketplace. I derive optimal interest rates that the platform may charge the seller depending on its performance risk. I derive conditions under which either BCF or PCF could be more profitable for the seller. Then, I introduce innovative contracts (*Guaranteed Demand Increment Contract* and *Lending Rate Matching Contract* initiated by the platform and *Lumpsum Transfer Contract* initiated by the seller) that incentivize the seller or platform to act in a mutually beneficial way. My analysis shows that these contracts achieve win-win outcomes and increase the total supply chain profit. To check the robustness of the findings and derive more insights, I extend the models and conduct various extended analyses. I reveal that most of the insights remain valid, and some additional findings are generated.

In Essay 2, I theoretically model a three-tier retail supply chain in which a capital-constrained online seller (also called retailer), exposed to operational risk, orders products from the manufacturer and sells them on an online platform. In a game-theoretic setup, I compare two

financing modes for the online retailer, namely the manufacturer credit financing (MCF) mode and platform credit financing (PCF) mode, offered respectively by the manufacturer and the platform. I analytically derive the optimal financing strategies for the online retailer based on the product category and the online retailer's operational risk. I show that all the supply chain players prefer PCF to MCF when the online retailer's operational risk level is high. I find that MCF (PCF) is the online retailer's preferred financing option for products with low (high) referral fees. MCF (PCF) is a better choice for products with moderate referral fees than PCF (MCF) at lower (higher) values of operational risk. I also determine win-win-win regions where the incentives of all three players are aligned. Furthermore, I design additional contracts to obtain a win-win-win situation in case of misalignment of choices.

Essay-3 jointly analyses an online platform's store brand (SB) introduction decision and a capital-constrained manufacturer's (online seller's) financing decision. Nowadays, platforms have been aggressively introducing their store brand (SB) products, which directly compete with the SMBs' national brand (NB) products. Therefore, the seller should have a proper strategy to maximise profit from the PCF and minimize the SB's detrimental effect. I develop a stylized model with a capital-constrained online seller, a platform, and a bank to find the optimal financing and store introduction strategy. I first characterize interest rate, NB price, and SB price regarding different market parameters. I find the seller's optimal financing strategy and the platform's optimal SB introduction strategy. Then I examine the Nash equilibrium strategy under various market conditions and inspect the impact of operational risk, product quality, and referral fee on the equilibrium results.