

Abstract

Essays on Textile Supply Chain

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In the eighteenth century, textile and clothing sector played a pivotal role in the industrial revolution. Still, it remains a basic building block of a country's economic growth and development because of contributing a significant portion of GDP and providing substantial employment opportunities. In 2015, the market size of global textile and apparel industry was around \$850 billion, and further growth is estimated in next five years (Shenglufashion, 2015).

From the inception, the textile supply chain remains an area of interest for the scholars and the practitioners. Since the 2000s textile industry has experienced many significant changes such as the abolishment of multi fibre arrangement (MFA), cotton production uncertainty, increasing need for supply chain coordination, etc. The elimination of quota for textile products from the developing economy countries to the developed countries i.e. MFA act in 2005 drew attention from every corner of the society. It has opened up a plethora of export opportunities of raw materials for the many countries of developing economy such as India, China, Bangladesh, etc. On the other hand, the final good i.e. apparel production of the supply chain in these countries are often being affected due to the shortage of low-cost domestic raw material. In 2010, the apparel and textile production in Pakistan were affected because of non-availability of the low-cost domestic raw material (Wall Street Journal, 2010). To maintain the abundant supply of domestic cotton and textile for the textile and apparel production, respectively, Indian government imposed a ban on the cotton and textile export (Reuters, 2012).

The uncertainties associated with the cotton production have an adverse impact on the overall textile supply chain performance. In recent times, technological changes, adverse climate, regulatory changes, etc. affected the cotton production of various countries such as India in 2013 (Business Standard, 2013), Ghana in 2014 (Ghananewsagency, 2014), the USA in 2015 (Delta Farm Press, 2015), and so on. It leads to a bleak growth scenario for the textile industry. These real life instances advocate the implementation of the appropriate measures to address the issue. Also, the cotton firm often incurs a huge loss due to this production uncertainty along with the

fluctuation in price. Besides, the rising price of the cotton leaves a negative impact on the overall supply chain performance. In 2011, large retailers such as Walmart and GAP incurred substantial production cost because of the increasing cotton prices (Triple Point, 2011).

The inherent fragmented nature of the textile industry often acts as a hindrance to the supply chain coordination. Also, the changing global scenario indicates the requirement of an appropriate coordination mechanism in this supply chain. Recent studies show that the shift of channel power in the supply chain and its impact on the coordination becomes one of the most significant phenomena irrespective of the industries. In the context of the textile supply chain, deviating from the conventional manufacturer-led structure where the apparel manufacturer has the channel power over the apparel retailer, a number of apparel retailers with same or more power compared to the manufacturer have emerged, and retailer-led structure has come into the picture. Examples of the apparel retail giants such as Nike, Ralph Lauren, Levi Strauss & Co, etc. signifies it (Business Insider, 2015). This change of channel power makes the coordination more complex

Existing scholarly works as well as the emerging issues related to the textile supply chain brings forth several interesting insights. First of all, existing literature related to textile supply chain indicates that research works are mostly limited to developed nations and some specific domain areas. Changing scenario in the post-MFA era requires an in-depth investigation into the textile supply chain of emerging economy countries. Secondly, from the methodological viewpoint, it has been observed that the analytical modeling in the context of a textile supply chain is not paid enough attention. Most of the scholars focus on developing the conceptual frameworks and conducting the empirical studies. Further, discussion of the scholarly works that adopt mathematical modeling approach is limited to the dyadic settings i.e. the interaction between the apparel manufacturer and the apparel retailer. The role of textile product manufacturers and cotton producers are not considered in the supply chain design. Thirdly, the issues related to the textile product manufacturer and the cotton firm are not addressed whereas pricing decisions of the textile product manufacturer as well as the cotton firm, mechanisms to deal with the cotton production uncertainty, and methods to improve the cotton firm's profitability is very important from the overall supply chain performance perspective.

Motivated by these issues, I focus on the following research questions in this dissertation:

- (i) Realistic depiction of the textile supply chain by deviating from dyadic setting and incorporating multi-level supply chain structure.
- (ii) Designing a coordinated textile supply chain as well as the improvement of the profitability of the upstream and middle stream members for the countries of developing economy.
- (iii) Analysing the impact of the cotton production uncertainty on the pricing decision of the upstream and middle stream members.
- (iv) Designing coordination mechanism for the textile supply chain considering both retailer – led and manufacturer-led scenario under demand and supply uncertainty.
- (v) Improvement of profitability of the cotton firms in a highly loss-making scenario.
- (vi) Investigating into the risk attitude of the apparel producer as well as the cotton producer and analysing its impact on the corresponding production planning decisions and supply chain coordination.

First, I provide a brief description of the textile supply chain and discuss the emerging issues in the textile supply chain along with the research opportunities. Next, I describe the existing scholarly works in various domains of the textile supply chain in the second chapter. In the third and fourth chapters, I demonstrate a method to design coordination mechanism for the textile supply chain of a country of emerging economy by adopting a three-level supply chain structure. Each of the supply chains comprises single cotton firm, single textile firm, and single apparel firm. Each of these firms interacts with the corresponding upstream or downstream player as well as the respective market of the developed economy. Here, I apply the wholesale price contract and deduce that it fails to coordinate the supply chain. Subsequently, I show how the textile supply chain can be coordinated by using two well-known contracts, viz., the cost sharing contract and revenue sharing contract. As per our design procedure, coordination may cause the loss of a fraction of export opportunity for the textile and cotton firms. To address this, I devise the criteria for which the profit levels of the cotton firm and the textile firm will be improved under coordinating contracts compared to the scenario where they use their full export quota under the wholesale price contract. I illustrate our model with an extensive numerical study and show how win-win situation for all supply chain members can be created.

In the fifth, sixth, and seventh chapters, I extend our analysis and represent the textile supply chain of a country irrespective of economy using a four-level supply chain structure comprising a cotton firm, a textile firm, an apparel manufacturer, and an apparel retailer under

demand and supply uncertainty. I show how supply uncertainty plays an instrumental role in the ordering, the production planning, and the pricing decisions. I conclude that the wholesale price contract fails to coordinate the supply chain. Next, I coordinate the supply chain by using buyback contract and option contract for the manufacturer-led and the retailer-led scenario, respectively. Apart from coordination, I show how a risk-sharing contract improves the profitability of the cotton firm in a high loss-making scenario. Finally, I investigate the risk attitude of the apparel retailer and the cotton firm and show that the risk-averse retailer orders less apparel and the risk-averse cotton firm sets higher planned production quantity of cotton compared to the risk neutral one. With an extensive numerical analysis, I present the graphical depiction of the insights obtained from the results. The dissertation concludes by discussing contribution and future research avenues in the eighth chapter.

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