Chapter 43

Using Big Data Analytics to Forecast Trade Volumes in Global Supply Chain Management

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ABSTRACT

As the supply chains become more global, the operations (such as procurement, production, warehousing, sales, and forecasting) must be managed with consideration of the global factors. International trade is one of these factors affecting the global supply chain operations. Estimating the future trade volumes of certain products for specific markets can help companies to adjust their own global supply chain operations and strategies. However, in today's competitive and complex global supply chain environments, making accurate forecasts has become significantly difficult. In this chapter, the authors present a novel big data analytics methodology to accurately forecast international trade volumes between countries for specific products. The methodology uses various open data sources and employs random forest and artificial neural networks. To demonstrate the effectiveness of their proposed methodology, the authors present a case study of forecasting the export volume of refrigerators and freezers from Turkey to United Kingdom. The results showed that the proposed methodology provides effective forecasts.

INTRODUCTION

With the rise of globalization, supply chains operations became more complex and therefore harder to manage. Nowadays, the companies not only interact with the companies within their supply chains and but also interact with outside supply chains. They also constantly compete with global supply chains. This fierce global competition increases the importance of the effective management of supply chain operations. Many supply chain operations, such as production, procurement, sales, warehousing, and forecasting, cannot be effectively designed with considering only local parameters. Today's supply chains are interconnected with global companies and supply chains, and this requires to think globally when designing and managing supply chain operations. Thus, the supply chain operations must be designed and managed with the global parameters and the effective management of global supply chain operations has become very important.

To effectively design logistics activities, the availability of accurate forecast data is crucial. For example, the effective resource allocation of a company for the distribution of its goods depends on the sales forecast data. Similarly, the quality of the sales forecast affects the performance of production scheduling and resource utilization. A good inventory management practice can help to achieve an agile response to the customer demand, however, it depends on the accurate forecast data. All these company level forecast related issues are important, but the requirement of a good forecast becomes more significant for the design of supply chain operations. In supply chain management, accurate forecasts help to streamline the operations. For example, data sharing with the other echelons of the supply chain can lead to better forecasts and help reducing bullwhip effect, which may lead to increased inventories, poor customer service levels, poor resource allocation, and wrong logistics decisions (Kabadurmus, Erdogan, & Tasgetiren, 2017). Therefore, an effective forecasting practice can reduce the inventory levels without affecting the service level and improve supply chain performance.

Forecasting in global supply chain operations is more challenging than the forecasting in local supply chains due to the complexity of the global supply chain networks. For exporters (or importers), predicting export (or import) volumes are also important since their entire supply chain operations depend on the forecasted exports. The prediction of total export volume of a country to a specific country may help to adjust their marketing strategies. If the exporting company can foresee that the total export volume would increase in the future, they can increase their production by adjusting their own supply chain operations. If they can predict that the export volume to a specific country to be reduced in the near future, they can search for alternative markets to sell their products and reshape their global supply chain operations without hindering the progress of supply chain strategies. Therefore, being able to make accurate forecasts is very important. However, in today's global and complex trade environment, forecasting has become even more difficult.

In the last fifteen years, the total exports in the world increased by more than 30 percent in value (Piezas-Jerbi & Wardyn, 2017). The major contribution to this increase has been the export of Asian countries, mainly China. However, with the increased competition, new country policies and recent trade wars, the international trade volumes can be significantly affected and accurate forecasting can become harder. In this dynamic world trade environment, the traditional forecasting tools cannot yield satisfactory results. However, with the consideration of the big data, accurate forecasts can be achieved.

For the last 20 years, the amount of data has increased significantly because of wide internet access, digitalization, and globalization. According to Chen, Mao & Liu (2014), the amount of data generated in two days in 2011 is equal to the amount of data from the start of the civilization to 2003. Today's

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