IMPACT OF WEATHER ON U.S. APPAREL RETAIL AND WHOLESALE SALES

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By

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APPROVAL PAGE

The undersigned, appointed by the dean of the graduate school,

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A candidate for the degree of Textile and Apparel Master's of Science Degree, and hereby certify that, in their opinion, it is worthy of acceptance.

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CHAPTER I: INTRODUCTION

Chapter I contains the following sections (a) background of the study, (b) purpose of the study, (c) significance of the study, (d) key definitions present in the study, and (e) organization of the study.

Background of the Study

The U.S. apparel retail and wholesale sales are influenced by several factors. The sales could be influenced by transportation disruptions, labor strikes, natural disasters, currency depreciation, and weather. Even though several studies have been done to see how these factors influence retail and wholesale sectors, very little research has tried to explore the impact of weather on retail and wholesale sectors, especially on sales. In fact, no study has been done in the United States to see how weather impacts apparel retail and wholesale sales. As climate change is aggravating climate variability, U.S. apparel retail and wholesale sectors are increasingly exposed to unseasonal weather (Bertrand, Brusset & Fortin, 2015). The unusual weather can change consumers' buying behavior or might cause disruptions in the supply chain, which eventually causes firms to end up with poor sales and profit. Retailers and wholesalers are closely related in the apparel industry. Wholesalers are the ones who are responsible for selling and distributing the goods to the retailers. Therefore poor retail sales might also influence the wholesalers' overall sales. If the retailers expect lower demand for a particular product due to weather anomalies, they will ask for fewer products from wholesalers which will eventually cause poor wholesales. On the other hand, wholesalers are sometime responsible for all the activities from production to delivery of the goods. In such cases, weather might negatively impact the production or the distribution process and cause delay in delivery of the merchandise

to the retailers. This might also cause a decrease in wholesalers' future sales. Thus, it seems that weather has some impact on both apparel retail and wholesale sales. Further study needs to be done to find out how and at what amount weather impacts apparel retail and wholesale sales in the United States.

Purpose of the Study

There is a huge gap in our comprehension on the effect of the weather on U.S. apparel retail and wholesale sales. This study tried to explain the relationship between weather and apparel retail and wholesale sales in the United States. The main purpose of this study was to formalize and test the mathematical relationship between U.S. apparel retail and wholesale sales and weather in a way which will help managers gain a better understanding of their business performance. This study was organized to develop a new model and test it to verify the relationship between weather and sales. For this purpose, this study was designed to quantify the impact of weather on the U.S. apparel retail and wholesale monthly sales. Furthermore, the study tested the relationship between apparel retail and wholesale sales and examine how weather influences that relationship.

Significance of the Study

Weather disruptions might impact the time to deliver the goods and thus the timing of the retail sells. Now the question is why timing of selling is so important in the apparel industry? Apparel goods are seasonal goods, which means that the selling period of apparel is likely to be very small. Thus, careful timing of the sales of the apparel goods is very important for retailers. For example, if the products reach the store too early, the products will not be sold. On the other hand, if the products arrive too late, there might be

a shortage in demand which will force companies to reduce the price so that customers can be motivated (Bahng and Kincade, 2012). Thus, failure to ensure that the precise amount of goods are available at the right time will negatively impact the overall apparel sales and revenue. To maximize sales and revenue, retailers have to scientifically forecast the exact demand of specific product. Even though retailers take different strategies to effectively predict customer demands, these are rarely studied in literature. Since wholesalers are directly related to the retailers, any kind of variations on the retail sales will directly influence wholesale sales. Thus, wholesalers must have their own forecasting strategy to mitigate the impact of decreases in sales due to weather variation. It would be more convenient for the wholesalers as well as the retailers to find out exactly what amount of their sales are influenced by weather deviation and how. This study aims to answer these questions. Therefore, the study findings will help managers to mitigate the negative impact of the weather on business activities. Moreover, this study will help U.S. apparel retailers and wholesalers in their strategic and financial decisions making.

Key Definitions Present in the Study

Apparel retail sector: The retail trade sector involves establishments engaged in selling merchandise generally without transformation and provides services related to the sale of merchandising. They directly sell merchandise to the end customers. The apparel retail sector consists of establishments which are primarily involved in retailing new apparels. (U.S. Census Bureau, 2015b)

Apparel Wholesale sector: The Wholesale Trade sector consists of establishments engaged in wholesaling merchandise generally without transformation and provides services related to the sale of merchandise. Wholesalers' work as an intermediate

between manufacturers and retailers. Apparel wholesale sectors primarily engaged in distribution of piece goods, notions, clothing, accessories, and footwear. (U.S. Census Bureau, 2015a)

Apparel Supply chain: Supply chain is a set of three or more companies directly linked by one or more of the upstream and downstream flows of products, services, finances, and information from a source to a customer (Mentzer, 2004). In apparel industry, ultimate source would be the fiber producers and the ultimate customer would be the end customers or users of the apparel.

Consumer Price Index (CPI): Change in the prices paid by urban customers for the consumer service and products.

NAICS: The North American Industry Classification System (NAICS) is used to define and classify business activities in every industry sector and business type.

NCEI: National Centers for Environmental Information (NCEI) under National Centers for Environmental Information (NOAA) is a U.S. based organization which hosts and provides comprehensive oceanic, atmospheric, and geographical data. (National Centers for Environmental Information, 2015a)

U.S. Census Bureau: United States Census Bureau, a part of U.S. Department of Commerce provides comprehensive quality data about the nation's people and economy. (U.S. Census Bureau, 2015c)

Organization of the Study

This thesis is divided into five chapters. Chapter 1 presents the background, purpose, significance of the study, as well as key terms of the study. Chapter 2 provides the literature review introducing the definitions and current status of U.S. apparel retail and wholesale sectors which is followed by market overview of U.S. apparel retail and wholesale sectors. Furthermore, the existing literature on the impact of weather on U.S. apparel retail and wholesale sectors are described. Later, research gaps and objectives are introduced and explained. Chapter 3 presents the research methodology, including the research design, sources of study data, sampling information, data collection, and data analysis techniques. Chapter 4 provides results and analysis for impact of weather on U.S. apparel retail sales, U.S. apparel wholesale sales, and the interaction between U.S. apparel retail and wholesale sales. Chapter 5 explains the summary of the study, discussion, implications, and contribution of the major findings. Finally, it presents study limitations and future research suggestions.

CHAPTER II: LITERATURE REVIEW

Chapter II contains the following sections: (a) U.S. apparel retail and wholesale sectors, (b) impact of weather on retail and wholesale sales, and (c) research gaps and objectives.

U.S. Apparel Retail and Wholesale Sectors

Definitions and Current Status of U.S. Retail Trade

In North America, the North American Industry Classification System (NAICS) is used to define and classify business activities in every industry sector and business type. NAICS uses a 2 to 6 digit hierarchical classification system to describe different industry sectors and business types (North American Industry Classification System Association, 2015). Retail sector belongs to NAICS codes 44 and 45 while wholesale sector belongs to NAICS code 42.

NAICS defines retailer (NAICS code 44 and 45) as a business entity who is "engaged in retailing merchandises, generally without transformation and rendering services incidental to the sale of merchandise. The retailing process is the final step in the distribution of merchandise; retailers are, therefore, organized to sell merchandise in small quantities" (U.S. Census Bureau, 2015b). Unlike industrial companies, retailers do not tend to produce tangible goods. Instead, they buy products from manufacturers and/or wholesalers and sell them to individual customers at a profit.

The retail sector includes motor vehicles and part dealers (441); furnishing and home furnishing stores (442); electronics and appliances stores (443); building material and garden equipment, and supplies dealers (444); food and beverage stores (445); health and personal care stores (446); Gasoline Stations (447); clothing and clothing accessories

stores (448); Sporting goods, hobby, musical instruments, and book stores (451); general merchandise stores (452); miscellaneous store retailers (453); and nonstore retailers (452). The retail sector has very strong influence on the manufacturing and wholesaling sectors as it deals with the final customers and sometime it can manipulate industries future trends. The U.S. retail sales were approximately US $4.5 trillion in 2013 (U.S. Census Bureau, 2015d). Some of the popular examples of retailer brands are Amazon.com, Dell, McDonald's, and Best Buy.

Within the retail sector, the clothing and clothing accessories sector represents under NAICS code 448. According to NAICS, clothing and clothing accessories marketers are defined as "retailers who sell new clothing and clothing accessories merchandise from fixed point-of-sale locations. Establishments in this subsector have similar display equipment and staff that is knowledgeable regarding fashion trends and the proper match of styles, colors, and combinations of clothing and accessories to the characteristics, and tastes of the customer" (U.S. Census Bureau, 2015e). The clothing and clothing accessories subcategory is directly related with the fashion industry. It deals with different fashion merchandise stores including clothing stores (4481), shoes stores (4482), and jewelry, luggage, and leather goods (4483). In 2013, total retail sales in clothing and clothing accessories subcategory was around US $244.5 billion (U.S. Census Bureau, 2015f). Any kind of fashion retail stores will be under this category for instances Nordstorm, Gucci, Louis Vuitton, and Chanel.

The next level, clothing stores listed under NAICS code 4481. This industry group "primarily engaged in retailing new clothing" (U.S. Census Bureau, 2015g). The retail stores which are primarily sales new clothing merchandises are described under

clothing stores subcategory. The clothing stores includes men's clothing stores (44811); women clothing stores (44812); children and infants' clothing stores (44813); family clothing stores (44814); clothing accessories stores (44815); and other clothing stores (44819). In 2013, total clothing stores sales was US $178.5 billion (U.S. Census Bureau, 2015f). Some of the popular retailers under this category are Gap.Inc, JC Penney's, American Eagle, and Ralph Lauren.

General Merchandise stores belong to NAICS code 452. Industries in the General Merchandise Stores are defined as "subsector retail new general merchandise from fixed point-of-sale locations. Establishments in this subsector are unique in that they have the equipment and staff capable of retailing a large variety of goods from a single location. This includes a variety of display equipment and staff trained to provide information on many lines of products." (U.S. Census Bureau, 2015h). General merchandise stores refers to a wide array of products commonly sold in retail stores. These includes any non-food and non-grocery products such as dry goods, auto parts, toys, apparel and accessories, electronics, furniture and home furnishings, small wares, hardware, and food. The general merchandise stores have two subcategories-department stores (4521) and other general merchandise stores (4529). In 2013, approximately US $653 billion worth of merchandise sold in general store (U.S. Census Bureau, 2015f). Some of the popular general merchandise stores includes Walmart, Target, K-mart, and Macy's.

Definitions and Current Status of U.S. Wholesale Trade

Wholesale is listed under NAICS code 42. According to NAICS "the wholesale trade sector comprises establishments engaged in wholesaling merchandise, generally without transformation and rendering services incidental to the sale of merchandise. The

wholesaling process is an intermediate step in the distribution of merchandise. Wholesalers are organized to sell or arrange the purchase or sale of (a) goods for resale (i.e., goods sold to other wholesalers or retailers), (b) capital or durable nonconsumer goods, and (c) raw and intermediate materials and supplies used in production (U.S. Census Bureau, 2015a)."

The wholesale sector comprises two main types of wholesalers: (a) merchant wholesaler type and (b) business-to-business wholesaler type. Merchant wholesaler type "sell(s) goods on their own account are known as wholesale merchants, distributors, jobbers, drop shippers, and import/export merchants, and manufacturer's sales offices, and sales branches (U.S. Census Bureau, 2015a)." Business-to-business wholesale type "arrange(s) for the purchase or sale of goods owned by others or purchasing goods, generally on a commission basis are known as business-to-business electronic markets, agents, and brokers, commission merchants, import/export agents, and brokers, auction companies, and manufacturers' representatives (U.S. Census Bureau, 2015a)." By definition, the wholesaler sector buys large quantities of goods from manufacturers, or owners of the goods and resells to other distributers, or retailers rather than to ultimate customers. Wholesalers work as a middleman between retailers and manufacturers.

There are three major subcategories under wholesale trade- (a) merchant wholesalers, durable goods (423); (b) merchant wholesalers, nondurable goods (424); and (c) wholesale electronic markets and agents and brokers (425). Total wholesale sales were around US $7.4 trillion in 2013 (U.S. Census Bureau, 2015i). Some of the examples of wholesaler includes Novatech Wholesale, Continental Belt Corp., Perfume Market, and MVP Trading Co., Inc. (Wholesalecentral.com, 2015).

Under the wholesale sector, the merchant wholesalers, nondurable goods listed in NAICS code 424. They "sell nondurable goods to other businesses. Nondurable goods are items generally with a normal life expectancy of less than three years. Nondurable goods merchant wholesale trade establishments are engaged in wholesaling products, such as paper and paper products, chemicals and chemical products, drugs, textiles and textile products, apparel, footwear, groceries, farm products, petroleum and petroleum products, alcoholic beverages, books, magazines, newspapers, flowers and nursery stock, and tobacco products". (U.S. Census Bureau, 2015j).

In NAICS, there are 9 sublevels under Merchant Wholesalers including Nondurable goods including paper and paper product merchant wholesalers (4241); drug and druggist's sundries merchant wholesalers (4242); apparel, piece goods, and notion merchant wholesalers (4243); grocery, and related product merchant wholesalers (4244); Farm product raw material merchant wholesalers (4245); chemical, and allied products merchant wholesalers (4246); petroleum, and petroleum products merchant wholesalers (4247); beer, wine, and distilled alcoholic beverage merchant wholesalers (4248); and miscellaneous nondurable goods merchant wholesalers (4249). The estimated sales for Merchant wholesalers, nondurable goods in 2013 were US $4.2 trillion (U.S. Census Bureau, 2015i). True North Trading, Cottonage.com, Maggie handbag, and Western express, Inc. are some of the examples of nondurable goods merchant wholesalers (Wholesalecentral.com, 2015).

Apparel, piece goods, and notions merchant wholesalers lies to NAICS code 4243 under Merchant wholesaler, nondurable goods subcategory. They are "primarily engaged in the merchant wholesale distribution of piece goods, notions, and other dry goods;

men's and boys' clothing and furnishings; women's, children's, and infants' clothing and accessories; and footwear" (U.S. Census Bureau, 2012k). In NAICS, categories include under the Apparel, piece goods, and notions merchant wholesalers are Piece goods, notions, and other dry goods merchant wholesalers (42431); Men's and boy's clothing and furnishings merchant wholesalers (42432); Women's, children's, and infant's clothing and accessories merchant wholesalers (42433); and Footwear merchant wholesalers (42444). In 2013, Apparel, piece goods, and notions merchant wholesale sales were around US $158.9 billion (U.S. Census Bureau, 2015i). Seven Seas, Inc., InterTradeCorp.com, Nikibiki Apparel, and Spring Import are some examples of apparel, piece goods, and notions merchant wholesalers (Wholesalecentral.com, 2015).

Market Overview of U.S. Apparel Retail and Wholesale Industry

Today, the US apparel market is the largest in the world, comprising approximately 29% of the global apparel sales and accounted for approximately 331 billion US dollar (Statista.com, 2015). This amount is enough to describe its importance in the U.S. economy. There has been a significant shift in the U.S. apparel industry in recent decades and the industry has transformed from manufacturing-based to import-based one. Unlike old market conditions, the U.S. apparel industry is now more involved in importing, marketing and retailing activities, rather than manufacturing activities. Reflecting this trend, apparel import volume has multiplied in the past decades (Ellis, 2007: Kunz & Garner, 2006). Moreover, over 90% of total apparel products available in U.S. market are manufactured in and imported from other countries (Ha-Brookshire & Dyer, 2008). It is expected that this trend will continue to increase as long as U.S. apparel businesses benefit from foreign goods and services to meet domestic demand (Kunz &

Garner, 2006). This shift in the industry has greatly influenced the overall organizational, structural, and economic conditions of U.S. apparel retail and wholesale sectors.

Recent study shows that, the retail sector is the largest employer and supports one out of four jobs in the United States. The retail sector offers 42 million jobs, provides 1.6 trillion US dollar in labor income and contributes 2.6 trillion US dollar annually to U.S. Gross Domestic Product (GDP) (National Retail Foundation, 2014). These figures simply explain the tremendous impact of the retail sector in the U.S. economy.

The Retail sector has been gone through significant changes during the past few decades in the United States (Abernathy et al, 1999). The apparel retail sector is one of the most emerging sectors which have gone through such dramatic changes called the "retailing revolution" (Crewe & Davenport, 1992). First, the number of large shopping malls have increased rapidly specially at the outskirts of the cities. These shopping malls have replaced city center department stores and boutiques (Nordas, 2004). Second, with the radical improvement of communication systems and technologies, the retail sector is now one of the greatest and the most profitable industries in the United States (National Retail Foundation, 2014; Nordas, 2004). In the United States, retail sector has been consolidated-causing larger buying power of retailers than that of suppliers (Nordas, 2004). Specifically, in the apparel retail sector, today's retailers are now directly involved in global manufacturing and therefore, becoming the competitors of manufacturers (Gereffi, 2001). Today, significant portion of apparel retailers in the United States source directly from manufacturers all over the world. In the U.S. apparel industry, the retailer sector have become more powerful than the wholesale and manufacturing sectors and thus have direct influence on current trends of the industry.

There are different types of retail channels in the United States through which apparel products are sold. Sen (2008) explained that apparel goods are sold through five types of retail channels. First, specialty stores, such as Gap, Inc. and The Limited, sell accessories and apparel products in a limited range for a specific customer market. Second, department stores, such as Nordstorm and Macy's, have a broad category of brands in both soft and hard goods industries. Third, a significant number of apparel sales take place in mass merchandiser stores, for instance Target and Wal-Mart. These merchandise stores sells different types of soft goods and hard goods along with apparel. Fourth, apparel chain stores, for instance Sears and J.C. Penney's, sells a broad category of clothing merchandises. Fifth, some of the off-price stores, for instance T.J. Maxx and Marshalls, buy additional amount of branded apparel and designer-label from producers as well as other retailers and sell them at a reasonably lower prices in an incomplete assortment condition. E-tailers, mail order companies, and factory outlets are some of the examples of companies that are involved in U.S. apparel retailing.

Sen (2008) further explained that the current trends of the retail industry includes retail consolidation, emergence of private labels, and vertical integration. First, due to consolidation, only few strong retail firms are in a position to influence contract in favor of them. Second, private label has been important as a major means to increase revenue for a variety of retailers including general stores, department stores, specialty retailers, and upscale retailers sell apparel under their own private labels. Third, more apparel manufacturers have become retailers, suggesting vertical integration. A significant number of manufacturers are now selling goods directly to the end customers where some

of them sell only excess or second-quality merchandise to the customers while they are continuing to sell their top quality products to the off-price retailers.

Most wholesalers in the apparel industry involve with sales and administrative activities such as marketing and branding their products to retailers, developing relationship between retailers and manufacturers, maintaining inventory, and transporting merchandise to the retailers. Some wholesalers are discount wholesalers who sell merchandise on a discount prices to the customers whereas other wholesalers are apparel wholesalers who only sell items to the retailers or other wholesalers.

Similar to the retail sector, the wholesale sector has gone through a lot of changes. With the shift of labor-intensive jobs in the manufacturing sector to the overseas, the wholesaling sector also expanded their business partners from domestic manufacturers to foreign suppliers (Ha-Brookshire & Lu, 2010). Ha-Brookshire and Dyer (2008), proposed apparel import intermediaries as a new term to explain this kind of wholesalers. They defined apparel intermediaries as domestic service firms that connect domestic wholesalers or retailers and foreign distributers or manufacturers. Apparel import intermediaries perform more complex and dynamic business activities than traditional wholesalers (Kincade & Gibson, 2010). Traditional wholesalers typically buy product in bulk for resale to other wholesalers or retailers without design or product development attempt. Ha-Brookshire and Dyer (2008) explained that apparel import intermediaries generally perform four distinct sets of activities-design, marketing, sourcing, and service.

Apart from import retailers, more and more apparel import intermediaries are now involved in import processes. Despite the active presence of large import retailers, such

as Wal-Mart and Target, a significant number of less-powerful and low-profile apparel import intermediaries are the workhorses of the import process, aggregately contributing to a major portion of U.S. imports (Gereffi, 1994; Jin, 2004). Nike, Gap.Inc., and Reebok are some of the firms who design and import merchandise from foreign countries and sell them in the United States. In addition to these intermediary firms, there are still some firms in the U.S. apparel industry who perform traditional wholesale activities, for instance Albama Wholesale Socks, Silver Stars Collection and Biki Fashion (Wholesalecentral.com, 2015).

The changing market conditions also made negative impact on the U.S. apparel wholesale industry. According to Newstex Trade & Industry Blogs, Newstex (2014), notable changes in the U.S. apparel wholesale sector are, first, a negative impact of the 2008 economic recession on the U.S. apparel wholesale sector. According to the blog, during and after the recession, retailers have offered deep discounts to customers, which have caused wholesalers to be left with excess inventories and lower prices to move avoid frozen stock. Second, the blog also reported that rising import penetration has displaced the downstream demand for apparel from domestic wholesalers to international manufacturers. Third, more and more downstream buyers are now reported to source directly from manufacturers to cut expenses and sustain margins. As a result, the blog shared that this trend has constrained wholesalers function in the domestic supply chain, and eliminated many from the business. Wholesalers have forced to cut prices to remain relevant in the global apparel supply chain.

Impact of Weather on Retail and Wholesale Sales

Weather and Retail Sales

With aforementioned market characteristics, the impact of weather on retail and wholesale sales has recently been on the researchers' radar. The impact of weather on commercial and business activities has been largely ignored, despite its important role (Bertrand & Sinclair-Desgagne, 2012). In recent years, weather and its potential impact on economy have become a focus due to climate changes which increase uncertainties in the weather sensitive business sectors (Intergovernmental Panel on Climate Change (IPCC), 2014; World Meteorological Organization (WMO), 2013). In fact some argue that, almost 70 % of companies in industrialized countries are affected by everyday weather changes (Bertrand, Brusset, & Fortin, 2015; Dutton, 2002; Larsen, 2006).

The impact of weather on business activities and human behavior has been studied in various fields for instance finance and psychology (Cao & Wei, 1998; Goeree & Holt, 1999). However, it is well established that the weather has a "significant, but short lived, effect on economic activity" (Bloesch & Gourio, 2015, p.17). For some industries such as agriculture and energy, the weather plays such a vital role that it is consider a risk factor and thus, dealt with risk management instruments (Lee & Oren, 2009). Cachon and Gallino (2012) found that, adverse weather conditions lead to a significant reduction in automobile production. Tourism, forestry, constructions, hospitality, utilities are another sectors which are directly affected by the weather (Bloesch & Gourio, 2015; Cachon and Gallino, 2012).

Until now, many studies have been done to establish a correlation between actual weather variables and sales focusing on how the level of sales varies with the changing level of temperature or precipitation (Bahng & Kincade, 2012; Marteau et al, 2004). One of the major problems with weather forecast is that the reliable temperature forecasts become invalid within two weeks (Bertrand, Brusset & Fortin, 2015). On the other hand, very few companies can utilize the weather forecast to adjust their supply chains within such a short period and get benefit from such adjustments. However, the weather is still important for apparel retail and wholesale sales but little is known about it. In the apparel retail sector for instance, for the most efficient companies, the lead time ranges from 3 to 5 weeks, while companies that source their products from Asia or other long distance foreign countries, the lead time might range from 3 to 5 months (Crehalet, Bertrand, & Fortin, 2013). This manufacturing, sourcing, and transportations processes are often conducted by wholesales or import intermediaries, adding even longer lead time from manufacturing to retailing. Additionally, the impact of weather on consumers' shopping behavior is also little known despite weather conditions could affect consumers' short-term shopping intentions and behaviors.

Little research has been done to see the impact of weather on apparel sales, mostly apparel retail sales (Bahng & Kincade, 2012). A few studies that exist have been limited to restricted samples, brands, or type of garments, for a limited period of time and in very restricted geographical areas (Bertrand, Brusset & Fortin, 2015). As sales depends on fashion trends along with other individual causes (Cachon & Swinney, 2009), thus the results were not sufficient to generalize to a greater population.

For example, Bahng and Kincade (2012) studied the relationship between weather and retail sales of seasonal apparel. In this study, the researchers collected sales data from a retailer of branded women's wear in the Seul-Kyunggi area in South Korea. They collected sales data for seasonal basic styles and for weather, they used daily and weekly average temperature data. In their study, the authors used descriptive analysis including graphical evaluations, correlation analysis and paired-samples t-test. In addition to that interviews with retailer's merchandisers were used to supplement interpretation of the statistical datasets.

Bahng and Kincade (2012) found that temperature has a strong impact on the sales of seasonal apparel products. They also found that when there is a drastic change in weather occurred especially during the sales periods, more seasonal garments were sold that time. Their findings also suggest that temperature changes from day to day or week to week did not really affect the total sells for the whole season. The study showed the impact of daily and weekly temperature on seasonal apparel sales, but it did not evaluate the potential impact on the long-term effects of the weather, such as monthly, seasonal or even annual. This pilot study was limited to the analysis of one apparel brand and one apparel product category with 50 basic and carryover styles targeting women aged 30 to 40, from February 1, 2007 to February 29, 2008. This study was also restricted to two cities in South Korea. Thus the authors suggested that the results cannot be generalized due to the limitations in product category and location.

On a slightly different note, Bertrand, Brusset and Fortin (2015) studied the impact of unexpected deviations of daily temperature from seasonal patterns on apparel retail sales in France. In their study, the researchers applied Seasonal Trend

decomposition using Loess to isolate changes in sales volumes. They used a linear regression to find the relationship between temperature and sales anomalies and construct the historical distribution to determine sales-at-risk due to unseasonal weather. In their research they showed how we can use weather derivatives to offset the potential loss due to weather deviations. They found that seasons do not have the same level of sales impact to temperature anomalies. They also claimed that the responses of men, women, and kids apparel sales to the same weather risk were different and different distribution channels exhibited different outcomes to the same risk. The study used monthly textile and apparel retail sales data of several retail apparel categories and distributions channels. This study was also restricted to a single country, France. Though this study provided a strong correlation between temperature and retail sales, it did not cover all possible apparel categories and distributions channels. Thus generalization of the findings were not advised by the authors. The study also did not explain the impact of weather on other players in supply chain such as wholesalers and manufacturers.

Weather and Wholesale Sales

As previously discussed, overall understanding of the impact of the weather on wholesale sales in the U.S. apparel market is not clear enough. Moreover, very few research articles discussed about the importance of the U.S. apparel wholesale sector compared to the retail sector. The wholesale sector has strong influence on the U.S. Apparel supply chain. Unlike the traditional wholesalers who are primarily engaged in selling products to the other members of the supply chain, today's wholesalers actively participate in product transformation activities, including design, production, branding, marketing, or even, selling products to ultimate customers (Ha-Brookshire & Dyer,

2008). Ha-Brookshire and Dyer (2008) explained that the U.S. apparel industry also heavily relies on wholesalers for various important intermediary activities, such as contracting made-to-order manufacturing, making arrangements with distributors, jointly developing products, or contracting for ready-made garments. Therefore the success of the apparel retailers largely depends on wholesalers. With the change in old market conditions and introduction of new market condition, such as global manufacturing, intense competition, fragmented manufacturing processes, and fickle, and strong consumer demand, the role of wholesalers are becoming more and more important day by day (Ha-Brookshire & Dyer, 2008). The most recent Economic Census indicated that the U.S. apparel wholesale sector has generated over U.S. $160 billion on sales in 2013 (U.S. Census Bureau, 2015i). So it is very clear that the impact of the U.S. apparel wholesale sector on U.S. apparel industry is significant.

Wholesalers are responsible for delivering the goods to the retailers. They design, produce or source, import, and transport the goods to the retailers. This whole process takes long time to execute and thus, make it more vulnerable for different types of supply chain disruptions. As wholesalers mainly perform the work on behalf of retailers, so failure to deliver the goods on time due to various disruptions may have negative impact on their sales. So any kind of disruptions in supply chain might impact wholesale sales. Weather is one of the natural disasters to which wholesales are exposed, yet we know little about whether or not weather conditions impact their sales.

Research Gaps and Objectives

The review of the literature suggests that apparel retail and wholesale sales may be affected by weather conditions. There is virtually no research exists that explains the relationship between weather conditions and retail and wholesale sales. Even if there are, earlier research failed to draw a conclusion regarding the impact of weather on U.S. apparel retail sales. Previous studies considered deviation of temperature as the single most weather variable to find out a relationship between weather and sales. However, there are several other weather variables such as precipitation, maximum temperature, and minimum temperature which should be included in the weather-sensitive analysis since all of them could impact on market transactions.

Thus, this study aims to fill this gap in literature by incorporating other weather variables in addition to temperature deviation. Even though, earlier research has been done on mostly severe impact of weather on retail sales, however, in reality, weather does not need to be severe to impact on economic activities according to Berlage (2013). Therefore, this study aims to capture the impact of average weather changes on both retail and wholesale sales. Since there is not sufficient prior research on this relationship, this study was designed in an exploratory manner.

For this exploratory purpose, the following specific research question was proposed.

Research Question 1: What are the impacts of weather conditions in general on U.S. apparel retail sales?

The wholesale sector is also expected to be vulnerable to weather for the reasons explained above. However, there is no research available to explain or show this

relationship. Therefore, the study was designed in an exploratory in nature. Specifically, following research question would be investigated in this study.

Research Question 2: What are the impacts of weather conditions in general on U.S. apparel wholesale sales?

As retailers and wholesalers are dependent on each other for their business functions, there might be some kind of relationship between retail and wholesale sector in terms of sales. Since the study looks for impact of weather on individual retail and wholesale sales, one additional question was deigned:

Research Question 3: What are the impacts of weather on the relationship between U.S. apparel retail and wholesale sales?

CHAPTER III: RESERCH METHODOLOGY

Chapter III contains the following sections: (a) research design, (b) sources of study data, (c) sampling information, (c) data collection, and (d) data analysis.

Research Design

The aim of the study is to assess and quantify the impact of weather as well as several weather derivatives such as maximum temperature, minimum temperature, average temperature, and precipitation on U.S. apparel retail and wholesale sales. To achieve this goal, multiple regression analysis with secondary data was used. Multiple regression analysis was done to discover the effect of one variable on another.

Sources of the Study Data

In this study, the national level economics and weather data published by U.S. Census Bureau and National Centers for Environmental Information (NCEI) were used. In addition to that this study used secondary data. There are several benefits of using secondary data in research. First, secondary data are popular because of their breadth. A wide range of data irrespective of time and place can be accessed through secondary data which could be impossible otherwise. Second, for secondary sources, the data collection process is usually guided by time, money, expertise, and professionalism that is often difficult to obtain for an individual researcher. Third, secondary data is publicly accessible. With the availability of the internet, a large dataset can be easily accessed by anyone, which makes the whole data collection method much easier. Fourth, the secondary data involves larger samples that are more representative of the target population, which ensures the higher quality of the datasets.

Numerous studies are conducted by the federal government on a national scale which are publicly available. For this particular study, this study used the data from sources including U.S. Census Bureau and National Centers for Environmental Information (NCEI). One of the motivations for using data from these sources is that these two organizations are the central organizations for all types of economic and weather related data in the United States. Both of these government institutions are responsible for collecting, sorting, and listing national level economic and weather data. These data are collected by the federal government and widely used by different government agencies and private organizations. Another reason is that, U.S. Census Bureau performs continuous or regular surveys to collect economic data. On the other hand, NCEI keeps track of high quality environmental data which is funded by the federal government. Both of these organizations cover a wide range of national level historical datasets which are very suitable for longitudinal studies, such as this study.

Sampling Information

U.S. apparel monthly retail sales, wholesale sales, and weather data were collected and analyzed. The U.S. Census Bureau is responsible for collecting, documenting, and updating all kinds of business data in the United States. The Census Bureau has a wide range of historical datasets on U.S. apparel sales, both retail and wholesale sales which are updated regularly. The Census Bureau listed apparel wholesale sales data in subgroup apparel, piece goods, and notions merchant wholesalers under wholesale trade category in accordance with NAICS code 4243 (U.S. Census Bureau, 2015j). Retail sales data are listed in the subgroup clothing stores (NAICS code 4481) under retail trade in the U.S. census Bureau (U.S. Census Bureau, 2015g). All the

apparel retailers and wholesalers in the United States was the population of this study, and the sample unit was month, from 1992 to 2015. In total, 300 months.

The U.S. Census Bureau (2015l) describes its sampling process on its website. According to the U.S. Census Bureau, monthly wholesale trade sampling uses a stratified, one-stage design with primary strata defined by industry. The primary strata are later substratified into 4, 7, 10 or 13 annual sales size data. The largest sales size stratum within each industry stratum consists of companies, all of which are selected with certainty. Employer Identification Numbers (EIN) is used to populate other strata. Sample sizes are computed to meet multiple coefficients of variation constraints on estimated sales. The sample consists of approximately 1,200 certainty companies and 3000 EINs. Wholesale sales data are collected using survey method by mail, internet, fax, and telephone. Surveys are sent to companies, parts of companies, and single units that are situated in the United States, and have paid employees, and are classified as merchant wholesalers. Questionnaires are mailed each month to the wholesale establishments and requested data for the end of each month. Monthly sales data are requested along with end-of-month inventories and number of establishments. After collecting, analyzing, and classifying the data, they are adjusted for seasonal variation and trading-day differences.

The monthly retail trade survey developed by the U.S. census bureau was the main source of monthly retail sales for this study. According to U.S. Census Bureau (2015m), a mail-out/mail-back survey has been done on around 12,000 retail businesses with paid employees. In addition to that supplemented estimates are made for the new employers, non-employers, and missed employers. To create the sampling frame, the census bureau extracts the data for all retail institutions located in the United States.

Business Register is the source for the sample of retail firms which enlist each and every establishment location and Employer Identification Numbers (EINs). A stratified sampling is done for the firms selected for the survey based on estimated sales and kind of business. Firms which have sales higher than the minimum cutoffs and are certain, are included in the survey. Out of 12,000 retail firms, 2,500 firms has been selected where probability is equal to 1. EINs has been randomly selected for each stratum and classified based on sales and major kind of business. Estimates of monthly sales are derived from data collected in the monthly retail trade surveys and approximately six weeks after the end of the reference month, updates are released. Each month, retail establishments report to the census bureau the total value of their sales in the previous month. Later, the sales data are seasonally adjusted and unadjusted, and released in two different forms (U.S. Census Bureau, 2015n).

Weather data were collected from National Centers for Environmental Information (NCEI) under National Oceanic and Atmospheric Administration (NOAA) and it came from the U.S. divisional database which has data from 1895 to the present. According to NCEI (National Centers for Environmental Information, 2015a), the NCEI is responsible for holding and providing access to one of the most noteworthy archives on earth which contains comprehensive atmospheric, oceanic, and geophysical data. The NCEI uses near real-time observation of hourly, daily, monthly, and yearly temperature and precipitation data across the country. NCEI uses most sophisticated satellite technology to gather the information. Later, observations were adjusted and artificial effects developed into the climate record by factors such as urbanization, station relocation, instrument changes, and observer practice changes.

Data Collection

U.S. apparel monthly retail and wholesale sales were used as dependent variables in this study. For this study, monthly U.S. apparel retail and wholesale sales data from 1992 to 2015 were collected through the U.S. Census Bureau website. Therefore, the study introduced 24 years (1992 to 2015) of retail and wholesale sales observations to find out the impact of weather on sales. Here, the datasets were longitudinal which means that the same data had been collected from the same population over several different time periods. These longitudinal datasets would help us to look at trends and changes of the sales and weather over time. One of the reasons of using the last 24 years data was its convenience. Since U.S. Census Bureau has digitalized and updated business data on monthly basis starting from 1992, it was more convenient to use retail and wholesale sales data from 1992 to simultaneously compare all data in both sectors. Another reason was that, at the beginning of the 1990's, the U.S. apparel industry underwent a major shift from manufacturing based industry to more retail and wholesale sectors based industry. Thus, it was more rational to see how weather impacted retail and wholesale sales starting from the early 1990's to now. Consequently, the sample unit was month: from 1992 to 2015, for a total of 288 months.

All the weather and sales data were national level data. One of the benefits of using national level data was that more monthly economic data are available on the national level compared to the state level (Bloesch & Gourio, 2015). As the main purpose of the study is to assess the impact of weather on the U.S. apparel retail and wholesale sales, thus it was more reasonable to use national level data compared to state level or regional data.

Financial sales data, or real sales data, were used to capture the change in sales between years. The study used seasonally unadjusted datasets. In other words, the effects of regular or seasonal patterns have not been removed from the data series. Since we are looking for original impact of weather on sales, seasonally unadjusted datasets were more appropriate for this study. This will help us to get the actual trends of the sales. In this study, seasonally unadjusted data were directly retrieved from U.S. Census Bureau.

The seasonally unadjusted sales data were later normalized to eliminate the impact of Consumer Price Index (CPI). The Bureau of Labor Statistics (Bureau of Labor Statistics, 2015b) defines Consumer Price Index (CPI) as the change in the prices paid by urban customers for the consumer services and products. The monthly Consumer Price Index (CPI) was derived from Bureau of Labor Statistics, and each month of every year data were discounted based on CPI values prior to any further analysis. The seasonally unadjusted sales data were divided by CPI to normalize the impact of CPI on sales. In addition, monthly data were used in this study because most previous studies used quarterly or annual data, therefore capturing weather impacts that would otherwise overlook using longer time intervals.

The weather data were collected from National Centers for Environmental Information (NCEI) which is a part of National Oceanic and Atmospheric Administration (NOAA). NCEI develops datasets which help describe the climate of the United States as well as the trends and anomalies of weather and climate. These datasets have monthly national measures of many weather variables, including average temperature, minimum temperature, maximum temperature, and precipitation which were considered for this

particular study. No adjustment were made on the datasets, since these were real time data and the study would like to assess the real time weather impact on sales.

In this study, the impact of the changes in temperature or precipitation on apparel retail and wholesale sales were assessed. Apparel retail and wholesale sales were defined as sales in millions of dollars. One of the reasons of using sales in monetary value was that it is one of the most popular and widely used methods of evaluating economic performance. By comparing the amount of retail sales among months, the researcher can easily measure the actual change in sales. The temperature variables were defined by Fahrenheit whereas precipitation was measured by inch. NCEI also defines temperature and precipitation as Fahrenheit and inch respectively.

The control variables of the study were population and Gross Domestic Product (GDP). Population is directly related with sales. Since population and consumer traffic drive sales demand (Bertrand, Brusset & Fortin 2015; Parsons, 2001), the level of population is expected to influence the impact of weather on sales. The data of population were collected from the U.S. Census Bureau website. On the other hand, GDP or Gross domestic product is the standard measure of the value of final goods and services produced by a country minus the value of total imports in a particular time range (Organization for Economic Co-operation and Development, 2015). GDP defines the economic progress of the country (Stockhammer et al, 1997) and the increase in GDP might positively affect the apparel retail and wholesale sales. GDP data were collected from the Bureau of Economic Analysis under the U.S. Department of Commerce. Later, GDP data were discounted by annual CPI. Therefore, real GDP used in this study.

In this study, both population and GDP were used as control variables. Therefore, the results would eliminate the impact of these control variables, and capture only the impact of weather on apparel retail and wholesale sales.

Data Analysis

Regression analysis method was used in this study. Regression analysis is the statistic tool for the investigation of the relationships between variables. Regression is widely used in the field of statistics especially economic statistics. Regression are used to quantify the relationship between one variable and the other variables. They can also be used to determine how close and well determined the relationship is. Since the aim of this study is to find out the relationship between weather and sales, therefore, regression analysis is a suitable statistical method to determine the relationship. The following regression equations have been developed by capturing all the above variables, which is given below.

To find out the impact of average temperature on January retail sales,

$$R_{Jan.j} = \beta_0 + \beta_1 GDP_j + \beta_2 POP_{Jan.j} + \beta_3 Av_{Jan.j} + \acute{\varepsilon}_{Jan.j} \quad \text{----------(1)}$$

Where,

$R_{Jan.j}$ = U.S. apparel retail sales for January & year j=1992 to 2015 and measured in millions of dollars.

GDP_j = Gross Domestic Product for year j=1992 to 2015 and measured in U.S. dollar.

$POP_{Jan.j}$= Population for January & year j=1992-2015 and measured in millions.

$Av_{Jan.j,}$ = Average temperature for January & year j=1992 to 2015 and measured in Fahrenheit.

$\acute{\varepsilon}_{Jan.j}$= Error term which covers factors excluding the average temperature, minimum temperature, maximum temperature, and precipitation for month January & year j=1992-2015.

This formula was repeated for the remaining 11 months from February, March, April, May, June, July, August, September, October, November, to December.

To find out the impact of maximum temperature on January retail sales,

$R_{Jan.j}= \beta_0 + \beta_1 GDP_j + \beta_2 POP_{Jan.j} + \beta_3 Mx_{Jan.j} + \acute{\varepsilon}_{Jan.j}$ ----------(2)

Where,

$R_{Jan.j}$ = U.S. apparel retail sales for January & year j=1992 to 2015 and measured in millions of dollars.

GDP_j = Gross Domestic Product for year j=1992 to 2015 and measured in U.S. dollar.

$POP_{Jan.j}$= Population for January & year j=1992-2015 and measured in millions.

$Mx_{Jan.j,}$= Maximum temperature for January & year j=1992 to 2015 and measured in Fahrenheit.

$\acute{\varepsilon}_{Jan.j}$= Error term which covers factors excluding the average temperature, minimum temperature, maximum temperature, and precipitation for month January & year j=1992-2015.

This formula was repeated for the remaining 11 months from February, March, April, May, June, July, August, September, October, November, to December.

To find out the impact of minimum temperature on January retail sales,

$R_{Jan.j} = \beta_0 + \beta_1 GDP_j + \beta_2 POP_{Jan.j} + \beta_3 Mn_{Jan.j} + \acute{\varepsilon}_{Jan.j}$ ----------(3)

Where,

$R_{Jan.j}$ = U.S. apparel retail sales for January & year j=1992 to 2015 and measured in millions of dollars.

GDP_j = Gross Domestic Product for year j=1992 to 2015 and measured in U.S. dollar.

$POP_{Jan.j}$= Population for month January & year j=1992-2015 and measured in millions.

$Mn_{Jan.j,}$= Minimum temperature for January & year j=1992 to 2015 and measured in Fahrenheit.

$\acute{\varepsilon}_{Jan.j}$= Error term which covers factors excluding the average temperature, minimum temperature, maximum temperature, and precipitation for month January & year j=1992-2015.

Later, 11 more similar regression equations have been developed for the month of February, March, April, May, June, July, August, September, October, November, and December.

To find out the impact of precipitation on January retail sales,

$R_{Jan.j} = \beta_0 + \beta_1 GDP_j + \beta_2 POP_{Jan.j} + \beta_3 Pr_{Jan.j} + \acute{\varepsilon}_{Jan.j}$ ----------(4)

Where,

$R_{Jan.j}$ = U.S. apparel retail sales for January & year j=1992 to 2015 and measured in millions of dollars.

GDP_j = Gross Domestic Product for year j=1992 to 2015 and measured in U.S. dollar.

$POP_{Jan.j}$= Population for January & year j=1992-2015 and measured in millions.

$Pr_{Jan.j}$ = Average precipitation for January & year j=1992 to 2015 and measured in inch.

$\acute{\varepsilon}_{Jan.j}$= Error term which covers factors excluding the average temperature, minimum temperature, maximum temperature, and precipitation for month January & year j=1992-2015.

This formula was repeated for the remaining 11 months from February, March, April, May, June, July, August, September, October, November, to December.

To find out the impact of average temperature on January wholesale sales,

$W_{Jan.j} = \beta_0 + \beta_1 GDP_j + \beta_2 POP_{Jan.j} + \beta_3 Av_{Jan.j} + \acute{\varepsilon}_{Jan.j}$ ----------(5)

Where,

W_{Janj} = U.S. apparel wholesale sales for January & year j=1992 to 2015 and measured in millions of dollars.

GDP_j = Gross Domestic Product for year j=1992 to 2015 and measured in U.S. dollar.

$POP_{Jan.j}$= Population for January & year j=1992-2015 and measured in millions.

$Av_{Jan.j,}$ = Average temperature for January & year j=1992 to 2015 and measured in Fahrenheit.

$\acute{\varepsilon}_{Jan.j}$= Error term which covers factors excluding the average temperature, minimum t emperature, maximum temperature, and precipitation for month January & year j=1992-2015.

This formula was repeated for the remaining 11 months from February, March, April, May, June, July, August, September, October, November, to December.

To find out the impact of maximum temperature on January wholesale sales,

$W_{Jan.j}= \beta_0 + \beta_1 GDP_j + \beta_2 POP_{Jan.j} + \beta_3 Mx_{Jan.j} + \acute{\varepsilon}_{Jan.j}$----------(6)

Where,

W_{Janj} = U.S. apparel wholesale sales for January & year j=1992 to 2015 and measured in millions of dollars.

GDP_j = Gross Domestic Product for year j=1992 to 2015 and measured in U.S. dollar.

$POP_{Jan.j}$= Population for January & year j=1992-2015 and measured in millions.

$Mx_{Jan.j,}$= Maximum temperature for January & year j=1992 to 2015 and measured in Fahrenheit.

$\acute{\varepsilon}_{Jan.j}$= Error term which covers factors excluding the average temperature, minimum temperature, maximum temperature, and precipitation for month January & year j=1992-2015.

This formula was repeated for the remaining 11 months from February, March, April, May, June, July, August, September, October, November, to December.

To find out the impact of minimum temperature on January wholesale sales,

$W_{Jan.j} = \beta_0 + \beta_1 GDP_j + \beta_2 POP_{Jan.j} + \beta_3 Mn_{Jan.j} + \acute{\varepsilon}_{Jan.j}$----------(7)

Where,

W_{Janj} = U.S. apparel wholesale sales for January & year j=1992 to 2015 and measured in millions of dollars.

GDP_j = Gross Domestic Product for year j=1992 to 2015 and measured in U.S. dollar.

$POP_{Jan.j}$= Population for January & year j=1992-2015 and measured in millions.

$Mn_{Jan.j,}$= Minimum temperature for January & year j=1992 to 2015 and measured in Fahrenheit.

$\acute{\varepsilon}_{Jan.j}$= Error term which covers factors excluding the average temperature, minimum temperature, maximum temperature, and precipitation for month January & year j=1992-2015.

This formula was repeated for the remaining 11 months from February, March, April, May, June, July, August, September, October, November, to December.

To find out the impact of precipitation on January wholesale sales,

$W_{Jan.j} = \beta_0 + \beta_1 GDP_j + \beta_2 POP_{Jan.j} + \beta_3 Pr_{Jan.j} + \acute{\varepsilon}_{Jan.j}$ ----------(8)

Where,

W_{Janj} = U.S. apparel wholesale sales for January & year j=1992 to 2015 and measured in millions of dollars.

GDP_j = Gross Domestic Product for year j=1992 to 2015 and measured in U.S. dollar.

$POP_{Jan.j}$= Population for January & year j=1992-2015 and measured in millions.

$Pr_{Jan.j}$ = Average precipitation for January & year j=1992 to 2015 and measured in inch.

$\acute{\varepsilon}_{Jan.j}$= Error term which covers factors excluding the average temperature, minimum temperature, maximum temperature, and precipitation for month January & year j=1992-2015.

This formula was repeated for the remaining 11 months from February, March, April, May, June, July, August, September, October, November, to December.

Later, this study also tried to investigate the overall impact of weather on the relationship between retail and wholesale sales. Therefore, another set of regression equations was developed to assess the correlation between U.S. apparel retail and wholesale sales which is given below.

To find out the impact of average temperature on the interaction between January retail and wholesale sales,

$R_{Jan.j} = \beta_0 + \beta_1 GDP_j + \beta_2 POP_{Jan.j} + \beta_3 W_{Jan.j} + \beta_4 Av_{Jan.j} + \beta_5 W_{Jan.j} Av_{Jan.j} + \acute{\varepsilon}_{Jan.j}$ ---- (9)

Where,

$R_{Jan.j}$ = U.S. apparel retail sales for January & year j=1992 to 2015 and measured in millions of dollars.

GDP_j = Gross Domestic Product for year j=1992 to 2015 and measured in U.S. dollar.

$POP_{Jan.j}$= Population for January & year j=1992-2015 and measured in millions.

W_{Janj} = U.S. apparel wholesale sales for January & year j=1992 to 2015 and measured in millions of dollars.

$Av_{Jan.j,}$ = Average temperature for January & year j=1992 to 2015 and measured in Fahrenheit.

$\acute{\varepsilon}_{Jan.j}$= Error term which covers factors excluding the average temperature, minimum temperature, maximum temperature, and precipitation for month January & year j=1992-2015.

This formula was repeated for the remaining 11 months from February, March, April, May, June, July, August, September, October, November, to December.

To find out the impact of maximum temperature on the interaction between January retail and wholesale sales,

$R_{Jan.j} = \beta_0 + \beta_1 GDP_j + \beta_2 POP_{Jan.j} + \beta_3 W_{Jan.j} + \beta_4 Mx_{Jan.j} + \beta_5 W_{Jan.j} Mx_{Jan.j,} + \acute{\varepsilon}_{Jan.j}$ --(10)

Where,

$R_{Jan.j}$ = U.S. apparel retail sales for January & year j=1992 to 2015 and measured in millions of dollars.

GDP_j = Gross Domestic Product for year j=1992 to 2015 and measured in U.S. dollar.

$POP_{Jan.j}$= Population for January & year j=1992-2015 and measured in millions.

W_{Janj} = U.S. apparel wholesale sales for January & year j=1992 to 2015 and measured in millions of dollars.

$Mx_{Jan.j,}$= Maximum temperature for January & year j=1992 to 2015 and measured in Fahrenheit.

$\acute{\varepsilon}_{Jan.j}$= Error term which covers factors excluding the average temperature, minimum temperature, maximum temperature, and precipitation for month January & year j=1992-2015.

This formula was repeated for the remaining 11 months from February, March, April, May, June, July, August, September, October, November, to December.

To find out the impact of minimum temperature on the interaction between January retail and wholesale sales,

$$R_{Jan.j} = \beta_0 + \beta_1 GDP_j + \beta_2 POP_{Jan.j} + \beta_3 W_{Jan.j} + \beta_4 Mn_{Jan.j} + \beta_5 W_{Jan.j} Mn_{Jan.j} + \acute{\varepsilon}_{Jan.j} \text{ -- (11)}$$

Where,

$R_{Jan.j}$ = U.S. apparel retail sales for January & year j=1992 to 2015 and measured in millions of dollars.

GDP_j = Gross Domestic Product for year j=1992 to 2015 and measured in U.S. dollar.

$POP_{Jan.j}$= Population for January & year j=1992-2015 and measured in millions.

W_{Janj} = U.S. apparel wholesale sales for January & year j=1992 to 2015 and measured in millions of dollars.

$Mn_{Jan.j,}$= Minimum temperature for January & year j=1992 to 2015 and measured in Fahrenheit.

$\acute{\varepsilon}_{Jan.j}$= Error term which covers factors excluding the average temperature, minimum temperature, maximum temperature, and precipitation for month January & year j=1992-2015.

This formula was repeated for the remaining 11 months from February, March, April, May, June, July, August, September, October, November, to December.

To find out the impact of precipitation on the interaction between January retail and wholesale sales,

$$R_{Jan.j} = \beta_0 + \beta_1 GDP_j + \beta_2 POP_{Jan.j} + \beta_3 W_{Jan.j} + \beta_4 Pr_{Jan.j} + \beta_5 W_{Jan.j} Pr_{Jan.j} + \acute{\varepsilon}_{Jan.j} \text{ --- (12)}$$

Where,

$R_{Jan.j}$ = U.S. apparel retail sales for January & year j=1992 to 2015 and measured in millions of dollars.

GDP_j = Gross Domestic Product for year j=1992 to 2015 and measured in U.S. dollar.

$POP_{Jan.j}$= Population for January & year j=1992-2015 and measured in millions.

W_{Janj} = U.S. apparel wholesale sales for January & year j=1992 to 2015 and measured in millions of dollars.

$Pr_{Jan.j}$ = Average precipitation for January & year j=1992 to 2015 and measured in inch.

$\acute{\varepsilon}_{Jan.j}$= Error term which covers factors excluding the average temperature, minimum temperature, maximum temperature, and precipitation for month January & year j=1992-2015.

This formula was repeated for the remaining 11 months from February, March, April, May, June, July, August, September, October, November, to December.

The basic assumption behind these models is that all the variables are directly related with the dependent variables, U.S. apparel retail and wholesale sales.

The computer program SPSS were used to perform all statistical analysis. Each equation was run to assess the impact of weather on a particular month. Since there are 12 months in a year and the datasets were collected from 1992 to 2015, so each equation were run for 12 times from January to December and the total number of sample for each equation were 24. To analyze weather impacts on economic activities, multiple regressions were conducted to assess the contribution of each weather factors on sales.

Several measurements were taken to ensure reliability and validity of the models. Sample size might impact the generalizability of the results (Hair et al, 2006). Hair et al (2006) explained that the ratio of observations to independent variables should be five or

higher although the desired level is 15 to 20. Given the lack of data, in this study, first two research questions were assessed based on the monthly data (n=24) for 3 independent variables. The last research question was assessed on the monthly data for 3 independent variables.

Moreover, statistical analysis such as standard error, t-test, and corresponding p-values were calculated to test the validity of the models. The model should accurately explain the relationship between weather and sales. Further assessment were made to test if the model is structured well and gives positive results while applying in practice.

CHAPTER IV: RESULTS

This chapter includes (a) results of analysis for impact of weather on U.S. apparel retail sales, (b) results of analysis for impact of weather on U.S. apparel wholesale sales, (c) results of analysis for impact of weather on the interaction between U.S. apparel retail and wholesale sales.

Results of Analysis for Impact of Weather on U.S. Apparel Retail Sales

In this study, regression analysis was performed to find out the impact of weather on retail sales. The study used monthly average temperature, maximum temperature, minimum temperature, and precipitation as weather variables and run individual regression analysis to explore their impact on U.S. monthly apparel retail sales.

Impact of average temperature on U.S. apparel retail sales

Table 4.1

Monthly average temperature sensitivity of apparel retail sales

Month	β	t value	p-value	R^2	F	Sig.
January	-2.216	-0.063	0.951	0.892	54.817	0.001
February	24.319	0.927	0.365	0.945	114.556	0.001
March	**57.794**	**1.873**	**0.076**	**0.939**	**103.081**	**0.001**
April	**105.049**	**2.385**	**0.027**	**0.927**	**84.209**	**0.001**
May	36.246	0.752	0.461	0.949	123.224	0.001
June	65.691	0.979	0.339	0.924	80.71	0.001
July	-72.589	-1.316	0.203	0.942	108.291	0.001
August	-37.038	-0.788	0.440	0.932	91.695	0.001
September	**-127.485**	**-2.15**	**0.044**	**0.850**	**37.819**	**0.001**
October	4.392	0.089	0.930	0.876	47.227	0.001
November	**-76.431**	**-2.415**	**0.025**	**0.909**	**66.902**	**.000**
December	48.975	0.655	0.520	0.511	6.972	.002

The study used multiple regression analysis to regress U.S. apparel retail sales on average temperature. The study result showed that average temperature had a statistically significant impact on apparel retail sales in the month of April, September, and November. Regression coefficients were significant at the 5 percent level. In the month of **April**, average temperature along with GDP and population all together accounted for 92.7% variation in retail sales (R^2 = .927; $F(3, 20) = 84.209$; p=0.001). The average temperature was a significant predictor of the retail sales (β = 105.049; t (20) = 2.39; p= 0.027). Holding GDP and population constant, with one degree Fahrenheit increase of average temperature in April, the apparel retail sales increased by $105.05 millions of dollars. As expected in April, when the temperature is warmer than the normal temperature, there will be more demand in the market for summer clothing. Therefore the sales will increase.

In the month of **September**, average temperature along with GDP and population all together accounted for 85% variation in retail sales (R^2 = 0.85; $F(3, 20) = 37.819$; p=0.001). The average temperature was a significant predictor of the monthly retail sales, (β = -127.49; t (20) = -2.15, p=0.044). Holding GDP and population constant, with one degree Fahrenheit increase of average temperature, the apparel retail sales decreased by $127.49 millions of dollars. That is, in September, if the temperature is higher than the regular temperature, the apparel sales also drops as September is the month when the retailers carry fall or early winter items. Warm weather does not help such sales.

Again, in the month of **November**, average temperature along with GDP and population all together accounted for 90.9% variation in retail sales (R^2 = 0.909; $F(3, 20)$ = 66.902; p=0.000). The average temperature was a significant predictor of the retail

sales, (β = -76.43; t (20) = -2.42, p=0.025). Holding GDP and population constant, with one degree Fahrenheit increase of average temperature, the apparel retail sales decreased by $76.43 millions of dollars. Again similar to September, in November, increase of the average temperature lowers apparel retail sales. However, with the change of one degree Fahrenheit, the decrease in sales in November ($76.431 millions of dollars) is comparatively lower to sales in the September ($127.485 millions of dollars).

Moreover, **March** shows inconclusive but statistically suggestive evidence that average temperature affects retail sales where regression coefficient was significant at the 10 percent level (Ramsey & Schafer, 2012). In the month of March, the average temperature along with GDP and population all together accounted for 93.9% variation in retail sales (R^2 = .939; F(3, 20) = 103.08; p=0.001). The average temperature was a significant predictor of the retail sales (β = 57.79; t (20) = 1.87; p=0.076). Holding GDP and population constant, with one degree Fahrenheit increase of average temperature in March, the apparel retail sales increased by $57.79 millions of dollars. Similar to April, when the temperature is warmer than the normal temperature, there will be more demand in the market for summer clothing. Therefore the overall sales will increase in March.

However, the study did not find any statistically significant relationship between average temperature and retail sales for any other months. So we can conclude that average temperature does not have any impact on apparel retail sales on January, February, May, June, July, August, October, and December.

Impact of maximum temperature on U.S. apparel retail sales

Table 4.2

Monthly maximum temperature sensitivity of apparel retail sales

Month	β	t value	p-value	R^2	F	Sig.
January	-16.77	-0.505	0.619	0.893	55.59	0.001
February	23.359	0.975	0.341	0.945	115.087	0.001
March	**57.261**	**2.041**	**0.055**	**0.941**	**106.158**	**0.001**
April	**85.185**	**2.154**	**0.044**	**0.924**	**80.497**	**0.001**
May	30.979	0.78	0.445	0.949	123.495	0.001
June	80.968	1.647	0.115	0.930	88.028	0.001
July	**-78.177**	**-1.804**	**0.086**	**0.946**	**116.330**	**0.001**
August	-27.229	-0.689	0.499	0.932	90.994	0.001
September	-76.816	-1.348	0.193	0.831	32.751	0.001
October	-18.976	-0.522	0.607	0.878	47.941	.000
November	**-52.769**	**-1.978**	**0.062**	**0.902**	**61.435**	**.000**
December	43.159	0.569	0.576	0.509	6.902	.002

Again, a multiple regression analysis was used to regress U.S. apparel retail sales on maximum temperature. The study result showed that the maximum temperature had statistically significant impact on apparel retail sales in the month of April. Regression coefficient was significant at the 5 percent level. In the month of **April**, maximum temperature along with GDP and population all together accounted for 92.4% variation in retail sales (R^2 = .924; F(3, 20) = 80.497; p=0.001). Maximum temperature was a significant predictor of the retail sales, (β = 85.19; t (20) = 2.154; p=0.044). Holding GDP and population constant, with one degree Fahrenheit increase of maximum temperature, the apparel retail sales increased by $85.19 millions of dollars. Similar to average temperature in April, when the maximum temperature is higher than the normal maximum temperature, there will be more demand in the market for summer clothing. Therefore the sales will increase.

Moreover, **March** shows inconclusive but statistically suggestive evidence that the maximum temperature affects retail sales where regression coefficient was significant at the 10 percent level. In the month of March, maximum temperature along with GDP and population all together accounted for 94.1% variation in retail sales (R^2 = .941; F(3, 20) = 106.16; p=0.001). Maximum temperature was a significant predictor of the monthly retail sales (β = 57.26; t (20) = 2.04; p=0.055). Holding GDP and population constant, with the one degree Fahrenheit increase of maximum temperature in March, the apparel retail sales increased by $57.26 millions of dollars. Similar to April, when the maximum temperature is warmer than the normal temperature, there will be more demand in the market for summer clothing. Therefore the overall sales will increase in March.

In the month of **July**, the result shows inconclusive but statistically suggestive evidence that maximum temperature affects retail sales where regression coefficient was significant at the 10 percent level. In the month of July, maximum temperature along with GDP and population all together accounted for 94.6% variation in retail sales (R^2 = .946; F(3, 20) = 116.33; p=0.001). Maximum temperature was a significant predictor of the monthly retail sales (β = -78.18; t (20) = -1.80; p=0.086). Holding GDP and population constant, with one degree Fahrenheit increase of maximum temperature in July, the apparel retail sales decreased by $78.18 millions of dollars. In July, if maximum temperature is warmer than the normal temperature, the sales decrease.

Again, **November** shows inconclusive but statistically suggestive evidence that maximum temperature affects retail sales where regression coefficient was significant at the 10 percent level. In the month of November, maximum temperature along with GDP and population all together accounted for 90.2% variation in retail sales (R^2 = 0.902; F(3,

20) = 61.44; p=0.000). Maximum temperature was a significant predictor of the retail sales (β = -52.77; t (20) = -1.98; p=0.062). Holding GDP and population constant, with one degree Fahrenheit increase of maximum temperature in November, the apparel retail sales decreased by $52.77 millions of dollars. That is, in November, similar to September, if the temperature is higher than the regular temperature, the apparel sales also drops as November is the month when the retailers carry early winter items. Warm weather does not help such sales.

However, the study did not find any statistically significant relationship between maximum temperature and retail sales for any other months. So we can conclude that maximum temperature does not have any impact on apparel retail sales on any month of the year but March, April, July, and November.

Impact of minimum temperature on U.S. apparel retail sales

Table 4.3

Monthly minimum temperature sensitivity of apparel retail sales

Month	β	t value	p-value	R^2	F	Sig.
January	13.583	0.4	0.694	0.892	55.296	0.001
February	20.628	0.785	0.441	0.944	113.146	0.001
March	53.098	1.607	0.124	0.937	98.759	0.001
April	**121.021**	**2.523**	**0.020**	**0.929**	**86.616**	**0.001**
May	34.556	0.634	0.533	0.948	122.194	0.001
June	-10.469	-0.126	0.901	0.920	76.781	0.001
July	-40.337	-0.590	0.562	0.938	100.967	0.001
August	-52.732	-0.845	0.408	0.933	92.137	0.001
September	**-156.400**	**-2.859**	**0.010**	**0.869**	**44.240**	**0.001**
October	56.928	1.023	0.319	0.882	50.023	.000
November	**-97.931**	**-2.751**	**0.012**	**0.915**	**71.855**	**.000**
December	50.159	0.706	0.488	0.513	7.018	.002

Again, a multiple regression analysis was used to regress U.S. apparel retail sales on minimum temperature. The study result showed that minimum temperature had statistically significant impact on apparel retail sales in the month of April, September, and November. Regression coefficients were significant at the 5 percent level. In the month of **April**, minimum temperature along with GDP and population all together accounted for 92.9% variation in retail sales (R^2 = .929; F(3, 20) = 86.62; p=0.001). Minimum temperature was a significant predictor of the monthly retail sales, (β = 121.02; t (20) = 2.52; p=0.020). Holding GDP and population constant, with one degree Fahrenheit increase of minimum temperature, the apparel retail sales increased by $121.02 millions of dollars. As expected in April, when the minimum temperature is higher than the average, there will be more demand in the market for summer clothing. Therefore the sales will increase.

In the month of **September**, minimum temperature along with GDP and population all together accounted for 86.9% variation in retail sales (R^2 = 0.869; F(3, 20) = 44.24; p=0.001). Minimum temperature was a significant predictor of the retail sales, (β = -156.4; t (20) = -2.86; p=0.010). Holding GDP and population constant, with the one degree Fahrenheit increase of minimum temperature, the apparel retail sales decreased by $156.4 millions of dollars. This result is consistent with the previous results.

Again, in the month of **November**, minimum temperature along with GDP and population all together accounted for 91.5% variation in retail sales (R^2 = 0.915; F(3, 20) = 71.86; p=0.000). Minimum temperature was a significant predictor of the retail sales, (β = -97.93; t (20) = -2.75; p=0.012). Holding GDP and population constant, with the one degree Fahrenheit increase of minimum temperature, the apparel retail sales decreased by

$97.93 millions of dollars. However, with the change of one degree Fahrenheit, the decrease in sales in November ($97.93 millions of dollars) is comparatively lower to sales in the September ($156.4 millions of dollars).

However, the study did not find any statistically significant relationship between minimum temperature and retail sales for any other months. So we can conclude that minimum temperature does not have any impact on apparel retail sales on January, February, March, May, June, July, August, October, and December.

Impact of precipitation on U.S. apparel retail sales

Table 4.4

Monthly precipitation sensitivity of apparel retail sales

Month	β	t value	p-value	R^2	F	Sig.
January	57.57	0.359	0.723	0.892	55.201	0.001
February	-102.720	-0.649	0.524	0.944	112.007	0.001
March	-317.802	-1.171	0.255	0.933	93.115	0.001
April	-132.214	-0.515	0.612	0.907	65.028	0.001
May	4.850	0.036	0.971	0.947	119.665	0.001
June	**-297.114**	**-1.761**	**0.094**	**0.931**	**89.639**	**0.001**
July	**479.042**	**2.561**	**0.019**	**0.953**	**133.821**	**0.001**
August	-83.986	-0.392	0.699	0.931	89.464	0.001
September	-353.191	-1.471	0.157	0.834	33.380	0.001
October	56.958	0.431	0.671	0.877	47.706	.000
November	68.009	0.454	0.655	0.884	50.881	.000
December	-352.454	-0.960	0.348	0.523	7.301	.002

Finally, another multiple regression analysis was used to regress U.S. apparel retail sales on precipitation. The study result showed that precipitation had statistically significant impact on apparel retail sales in the month of July. Regression coefficient was

significant at the 5 percent level. In the month of **July**, the precipitation along with GDP and population all together accounted for 95.3% variation in retail sales (R^2 = 0.953; F(3, 20) = 133.82; p=0.001). Precipitation was a significant predictor of the retail sales, (β = 479.04; t (20) = 2.56; p=0.019). Holding GDP and population constant, with the one inch increase of precipitation, the apparel retail sales increased by $479.04 millions of dollars. That is, wetter the weather, more retail sales would take place. However, the reason behind this is not known.

Moreover, **June** shows inconclusive but statistically suggestive evidence that the precipitation affects retail sales where regression coefficient was significant at the 10 percent level. In the month of June, precipitation along with GDP and population all together accounted for 93.1% variation in retail sales (R^2 = .931; F(3, 20) = 89.64; p=0.001). Precipitation was a significant predictor of the retail sales (β = -297.11; t (20) = -1.76; p=0.094). Holding GDP and population constant, with the one inch increase of precipitation in June, the apparel retail sales decreased by $297.11 millions of dollars. Similar to July, the reason behind the effect of precipitation on retail sales is unknown.

However, the study did not find any statistically significant relationship between precipitation and retail sales for any other months. So we can conclude that precipitation does not have any impact on apparel retail sales on any month of the year but June and July.

Results of Analysis for Impact of Weather on U.S. Apparel Wholesale Sales

Similar to retail sales, regression analyses were performed to find out the impact of weather on wholesale sales. The study used monthly average temperature, maximum temperature, minimum temperature, and precipitation as weather variables and run individual regression analysis to explore their impact on U.S. monthly apparel wholesale sales.

Impact of average temperature on U.S. apparel wholesale sales

Table 4.5

Monthly average temperature sensitivity of apparel wholesale sales

Month	β	t value	p-value	R^2	F	Sig.
January	8.161	0.152	0.880	0.831	32.813	.000
February	6.110	0.176	0.862	0.907	64.744	.000
March	28.678	0.705	0.489	0.850	37.866	.000
April	-57.689	-1.025	0.318	0.908	65.819	.000
May	-16.440	-0.261	0.797	0.947	118.643	.000
June	111.079	1.710	0.103	0.952	133.042	.000
July	-94.628	-0.896	0.381	0.882	49.878	.000
August	30.423	0.372	0.714	0.907	64.956	.000
September	23.063	0.213	0.834	0.827	31.945	.000
October	144.444	1.580	0.130	0.874	46.395	.000
November	-70.711	-1.271	0.218	0.884	50.756	.000
December	**121.693**	**1.908**	**0.071**	**0.833**	**33.272**	**.000**

A multiple regression analysis was used to regress U.S. apparel wholesale sales on average temperature. The study result showed that average temperature had no statistically significant impact on apparel wholesale sales. However, December shows

inclusive but statistically suggestive evidence that average temperature affects wholesale sales where regression coefficient was significant at the 10 percent level. In the month of **December**, average temperature along with GDP and population all together accounted for 83.3% variation in wholesale sales (R^2 = 0.833; $F(3, 20) = 33.27$; p=0.000). Average temperature was a significant predictor of the wholesale sales (β = 121.693.11; t (20) = 1.91; p=0.071). Holding GDP and population constant, with one degree Fahrenheit increase of average temperature in December, the apparel wholesale sales increased by $121.69 millions of dollars. The study result is quite opposite than what we found for retail sales. In December, the retail sales were decreased when the average temperature had decreased but for wholesale it had increased. This is interesting that retailers are buying more items from wholesalers, but selling less. So there inventory level will be higher in December than usual which will eventually incur them higher cost. Therefore, retailers must take preventive steps if they want to reduce their operating costs.

However, the study did not find any statistically significant relationship between average temperature and wholesale sales for any other months. So we can conclude that average temperature does not have any impact on apparel wholesale sales on any of the month but December.

Impact of maximum temperature on U.S. apparel wholesale sales

Table 4.6

Monthly maximum temperature sensitivity of apparel wholesale sales

Month	β	t value	p-value	R^2	F	Sig.
January	0.496	0.010	0.992	0.831	32.767	.000
February	-8.139	-0.257	0.800	0.907	64.868	.000
March	26.802	0.715	0.483	0.850	37.897	.000
April	-55.293	-1.122	0.275	0.909	66.541	.000
May	21.797	0.420	0.679	0.947	119.321	.000
June	75.966	1.512	0.146	0.951	129.161	.000
July	-88.445	-1.037	0.312	0.884	50.617	.000
August	24.685	0.360	0.723	0.907	64.925	.000
September	-31.634	-0.323	0.750	0.828	32.058	.000
October	87.165	1.267	0.220	0.869	44.288	.000
November	-44.830	-0.978	0.340	0.880	49.007	.000
December	94.931	1.420	0.171	0.821	30.529	.000

A multiple regression analysis was used to regress U.S. apparel wholesale sales on maximum temperature. The study result showed that maximum temperature had no statistically significant relationship with apparel wholesale sales. Therefore, we can conclude that maximum temperature had no impact on apparel wholesale sales.

Impact of minimum temperature on U.S. apparel wholesale sales

Table 4.7

Monthly minimum temperature sensitivity of apparel wholesale sales

Month	β	t value	p-value	R^2	F	Sig.
January	14.959	0.289	0.775	0.832	32.932	.000
February	21.803	0.638	0.531	0.908	66.083	.000
March	28.170	0.658	0.518	0.850	37.729	.000
April	-52.283	-0.835	0.414	0.906	64.603	.000
May	-83.634	-1.219	0.237	0.950	127.490	.000
June	**136.600**	**1.736**	**0.098**	**0.952**	**133.590**	**.000**
July	-80.527	-0.629	0.536	0.880	48.772	.000
August	-87.904	-0.818	0.423	0.909	66.844	.000
September	82.315	0.780	0.445	0.832	33.029	.000
October	169.496	1.614	0.122	0.875	46.649	.000
November	-98.515	-1.552	0.136	0.888	52.863	.000
December	**135.948**	**2.321**	**0.031**	**0.845**	**36.223**	**.000**

A multiple regression analysis was used to regress U.S. apparel wholesale sales on minimum temperature. The study result showed that minimum temperature had statistically significant impact on apparel wholesale sales in the month of December. Regression coefficients was significant at the 5 percent level. In the month of **December**, minimum temperature along with GDP and population all together accounted for 84.5% variation in retail sales (R^2 = .845; $F(3, 20) = 36.22$; p=0.000). Minimum temperature was a significant predictor of the monthly wholesale sales, (β = 135.95; t (20) = 2.32; p=0.031). Holding GDP and population constant, with one degree Fahrenheit increase of minimum temperature, the apparel wholesale sales increased by $135.95 millions of dollars. Similar to average temperature in December, if the minimum temperature is

warmer in December than regular, the wholesalers will expect more order for early winter items. Therefore, the wholesale sales will increase with the increase of demand.

The study also found that June showed inconclusive but statistically suggestive evidence that minimum temperature affects wholesale sales where regression coefficients were significant at the 10 percent level. In the month of **June**, minimum temperature along with GDP and population all together accounted for 95.2% variation in retail sales (R^2 = .952; $F(3, 20) = 133.59$; p=0.000). Minimum temperature was a significant predictor of wholesale sales (β = 136.60; t (20) = 1.74; p=0.098). Holding GDP and population constant, with one degree Fahrenheit increase of minimum temperature in June, the apparel wholesale sales increased by $136.60 millions of dollars. Which is consistent with the previous studies. In June, there will be more demand for summer clothing which will make wholesalers to gather more items. Therefore, with the increase of demand, sells will increase.

However, the study did not find any statistically significant relationship between minimum temperature and wholesale sales for any other months. So we can conclude that minimum temperature does not have any impact on apparel wholesale sales on any other months but June and December.

Impact of precipitation on U.S. apparel wholesale sales

Table 4.8

Monthly precipitation sensitivity of apparel wholesale sales

Month	β	t value	p-value	R^2	F	Sig.
January	-169.484	-0.702	0.490	0.835	33.740	.000
February	**384.577**	**2.040**	**0.055**	**0.923**	**79.466**	**.000**
March	-79.258	-0.230	0.821	0.847	36.901	.000
April	255.055	0.870	0.395	0.907	64.808	.000
May	**-286.135**	**-1.778**	**0.091**	**0.954**	**137.964**	**.000**
June	-64.693	-0.353	0.727	0.946	115.990	.000
July	417.500	1.063	0.301	0.884	50.764	.000
August	-48.209	-0.130	0.898	0.906	64.525	.000
September	8.533	0.020	0.984	0.827	31.858	.000
October	-90.101	-0.348	0.731	0.860	40.790	.000
November	195.749	0.821	0.421	0.879	48.257	.000
December	**655.826**	**2.104**	**0.048**	**0.838**	**34.605**	**.000**

A multiple regression analysis was used to regress U.S. apparel wholesale sales on precipitation. The study result showed that precipitation had statistically significant impact on apparel wholesale sales in the month of December. Regression coefficient was significant at the 5 percent level. In the month of **December**, precipitation along with GDP and population all together accounted for 83.8% variation in retail sales (R^2 = .838; F (3, 20) = 34.61; p=0.000). The precipitation was a significant predictor of the wholesale sales, (β = 655.83; t (20) = 2.10; p=0.048). Holding GDP and population constant, with one inch increase of precipitation, the apparel retail sales increased by $655.83 millions of dollars. This means, with the increase of precipitation, more sales will incur at the apparel wholesale level. However, the reason is not known.

The study also found that February showed statistically suggestive evidence that precipitation affects wholesale sales where regression coefficient was significant at the 10 percent level. In the month of **February**, precipitation along with GDP and population all together accounted for 92.3% variation in retail sales (R^2 = .923; $F(3, 20) = 79.47$; p=0.000). Precipitation was a significant predictor of the monthly wholesale sales (β = 384.58; t (20) = 2.04; p=0.055). Holding GDP and population constant, with the one inch increase of precipitation in February, the apparel wholesale sales increased by $384.28 millions of dollars.

Again, May showed inconclusive but statistically suggestive evidence that precipitation affects wholesale sales where regression coefficient was significant at the 10 percent level. In the month of **May**, precipitation along with GDP and population all together accounted for 95.4% variation in retail sales (R^2 = 0.954; $F(3, 20) = 137.96$; p=0.000). Precipitation was a significant predictor of the wholesale sales (β = -286.14; t (20) = -1.78; p=0.091). Holding GDP and population constant, with one inch increase of precipitation in May, the apparel wholesale sales decreased by $286.14 millions of dollars. However, the reason behind the negative effect of precipitation on wholesale sales is unknown.

However, the study did not find any statistically significant relationship between precipitation and apparel wholesale sales for any other months. So we can conclude that precipitation does not have any impact on apparel wholesale sales on other month of the year but February, May, and December.

Results of Analysis for Impact of Weather on the Interaction between U.S. Apparel Retail Sales and Wholesale Sales

Impact of monthly weather on the interaction between apparel retail sales and wholesale sales

Regression analyses were performed to find out the impact of monthly weather on the relationship between U.S. apparel retail and wholesale sales. The study used interaction between monthly average temperature and apparel wholesale sales, monthly maximum temperature and apparel wholesale sales, monthly minimum temperature and apparel wholesale sales, and monthly precipitation and apparel wholesale sales as independent variables and run individual regression analysis to explore their impact on U.S. monthly apparel retail sales.

Impact of average temperature on the interaction between U.S. apparel retail and wholesale sales

Table 4.9

Monthly average temperature sensitivity on the interaction between apparel retail and wholesale sales

Month	β_3	β_4	β_5	t value	p-value	R^2	F	Sig.
January	-0.012	-51.288	0.005	0.160	0.875	0.898	31.625	.000
February	-0.747	-153.334	0.020	1.010	0.326	0.948	65.814	.000
March	-0.024	68.009	-0.001	-0.027	0.979	0.940	56.026	.000
April	0.383	200.115	-0.013	-0.341	0.737	0.936	52.352	.000
May	0.510	97.344	-0.007	-0.183	0.856	0.950	67.920	.000
June	-4.725	-604.552	**0.073**	**1.894**	**0.074**	**0.946**	**62.677**	**.000**
July	-9.214	-1302.746	**0.124**	**3.866**	**0.001**	**0.969**	**111.255**	**.000**
August	-1.212	-242.211	0.019	0.525	0.606	0.945	62.130	.000
September	-2.248	-469.491	0.033	0.799	0.435	0.855	21.281	.000
October	0.593	87.314	-0.008	-0.189	0.852	0.882	26.806	.000
November	1.039	84.469	-0.014	-0.924	0.368	0.961	89.805	.000
December	1.479	312.368	-0.034	-0.595	0.559	0.528	4.028	.013

In this study, a multiple regression analysis was used to explore the effect of average temperature on the interaction between apparel retail and wholesale sales. The study result showed that the interaction had a statistically significant impact on apparel retail sales in the month of July. Regression coefficient was significant at the 1 percent level. In the month of **July**, wholesales, average temperature, interaction between average temperature and apparel wholesale sales along with GDP and population all together accounted for 96.9% variation in retail sales (R^2 = .969; $F(3, 20) = 111.26$; p=0.000). That the interaction was a decent predictor of the retail sales (β = .12; t (20) = 3.87;

p=0.001). Holding GDP and population constant, change in average temperature affects the impact of wholesale sales on retail sales.

Moreover, June shows inconclusive but statistically suggestive evidence that the interaction between monthly average temperature and apparel wholesale sales affects retail sales where regression coefficient was significant at the 10 percent level. In the month of **June**, wholesale sales, average temperature, interaction between average temperature and apparel wholesale sales along with GDP and population all together accounted for 94.6% variation in retail sales (R^2 = .946; $F(3, 20) = 62.68$; p=0.000). The interaction was a significant predictor of the retail sales ($\beta = 0.073$; $t\ (20) = 1.89$; p=0.074). Holding GDP and population constant, change in average temperature affects the impact of wholesale sales on retail sales.

However, the study did not find any statistically significant relationship between average temperature and interaction between retail and wholesale sales for any other months. So we can conclude the average temperature does not have any impact on the relationship between apparel retail and wholesale sales on any other months but June and July.

Impact of maximum temperature on the interaction between U.S. apparel retail and wholesale sales

Table 4.10

Monthly maximum temperature sensitivity on the interaction between apparel retail and wholesale sales

Month	β_3	β_4	β_5	t value	p-value	R^2	F	Sig.
January	-0.766	-214.354	0.022	0.608	0.551	0.901	32.770	.000
February	-0.913	-147.793	0.019	1.030	0.316	0.948	66.131	.000
March	-0.031	65.225	-0.001	-0.021	0.983	0.941	57.768	.000
April	-0.493	40.056	0.003	0.104	0.918	0.932	49.510	.000
May	0.902	126.720	-0.011	-0.415	0.683	0.950	68.174	.000
June	-6.297	-645.439	**0.080**	**2.853**	**0.011**	**0.958**	**81.293**	**.000**
July	-7.630	-938.942	**0.087**	**3.832**	**0.001**	**0.971**	**119.404**	**.000**
August	-0.807	-157.500	0.012	0.399	0.694	0.944	60.994	.000
September	-2.254	-365.372	0.028	0.721	0.480	0.836	18.318	.000
October	-0.051	-58.960	0.003	0.071	0.944	0.885	27.692	.000
November	0.833	32.789	-0.007	-0.518	0.611	0.958	82.928	.000
December	0.715	121.058	-0.011	-0.182	0.858	0.519	3.886	.015

Again, a multiple regression analysis was used to explore the effect of maximum temperature on the interaction between apparel retail and wholesale sales. The study results showed that the interaction had a statistically significant impact on apparel retail sales in the month of July and June. Regression coefficients were significant at the 1 percent and 5 percent levels respectively. In the month of **July**, wholesale sales, maximum temperature, interaction between maximum temperature and apparel wholesale sales along with GDP and population all together accounted for 97.1% variation in retail sales (R^2 = 0.971; $F(3, 20) = 119.40$; p=0.000). That the interaction was a decent predictor of the retail sales (β = .09; t (20) = 3.83; p=0.001). Holding GDP and

population constant, change in maximum temperature affects the impact of wholesale sales on retail sales.

Again, June shows that the interaction between maximum temperature and apparel wholesale sales affects retail sales where regression coefficient was significant at the 5 percent level. In the month of **June**, wholesale sales, maximum temperature, interaction between maximum temperature and apparel wholesale sales along with GDP and population all together accounted for 95.8% variation in retail sales (R^2 = .958; F(3, 20) = 81.29; p=0.000). The interaction was a predictor of the retail sales (β = 0.080; t (20) = 2.85; p=0.011). Holding GDP and population constant, change in maximum temperature affects the impact of wholesale sales on retail sales.

However, the study did not find any statistically significant relationship between maximum temperature and interaction between retail and wholesale sales for any other months. So we can conclude that the maximum temperature does not have any impact on the relationship between apparel retail and wholesale sales except for June and July.

Impact of minimum temperature on the interaction between U.S. apparel retail and wholesale sales

Table 4.11

Monthly minimum temperature sensitivity on the interaction between apparel retail and wholesale sales

Month	β_3	β_4	β_5	t value	p-value	R^2	F	Sig.
January	0.208	34.931	-0.003	-0.098	0.923	0.898	31.780	.000
February	-0.480	-135.389	0.018	0.866	0.398	0.947	64.191	.000
March	-0.080	44.254	0.001	0.032	0.975	0.937	53.570	.000
April	1.109	420.632	-0.035	-0.906	0.377	0.941	56.985	.000
May	-0.584	-86.175	0.015	0.322	0.751	0.950	68.335	.000
June	-1.445	-382.884	0.034	0.795	0.437	0.940	56.077	.000
July	-9.404	-1575.623	**0.153**	**3.094**	**0.006**	**0.960**	**85.761**	**.000**
August	-	-68.706	**0.004**	**1.883**	**0.075**	**0.943**	**78.781**	**.000**
September	-1.874	-516.941	0.035	0.838	0.413	0.875	25.277	.000
October	1.198	334.810	-0.025	-0.665	0.515	0.887	28.326	.000
November	1.109	144.343	-0.021	-1.384	0.183	0.964	97.223	.000
December	1.520	427.435	-0.047	-0.933	0.363	0.541	4.246	.010

In this study, a multiple regression analysis was used to explore the effect of minimum temperature on the interaction between apparel retail and wholesale sales. The study result showed that the interaction had a statistically significant impact on apparel retail sales in the month of July. Regression coefficient was significant at the 1 percent level. In the month of **July**, wholesale sales, minimum temperature, interaction between minimum temperature and apparel wholesale sales along with GDP and population all together accounted for 96% variation in retail sales (R^2 = 0.96; $F(3, 20) = 85.76$; p=0.000). That the interaction was a decent predictor of the retail sales ($\beta = 0.15$; $t\ (20) = 3.09$; p=0.006). Holding GDP and population constant, change in minimum temperature affects the impact of wholesale sales on retail sales.

Moreover, August shows inconclusive but statistically suggestive evidence that the interaction between minimum temperature and apparel wholesale sales affects retail sales where regression coefficient was significant at the 10 percent level. In the month of **August**, wholesale sales, minimum temperature, interaction between minimum temperature and apparel wholesale sales along with GDP and population all together accounted for 94.3% variation in retail sales (R^2 = 0.943; $F(3, 20) = 78.78$; p=0.000). The interaction was a small predictor of the retail sales (β = 0.004; t (20) = 1.89; p=0.075). Holding GDP and population constant, change in minimum temperature affects the impact of wholesale sales on retail sales.

However, the study did not find any statistically significant relationship between minimum temperature and interaction between monthly retail and wholesale sales for any other months. So we can conclude that minimum temperature does not have any impact on the relationship between apparel retail and wholesale sales except for July and August.

Impact of precipitation on the interaction between U.S. apparel retail and wholesale sales

Table 4.12

Monthly precipitation sensitivity on the interaction between apparel retail and wholesale sales

Month	β_3	β_4	β_5	t value	p-value	R^2	F	Sig.
January	-0.029	-565.964	0.080	0.591	0.562	0.901	32.776	.000
February	0.294	1429.138	-0.163	-0.745	0.466	0.946	62.466	.000
March	0.107	205.681	-0.052	-0.214	0.833	0.933	50.452	.000
April	-0.847	-1677.260	0.189	1.050	0.307	0.926	44.744	.000
May	-0.187	-901.181	**0.111**	**1.775**	**0.093**	**0.956**	**78.002**	**.000**
June	1.290	2702.990	**-0.301**	**-2.331**	**0.032**	**0.957**	**79.230**	**.000**
July	0.641	3049.551	**-0.260**	**-2.691**	**0.015**	**0.967**	**106.582**	**.000**
August	0.170	-349.469	0.025	0.129	0.898	0.942	58.293	.000
September	-0.176	-1143.560	0.078	0.444	0.662	0.835	18.262	.000
October	-0.526	-2242.344	0.214	1.720	0.103	0.899	32.106	.000
November	0.902	1673.828	**-0.169**	**-3.981**	**0.001**	**0.974**	**133.869**	**.000**
December	0.840	533.341	-0.130	-0.822	0.422	0.580	4.962	.005

Finally, another multiple regression analysis was used to explore the effect of precipitation on the interaction between apparel retail and wholesale sales. The study result showed that the interaction had a statistically significant impact on apparel retail sales in the month of November, June, and July. Regression coefficients were significant at the 1 percent level for the former month and 5 percent level for the latter two. In the month of **November**, wholesale sales, precipitation, interaction between precipitation and apparel wholesale sales along with GDP and population all together accounted for 97.4% variation in retail sales (R^2 = .974; $F(3, 20) = 133.87$; p=0.000). The interaction was a decent predictor of the retail sales (β = -0.17; t (20) = -3.98; p=0.001). Holding GDP and

population constant, change in precipitation affects the impact of wholesale sales on retail sales.

In the month of **June**, wholesale sales, precipitation, interaction between precipitation and apparel wholesale sales along with GDP and population all together accounted for 95.7% variation in retail sales (R^2 = 0.957; F(3, 20) = 79.23; p=0.000). That the interaction was a decent predictor of the retail sales (β = -0.30; t (20) = -2.33; p=0.032). Holding GDP and population constant, change in precipitation affects the impact of wholesale sales on retail sales. In the month of **July**, wholesale sales, precipitation, interaction between precipitation and apparel wholesale sales along with GDP and population all together accounted for 96.7% variation in retail sales (R^2 = .967; F(3, 20) = 106.58; p=0.000). That the interaction was a decent predictor of the retail sales (β = -0.26; t (20) = -2.69; p=0.015). Holding GDP and population constant, change in precipitation affects the impact of wholesale sales on retail sales.

Moreover, May shows inconclusive but statistically suggestive evidence that the interaction between precipitation and apparel wholesale sales affects retail sales where regression coefficient was significant at the 10 percent level. In the month of **May**, the interaction between precipitation and apparel wholesale sales along with GDP and population all together accounted for 95.6% variation in retail sales (R^2 = 0.956; F(3, 20) = 78.00; p=0.000). The interaction was a small predictor of the retail sales (β = 0.11; t (20) = 1.78; p=0.093). Holding GDP and population constant, precipitation affected the relationship between retail and wholesale sales.

However, the study did not find any statistically significant relationship between precipitation and interaction between retail and wholesale sales for any other months. So

we can conclude that precipitation does not have any impact on the relationship between apparel retail and wholesale sales except for May, June, July, and November.

CHAPTER V: CONCLUSIONS

Chapter V contains the following sections (a) summary of the study, (b) discussion and implications of the major findings, (c) contribution of findings, (d) study limitations and future research suggestions.

Summary of the Study

It has been proven that weather has a significant impact on business activities. Several studies have done in different fields to see how weather impact. Agriculture, tourism, and forestry are few of them. However, few studies have been done to see if weather has any influence on apparel sales. Apparel are seasonal goods and largely influenced by consumer behavior, contemporary fashion trends, and different supply chain factors i.e. labor strikes, transportation disruptions, and natural disasters. A change in the weather might influence all these factors and significantly impact retail and wholesale sales. Since retailers and wholesalers work very closely in the apparel industry, impact of weather on one will influence the other. Therefore, in this study it was assumed that weather might have some impact on both retail and wholesale sales as well as their interactions. The study found that weather does have some impact on both retail and wholesale sales as well as on their interactions.

This study was designed to find out how the weather impact on U.S. apparel retail sales and wholesale sales and at what amount. At the same time, study also tested the relationship between apparel retail and wholesale sales and examine how weather influences that relationship. Due to lack of sufficient prior research on this relationship,

this study was designed in an exploratory manner and the following specific research questions were proposed.

Research Question 1: What are the impacts of weather conditions in general on U.S. apparel retail sales?

Research Question 2: What are the impacts of weather conditions in general on U.S. apparel wholesale sales?

Research Question 3: What are the impacts of weather on the relationships between U.S. apparel retail and wholesale sales?

In this study, secondary data were used. U.S. apparel monthly retail sales, wholesale sales, and weather data were collected and analyzed. U.S. apparel monthly retail sales and wholesales data were seasonally unadjusted and collected from the U.S. census bureau. Later, the data were normalized to eliminate the impact of consumer price index (CPI). Weather data (including monthly average temperature, maximum temperature, minimum temperature, and precipitation) were collected from National Centers for Environmental Information (NCEI). The study used 24 years (1992 to 2015) of national level sales and weather data. The monthly average temperature (Av), maximum temperature (Mx), minimum temperature (Mn), and precipitation (Pr) were used as independent variables. Apparel retail and wholesale sales were defined as sales in millions of dollars whereas the temperature and precipitation variables were defined by Fahrenheit and inch respectively. Moreover, Gross Domestic Product (GDP), discounted by CPI and population were used as control variables in this study to minimize their impact on sales.

To analyze impact of weather on retail sales, the following regression equation was developed for Av and the Av data were then replaced for Mx, Mn, and Pr respectively ($R_{ij}= \beta_0 + \beta_1 GDP_j + \beta_2 POP_{ij} + \beta_3 Av_{ij} + \acute{\varepsilon}_{ij,}$ where, R_{ij} = U.S. apparel retail sales for month i and year j; GDP_j = Gross Domestic Product for year j; POP_{jj}= Population for month i and year j; $Av_{ij,}$ = Monthly average temperature for month i and year j; Mx_{ij},= Monthly maximum temperature for month i and year j; $Mn_{ij,}$= Monthly minimum temperature for month i and year j; Pr_{ij} = Monthly average precipitation for month i and year j; and $\acute{\varepsilon}_{ij}$ = Error term). Again, to analyze impact of weather on wholesale sales, following regression equation was developed for Av and the Av data were then replaced for Mx, Mn, and Pr respectively ($W_{ij}= \beta_0 + \beta_1 GDP_j + \beta_2 POP_{ij} + \beta_3 Av_{ij} + \acute{\varepsilon}_{ij,}$ where W_{ij}= U.S. apparel wholesale sales for month i and year j). Finally, to analyze impact of weather on the relationship between apparel retail and wholesale sales, regression equation was developed for Av and the Av data were then replaced for Mx, Mn, and Pr respectively ($R_{ij} = \beta_0 + \beta_1 GDP_j + \beta_2 POP_{ij} + \beta_3 W_{ij} + \beta_4 Av_{ij} + \beta_5 Y_{ij} Av_{ij} + \acute{\varepsilon}_{ij}$).

Next, regression analyses were conducted. Each equation was run to assess the impact of weather on a particular month. Since there are 12 months in a year and the datasets were collected from 1992 to 2015, so each equation was run for 12 times from January to December and the total number of sample for each equation was 24. To analyze weather impacts on economic activities, multiple regressions were conducted to assess the contribution of each weather factor on sales. All the statistical analysis was performed using the computer program SPSS.

Discussion and implication of Major Findings

The result of this study revealed that U.S. apparel sales are influenced by weather. The results have several implications.

The study found that the weather has impact on apparel retail sales. During spring, more specifically during March and April, increase in temperature positively impacts apparel retail sales. In these two months, for each unit increase of temperature, the retail sales increase. With one degree Fahrenheit increase, the retail sales in April ($105.05 millions of dollars) will be almost double compare to March ($57.79 millions of dollars). On the other hand, with one degree Fahrenheit increase in late fall and early winter, especially in September and November, the retail sales will decrease. With one degree Fahrenheit increase, the sales will decrease more in September ($127.49 millions of dollars) compared to November ($76.43 millions of dollars). The sales also decrease with the increase of temperature in the month of July.

As expected in March and April, sales increase with warmer than normal temperature while they decrease in September and November when the temperature is colder than normal. These results are consistent with previous studies which suggest that most significant correlation factors between apparel and temperature were observed in spring and fall seasons and in the months of March, April, and May on one side, and in September, October, and November, on the other side (Bertrand, Brusset & Fortin, 2015; Marteau et.al. 2004). Bahng and Kincade (2012) also suggested that more seasonal items are sold when the temperature changes drastically. The study also found that with the increase of precipitation, the sales decrease in June but increase in July. However, the reasons are unknown.

This information will be very useful to retailers. Retailers are now expected to buy more items in early spring if there is a possibility of warmer than regular temperature, and decrease their inventory in late fall and early spring, if the temperature forecasts colder than normal temperature. For example, if retailers assume that the temperature will be higher in March and April than the regular temperature, they can expect a higher rate of traffic in their stores. Therefore, they can store more items to fulfil the increasing demands. They can also predict, exactly what amount of the sales will increase in each month and buy their items accordingly. For example, in September, if the temperature increases by one degree Fahrenheit higher than the normal temperature, the retailers will know their sales will decrease by $127.49 millions of dollars. So the retailers can take precautions to avoid major loss in their sales. For instance, retailers can order less items in September or offer promotions in August so that they have higher sales in August and lower inventory in September. Retailers also know that they have to take different strategies in June and July with the increase in precipitation.

Moreover, the study also revealed that weather has some impact on U.S. apparel wholesale sales. In June and December, the wholesale sales increase as the temperature increases. As expected in June, sales increase with the warmer than normal temperature while the demand for summer clothing is usually higher. On the other hand, if the temperature is above average in December, there will be more demand for early winter items. Therefore, the wholesale sales will increase.

The study also found that the precipitation largely influences wholesale sales. During the winter, more specifically in December and January, the sales increase if there is higher precipitation than the normal. With the increase of one inch precipitation, the

sales will be almost double in December ($655.83 millions of dollars) compared to February ($384.58 millions of dollars). On the other hand, in May, the sales decreases with the increase of one inch precipitation and it will be around $286.14 millions of dollars. Therefore, this information will be extremely helpful for the wholesalers as they can now anticipate the impact of weather changes on their sales and take remedial steps to overcome the impact of weather.

Another interesting thing the study revealed is that with the increase in temperature in December, the wholesale sales increase but the retail sales decrease. This also means that with the increase in temperature in December, wholesalers are selling more items to retailers but retailers are failing to increase their sales. Therefore, retailers end up with higher inventory, which cause them incur higher cost. So retailers may realize the fact and implement some strategic managerial decisions to reduce their inventory as well as their cost.

The study also explained the impact of weather on the interaction between U.S. apparel retail and wholesale sales. The result revealed that change in temperature affects the impact of wholesale sales on retail sales during the months of June, July, and August. On the other hand, change in precipitation affects the impact of wholesale sales on retail sales during the months of May, June, July, and November.

Contributions of Findings

This research has several contributions. First, the study could be able to contribute to reduce the gap in literature significantly. This is the first time a study tried to find out a relationship between weather and U.S. apparel retail sales. There has been few studies

made outside the United States, but nobody has done it before in the United States. In addition to that, most of the studies used temperature deviation as the only weather factor but this study used average temperature, maximum temperature, minimum temperature, and precipitation as weather variables. Therefore, this study provides more comprehensive results of the impact of weather on sales. The study expands the existing apparel industry literature by showing impact of weather on wholesale sales. In addition to that, it also suggests an anticipated impact of weather on the interaction between apparel retail and wholesale sales. Therefore, this study tries to fill up the gap in the literature and answer several weather related questions which were largely ignored by academics.

Second, the study also significantly contributes to the apparel retail and wholesale sectors. The U.S. retailers now can predict how the change in weather will impact their sales and at what amount, and take corrective actions to mitigate the negative impact of the weather on business activities. Moreover, the findings help U.S. apparel retailers in their strategic and financial decisions making. The wholesalers will benefit from this study too. Since the study also predicts the impact of weather on wholesale sales, the wholesalers are now able to forecast their demand more accurately and take necessary actions to reduce the negative influence of weather. Since the study explains how weather impacts the interaction between retail and wholesale sales, this could be vital for retail companies who work closely with the wholesale sectors or the companies who perform both retailing and wholesaling activities.

Third, the study findings can also be used by the educators and advocating groups. The study provides an insight about how weather impact apparel retail and

wholesale sales as well as the interaction between retail and wholesale sales. This could open a totally new window for educators. Since the impact of weather on apparel retail and wholesale sales is often neglected by the academics, they can use this study to educate themselves as well as the industry professionals. They can carry out further study on the weather and apparel sales and explore different level of relationships between weather and sales. The apparel industry advocates and specialists can use this study to educate their clients.

Finally, textile and apparel educators may want to teach these relationships between weather and sales to students so that they could be better prepared for the industry. Having this specific information may help future industry leaders and employers to make both strategically and financially right decisions.

Study Limitations and Future Research Suggestions

Despite the significant results obtained from this study, there are few limitations. First, one of the major limitations relate to this particular study's sample size. The study used datasets from 1992 to 2015 and the sample size was 24. Even though the sample size provides statistically significant relationships between weather and sales, a larger sample size would provide better and more comprehensive results. Therefore, further studies with higher range of samples with a greater breadth is recommended.

Second, the study used average temperature, maximum temperature, minimum temperature and precipitation as weather variables. However, there might be some weather variables for example snow, drought, natural disasters such as floods, cyclones, tornados etc. which might impact the retail and wholesale sales. So, future study should

include all other factors which might influence sales. In this study, population and Gross Domestic Product (GDP) were used as control variables and measurement was taken to normalize their impact on sales. However, the sales might be influenced by several other factors such as markdown of price, clearance sales, and especial events. So future studies should include all other factors which have direct influences on sales.

Third, the study examined the impact of weather on both retail and wholesale sales and found that weather has significant impact on retail sales and wholesale sales as well as on their interaction. However, manufacturers are responsible for producing all kinds of apparel and textiles in the United States and the wholesalers and the retailers are largely depend on the manufacturers for their products. So if the weather has some kind of impact on manufacturers' sales, then that might have significant impact on both retail and wholesale sales. Therefore, future study should be done to find out the impact of weather on manufacturers sales too. An additional studies should be carried out to find out the impact of weather on the interaction among apparel manufacturer sales, wholesale sales, and retail sales.

Fourth, the data used in this study were mostly monthly level data which were used to find out the impact of weather on the interaction between apparel retail and wholesale sales. Since apparel products are seasonal products and seasons might have significant impact on the sales, therefore further study should be done by using seasonal data to see how weather influence on sales. This will help us to get a long term impact of weather on sales. Due to the limitation of data accessibility, the study used country level data. However, since there are fifty states in the United States and each state weather differ from each other significantly, we can get more comprehensive results if can use

state level or city level data. The study would give more realistic picture of the weather influence on sales if we could use individual firm level data. Since the change in amount of dollar could be normalized by the change in the price of the products, therefore further research is recommended using amount of sales data instead of monetary value. Future studies could be done both inside and outside the United States to find out how weather impact sales in general around the world.

Fifth, it was beyond the scope of the study to see retailers and consumers perception on the impact of weather on sales which can give us a more comprehensive answers about the true impact of weather on sales. The retailer should be aware about the negative impact of sales and how they can minimize these impacts. Therefore, various study should be done to develop appropriate mathematical tools which can accurately predict the negative impact of weather on sales and at the same time provide suggestions to overcome these impacts.

Moreover, this is the first time that a study tried to find out a relationship between weather and wholesale and impact of weather on the interaction between apparel retail and wholesale sales. The study found that weather has significant impact both on apparel wholesales as well as its interaction with retail sales. However, most of the cases the reasons are unknown due to lack of pertinent literatures which can exactly predict these relationships. Therefore, further studies are recommended to verify these relationships as well as to reveal the reasons behind weathers impact on these relationships.

To conclude, the impact of weather on sales should be developed further. Even though several studies have been done to see the impact of different supply chain factors on sales, most of the time weather has not considered a significant factor. Since the whole

world is vulnerable to the rapid weather changes, like all other business industries, future apparel industry will largely influenced by the weather. Therefore, both the academicians, apparel manufacturers, wholesalers, and retailers should consider weather as a vital factor for their business growth and work jointly to accurately predict and normalize its impact on business activities.

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APPENDIX A:

Regression Analysis of Monthly Apparel Retail Sales on Weather

Table A1:

Regression analysis of monthly apparel retail sales on monthly average temperature

Month	Variables	β	t value	p-value	R^2	F	Sig.
January	**Constant**	3438.166	0.847	0.407	0.892	54.817	0.001
	GDP	0.504	2.329	0.03			
	Population	-5.899E-06	-0.271	0.789			
	AvgTemp	-2.216	-0.063	0.951			
February	**Constant**	-2274.393	-0.651	0.523	0.945	114.556	0.001
	GDP	0.357	2.028	0.056			
	Population	1.924E-05	1.056	0.303			
	AvgTemp	24.319	0.927	0.365			
March	**Constant**	1905.158	0.492	0.628	0.939	103.081	0.001
	GDP	0.744	3.498	0.002			
	Population	-1.163E-05	-0.541	0.594			
	AvgTemp	57.794	1.873	**0.076**			
April	**Constant**	1405.870	0.334	0.742	0.927	84.209	0.001
	GDP	0.625	2.970	0.008			
	Population	-1.469E-05	-0.687	0.500			
	AvgTemp	105.049	2.385	**0.027**			
May	**Constant**	2763.907	0.600	0.555	0.949	123.224	0.001
	GDP	0.636	3.306	0.004			
	Population	-7.604E-06	-0.388	0.702			
	AvgTemp	36.246	0.752	0.461			
June	**Constant**	6519.626	1.251	0.225	0.924	80.71	0.001
	GDP	0.836	4.216	0.000			
	Population	-3.978E-05	-1.949	0.065			
	AvgTemp	65.691	0.979	0.339			
July	**Constant**	13862.121	2.383	0.027	0.942	108.291	0.001
	GDP	0.837	4.125	0.001			
	Population	-3.057E-05	-1.513	0.146			
	AvgTemp	-72.589	-1.316	0.203			
August	**Constant**	15024.155	3.188	0.005	0.932	91.695	0.001
	GDP	0.845	4.716	0.000			
	Population	-4.05E-05	-2.222	0.038			
	AvgTemp	-37.038	-0.788	0.44			
September	**Constant**	18933.903	3.596	0.002	0.850	37.819	0.001
	GDP	0.710	3.095	0.006			
	Population	-3.190E-05	-1.360	0.189			
	AvgTemp	-127.485	-2.15	**0.044**			
October	**Constant**	11712.957	2.273	0.034	0.876	47.227	0.001
	GDP	0.749	3.220	0.004			
	Population	-3.582E-05	-1.518	0.145			

	AvgTemp	4.392	0.089	0.930			
November	**Constant**	18235.140	4.045	0.001	0.909	66.902	.000
	GDP	0.979	4.153	0.000			
	Population	-5.140E-05	-2.167	0.042			
	AvgTemp	-76.431	-2.415	**0.025**			
December	**Constant**	38025.855	3.831	0.001	0.511	6.972	.002
	GDP	1.751	3.222	0.004			
	Population	0.000	-2.759	0.012			
	AvgTemp	48.975	0.655	0.520			

Table A2.

Regression analysis of monthly apparel retail sales on monthly maximum temperature

Month	**Variables**	**β**	**t value**	**p-value**	**R^2**	**F**	**Sig.**
January	**Constant**	4544.94	1.1111	0.28	0.893	55.59	0.001
	GDP	0.54	2.527	0.02			
	Population	-9.146E-06	-0.428	0.673			
	MaxTemp	-16.77	-0.505	0.619			
February	**Constant**	-2445.881	-0.692	0.497	0.945	115.087	0.001
	GDP	0.357	2.049	0.054			
	Population	1.905E-05	1.060	0.302			
	MaxTemp	23.359	0.975	0.341			
March	**Constant**	1289.072	0.33	0.745	0.941	106.158	0.001
	GDP	0.738	3.517	0.002			
	Population	-1.148E-05	-0.542	0.594			
	MaxTemp	**57.261**	**2.041**	**0.055**			
April	**Constant**	1418.813	0.322	0.751	0.924	80.497	0.001
	GDP	0.628	2.922	0.008			
	Population	-1.50E-05	-0.687	0.500			
	MaxTemp	85.185	2.154	**0.044**			
May	**Constant**	2555.967	0.543	0.593	0.949	123.495	0.001
	GDP	0.628	3.243	0.004			
	Population	-6.779E-06	-0.343	0.735			
	MaxTemp	30.979	0.78	0.445			
June	**Constant**	4539.225	0.945	0.356	0.930	88.028	0.001
	GDP	0.826	4.332	0.000			
	Population	-3.964E-05	-2.029	0.056			
	MaxTemp	80.968	1.647	0.115			

July	**Constant**	15841.823	2.842	0.010	0.946	116.330	0.001
	GDP	0.879	4.436	0.000			
	Population	-3.45E-05	-1.745	0.096			
	MaxTemp	-78.177	-1.804	**0.086**			
August	**Constant**	14624.459	3.126	0.005	0.932	90.994	0.001
	GDP	0.840	4.684	0.000			
	Population	-4.018E-05	-2.198	0.040			
	MaxTemp	-27.229	-0.689	0.499			
September	**Constant**	17132.675	2.856	0.010	0.831	32.751	0.001
	GDP	0.714	2.923	0.008			
	Population	-3.398E-05	-1.363	0.188			
	MaxTemp	-76.816	-1.348	0.193			
October	**Constant**	13738.443	2.757	0.012	0.878	47.941	.000
	GDP	0.785	3.421	0.003			
	Population	-3.924E-05	-1.676	0.109			
	MaxTemp	-18.976	-0.522	0.607			
November	**Constant**	17023.866	3.691	0.001	0.902	61.435	.000
	GDP	0.934	3.842	0.001			
	Population	-4.671E-05	-1.916	0.070			
	MaxTemp	-52.769	-1.978	**0.062**			
December	**Constant**	37285.873	3.419	0.003	0.509	6.902	.002
	GDP	1.721	3.053	0.006			
	Population	0.000	-2.611	0.017			
	MaxTemp	43.159	0.569	0.576			

Table A3.

Regression analysis of monthly apparel retail sales on monthly minimum temperature

Month	**Variables**	**β**	**t value**	**p-value**	**R^2**	**F**	**Sig.**
January	**Constant**	2446.163	0.631	0.535	0.892	55.296	0.001
	GDP	0.466	2.175	0.042			
	Population	-2.002E-06	-0.092	0.928			
	MinTemp	13.583	0.4	0.694			
February	**Constant**	-1741.829	-0.522	0.608	0.944	113.146	0.001
	GDP	0.367	2.082	0.050			
	Population	1.816E-05	0.994	0.332			

	MinTemp	20.628	0.785	0.441			
March	**Constant**	2775.864	0.725	0.477	0.937	98.759	0.001
	GDP	0.756	3.489	0.002			
	Population	-1.232E-05	-0.562	0.58			
	MinTemp	53.098	1.607	0.124			
April	**Constant**	2043.919	0.515	0.612	0.929	86.616	0.001
	GDP	0.628	3.028	0.007			
	Population	-1.46E-05	-0.693	0.496			
	MinTemp	121.021	2.523	**0.02**			
May	**Constant**	3527.369	0.838	0.412	0.948	122.194	0.001
	GDP	0.650	3.399	0.003			
	Population	-9.008E-06	-0.462	0.649			
	MinTemp	34.556	0.634	0.533			
June	**Constant**	10937.977	2.122	0.047	0.920	76.781	0.001
	GDP	0.836	4.114	0.001			
	Population	-3.73E-05	-1.770	0.092			
	MinTemp	-10.469	-0.126	0.901			
July	**Constant**	10230.331	1.775	0.091	0.938	100.967	0.001
	GDP	0.774	3.783	0.001			
	Population	-2.520E-05	-1.233	0.232			
August	**Constant**	15244.733	3.23	0.004	0.933	92.137	0.001
	GDP	0.837	4.721	0.000			
	Population	-3.927E-05	-2.173	0.042			
	MinTemp	-52.732	-0.845	0.408			
September	**Constant**	18116.845	4.177	0.000	0.869	44.240	0.001
	GDP	0.685	3.201	0.004			
	Population	-2.84E-05	-1.291	0.212			
	MinTemp	-156.400	-2.859	**0.01**			
October	**Constant**	9095.623	1.951	0.065	0.882	50.023	.000
	GDP	0.698	3.100	0.006			
	Population	-3.192E-05	-1.404	0.176			
	MinTemp	56.928	1.023	0.319			
November	**Constant**	18564.245	4.326	0.000	0.915	71.855	.000
	GDP	0.992	4.381	0.000			
	Population	-5.364E-05	-2.337	0.030			
	MinTemp	-97.931	-2.751	**0.012**			
December	**Constant**	39191.869	4.234	0.000	0.513	7.018	.002
	GDP	1.795	3.370	0.003			
	Population	0.000	-2.891	0.009			
	MinTemp	50.159	0.706	0.488			

Table A4.

Regression analysis of monthly apparel retail sales on monthly precipitation

Month	Variables	β	t value	p-value	R^2	F	Sig.
January	**Constant**	2680.07	0.731	0.473	0.892	55.201	0.001
	GDP	0.484	2.398	0.026			
	Population	-3.081E-06	-0.146	0.885			
	Precipit.	57.57	0.359	0.723			
February	**Constant**	333.755	0.116	0.909	0.944	112.007	0.001
	GDP	0.427	2.538	0.020			
	Population	1.072E-05	0.625	0.539			
	Precipit.	-102.720	-0.649	0.524			
March	**Constant**	5303.109	1.461	0.16	0.933	93.115	0.001
	GDP	0.743	3.269	0.004			
	Population	-1.195E-05	-0.525	0.606			
	Precipit.	-317.802	-1.171	0.255			
April	**Constant**	7011.556	1.787	0.089	0.907	65.028	0.001
	GDP	0.665	2.794	0.011			
	Population	-1.590E-05	-0.651	0.522			
	Precipit.	-132.214	-0.515	0.612			
May	**Constant**	5297.211	1.610	0.123	0.947	119.665	0.001
	GDP	0.661	3.319	0.003			
	Population	-9.920E-06	-0.481	0.635			
	Precipit.	4.850	0.036	0.971			
June	**Constant**	11575.011	3.585	0.002	0.931	89.639	0.001
	GDP	0.834	4.411	0.002			
	Population	-3.815E-05	-1.973	0.062			
	Precipit.	-297.114	-1.761	**0.094**			
July	**Constant**	9139.261	3.122	0.005	0.953	133.821	0.001
	GDP	0.950	5.018	0.000			
	Population	-4.27E-05	-2.236	0.037			
	Precipit.	479.042	2.561	**0.019**			
August	**Constant**	12355.786	4.041	0.001	0.931	89.464	0.001
	GDP	0.823	4.600	0.000			
	Population	-3.886E-05	-2.121	0.047			
	Precipit.	-83.986	-0.392	0.699			

September	**Constant**	11520.551	2.830	0.01	0.834	33.380	0.001
	GDP	0.649	2.678	0.014			
	Population	-2.94E-05	-1.185	0.250			
	Precipit.	-353.191	-1.471	0.157			
October	**Constant**	12041.868	3.206	0.004	0.877	47.706	.000
	GDP	0.760	3.412	0.003			
	Population	-3.712E-05	-1.623	0.120			
	Precipitat.	56.958	0.431	0.671			
November	**Constant**	11620.595	2.837	0.010	0.884	50.881	.000
	GDP	0.752	3.090	0.006			
	Population	-3.021E-05	-1.217	0.238			
	Precipitat.	68.009	0.454	0.655			
December	**Constant**	39121.421	4.320	0.000	0.523	7.301	.002
	GDP	1.729	3.232	0.004			
	Population	0.000	-2.650	0.015			
	Precipitat.	-352.454	-0.960	0.348			

APPENDIX B:

Regression Analysis of Monthly Apparel Wholesale Sales on Weather

Table B1.

Regression analysis of monthly apparel wholesale sales on monthly average temperature

Month	Variables	β	t value	p-value	R^2	F	Sig.
January	**Constant**	5996.239	0.973	0.342	0.831	32.813	.000
	GDP	0.800	2.436	0.024			
	Population	-2.879E-05	-0.870	0.394			
	AvgTemp	8.161	0.152	0.880			
February	**Constant**	11955.395	2.587	0.018	0.907	64.744	.000
	GDP	1.114	4.796	0.000			
	Population	-6.087E-05	-2.528	0.020			
	AvgTemp	6.110	0.176	0.862			
March	**Constant**	19939.992	3.905	0.001	0.850	37.866	.000
	GDP	1.522	5.424	0.000			
	Population	0.000	-3.810	0.001			
	AvgTemp	28.678	0.705	0.489			
April	**Constant**	7838.612	1.457	0.161	0.908	65.819	.000
	GDP	0.830	3.085	0.006			
	Population	-2.419E-05	-0.884	0.387			
	AvgTemp	-57.689	-1.025	0.318			
May	**Constant**	3750.612	0.623	0.540	0.947	118.643	.000
	GDP	0.948	3.769	0.001			
	Population	-2.286E-05	-0.892	0.383			
	AvgTemp	-16.440	-0.261	0.797			
June	**Constant**	7297.884	1.446	0.164	0.952	133.042	.000
	GDP	1.310	6.820	0.000			
	Population	-7.924E-05	-4.010	0.001			
	AvgTemp	111.079	1.710	0.103			
July	**Constant**	11535.424	1.035	0.313	0.882	49.878	.000
	GDP	0.941	2.421	0.025			
	Population	-2.438E-05	-0.630	0.536			

	AvgTemp	-94.628	-0.896	0.381			
August	**Constant**	1526.587	0.186	0.854	0.907	64.956	.000
	GDP	0.756	2.422	0.025			
	Population	-1.038E-05	-0.327	0.747			
	AvgTemp	30.423	0.372	0.714			
September	**Constant**	2633.033	0.273	0.787	0.827	31.945	.000
	GDP	0.736	1.756	0.094			
	Population	-1.177E-05	-0.274	0.787			
	AvgTemp	23.063	0.213	0.834			
October	**Constant**	-10599.293	-1.115	0.278	0.874	46.395	.000
	GDP	0.454	1.058	0.303			
	Population	2.669E-05	0.614	0.546			
	AvgTemp	144.444	1.580	0.130			
November	**Constant**	4992.760	0.630	0.536	0.884	50.756	.000
	GDP	0.853	2.058	0.053			
	Population	-1.245E-05	-0.299	0.768			
	AvgTemp	-70.711	-1.271	0.218			
December	**Constant**	-7779.560	-0.919	0.369	0.833	33.272	.000
	GDP	0.488	1.052	0.305			
	Population	1.830E-05	0.387	0.703			
	AvgTemp	121.693	1.908	**0.071**			

Table B2.

Regression analysis of monthly apparel wholesale sales on monthly maximum temperature

Month	Variables	β	t value	p-value	R^2	F	Sig.
January	**Constant**	6517.112	1.042	0.310	0.831	32.767	.000
	GDP	0.818	2.508	0.021			
	Population	-3.060E-05	-0.938	0.360			
	MaxTemp	0.496	0.010	0.992			
February	**Constant**	13238.851	2.830	0.010	0.907	64.868	.000
	GDP	1.148	4.978	0.000			

	Population	-6.480E-05	-2.725	0.013			
	MaxTemp	-8.139	-0.257	0.800			
March	**Constant**	19743.282	3.784	0.001	0.850	37.897	.000
	GDP	1.521	5.420	0.000			
	Population	0.000	-3.818	0.001			
	MaxTemp	26.802	0.715	0.483			
April	**Constant**	8393.089	1.527	0.142	0.909	66.541	.000
	GDP	0.834	3.114	0.005			
	Population	-2.432E-05	-0.893	0.382			
	MaxTemp	-55.293	-1.122	0.275			
May	**Constant**	701.837	0.114	0.910	0.947	119.321	.000
	GDP	0.915	3.620	0.002			
	Population	-1.986E-05	-0.770	0.450			
	MaxTemp	21.797	0.420	0.679			
June	**Constant**	8399.187	1.711	0.103	0.951	129.161	.000
	GDP	1.301	6.674	0.000			
	Population	-7.752E-05	-3.882	0.001			
	MaxTemp	75.966	1.512	0.146			
July	**Constant**	12665.912	1.155	0.262	0.884	50.617	.000
	GDP	0.971	2.490	0.022			
	Population	-2.738E-05	-0.704	0.489			
	MaxTemp	-88.445	-1.037	0.312			
August	**Constant**	1643.613	0.203	0.842	0.907	64.925	.000
	GDP	0.758	2.436	0.024			
	Population	-1.054E-05	-0.332	0.743			
	MaxTemp	24.685	0.360	0.723			
September	**Constant**	6456.665	0.626	0.538	0.828	32.058	.000
	GDP	0.754	1.796	0.088			
	Population	-1.195E-05	-0.279	0.783			
	MaxTemp	-31.634	-0.323	0.750			
October	**Constant**	-8241.979	-0.874	0.393	0.869	44.288	.000
	GDP	0.502	1.154	0.262			
	Population	2.345E-05	0.529	0.603			
	MaxTemp	87.165	1.267	0.220			
November	**Constant**	3472.298	0.438	0.666	0.880	49.007	.000
	GDP	0.796	1.907	0.071			
	Population	-6.809E-06	-0.163	0.872			
	MaxTemp	-44.830	-0.978	0.340			
December	**Constant**	-8624.120	-0.897	0.380	0.821	30.529	.000
	GDP	0.441	0.888	0.385			

	Population	2.322E-05	0.459	0.651
	MaxTemp	94.931	1.420	0.171

Table B3.

Regression analysis of monthly apparel wholesale sales on monthly minimum temperature

Month	Variables	β	t value	p-value	R^2	F	Sig.
January	**Constant**	5628.716	0.955	0.351	0.832	32.932	.000
	GDP	0.783	2.405	0.026			
	Population	-2.700E-05	-0.815	0.424			
	MinTemp	14.959	0.289	0.775			
February	**Constant**	10874.170	2.501	0.021	0.908	66.083	.000
	GDP	1.080	4.710	0.000			
	Population	-5.663E-05	-2.381	0.027			
	MinTemp	21.803	0.638	0.531			
March	**Constant**	20290.247	4.094	0.001	0.850	37.729	.000
	GDP	1.526	5.439	0.000			
	Population	0.000	-3.810	0.001			
	MinTemp	28.170	0.658	0.518			
April	**Constant**	6903.044	1.332	0.198	0.906	64.603	.000
	GDP	0.821	3.032	0.007			
	Population	-2.382E-05	-0.864	0.398			
	MinTemp	-52.283	-0.835	0.414			
May	**Constant**	6835.683	1.290	0.212	0.950	127.490	.000
	GDP	0.960	3.991	0.001			
	Population	-2.358E-05	-0.960	0.348			
	MinTemp	-83.634	-1.219	0.237			
June	**Constant**	7594.504	1.560	0.134	0.952	133.590	.000
	GDP	1.328	6.918	0.000			
	Population	-8.124E-05	-4.088	0.001			
	MinTemp	136.600	1.736	0.098			
July	**Constant**	8745.852	0.811	0.427	0.880	48.772	.000
	GDP	0.885	2.312	0.032			
	Population	-1.936E-05	-0.506	0.618			
	MinTemp	-80.527	-0.629	0.536			

August	**Constant**	9062.740	1.115	0.278	0.909	66.844	.000
	GDP	0.799	2.618	0.016			
	Population	-1.243E-05	-0.399	0.694			
	MinTemp	-87.904	-0.818	0.423			
September	**Constant**	402.627	0.048	0.962	0.832	33.029	.000
	GDP	0.740	1.792	0.088			
	Population	-1.402E-05	-0.331	0.744			
	MinTemp	82.315	0.780	0.445			
October	**Constant**	-9086.354	-1.033	0.314	0.875	46.649	.000
	GDP	0.471	1.110	0.280			
	Population	2.315E-05	0.540	0.595			
	MinTemp	169.496	1.614	0.122			
November	**Constant**	5849.025	0.764	0.454	0.888	52.863	.000
	GDP	0.885	2.191	0.040			
	Population	-1.648E-05	-0.402	0.692			
	MinTemp	-98.515	-1.552	0.136			
December	**Constant**	-5238.636	-0.687	0.500	0.845	36.223	.00
	GDP	0.589	1.341	0.195			
	Population	7.944E-06	0.177	0.861			
	MinTemp	135.948	2.321	**0.031**			

Table B4.

Regression analysis of monthly apparel wholesale sales on monthly precipitation

Month	**Variables**	**β**	**t value**	**p-value**	**R^2**	**F**	**Sig.**
January	**Constant**	8339.935	1.510	0.147	0.835	33.740	.000
	GDP	0.861	2.835	0.010			
	Population	-3.747E-05	-1.182	0.251			
	Precipitation	-169.484	-0.702	0.490			
February	**Constant**	10343.092	3.015	0.007	0.923	79.466	.000
	GDP	1.078	5.387	0.000			
	Population	-5.562E-05	-2.724	0.013			
	Precipitation	384.577	2.040	**0.055**			
March	**Constant**	21590.842	4.678	0.000	0.847	36.901	.000
	GDP	1.538	5.321	0.000			
	Population	0.000	-3.781	0.001			

	Precipitation	-79.258	-0.230	0.821			
April	**Constant**	4797.897	1.069	0.298	0.907	64.808	.000
	GDP	0.834	3.063	0.006			
	Population	-2.652E-05	-0.950	0.353			
	Precipitation	255.055	0.870	0.395			
May	**Constant**	1133.612	0.287	0.777	0.954	137.964	.000
	GDP	0.827	3.461	0.002			
	Population	-8.838E-06	-0.357	0.725			
	Precipitation	-286.135	-1.778	**0.091**			
June	**Constant**	14190.637	4.051	0.001	0.946	115.990	.000
	GDP	1.311	6.393	0.000			
	Population	-7.578E-05	-3.613	0.002			
	Precipitation	-64.693	-0.353	0.727			
July	**Constant**	4637.016	0.754	0.460	0.884	50.764	.000
	GDP	0.995	2.503	0.021			
	Population	-3.143E-05	-0.783	0.443			
	Precipitation	417.500	1.063	0.301			
August	**Constant**	4014.744	0.761	0.456	0.906	64.525	.000
	GDP	0.775	2.510	0.021			
	Population	-1.174E-05	-0.371	0.714			
	Precipitation	-48.209	-0.130	0.898			
September	**Constant**	4019.465	0.568	0.576	0.827	31.858	.000
	GDP	0.742	1.763	0.093			
	Population	-1.166E-05	-0.270	0.790			
	Precipitation	8.533	0.020	0.984			
October	**Constant**	-395.448	-0.054	0.958	0.860	40.790	.000
	GDP	0.634	1.452	0.162			
	Population	1.129E-05	0.252	0.803			
	Precipitation	-90.101	-0.348	0.731			
November	**Constant**	-1350.073	-0.207	0.838	0.879	48.257	.000
	GDP	0.667	1.724	0.100			
	Population	5.763E-06	0.146	0.885			
	Precipitation	195.749	0.821	0.421			
December	**Constant**	2113.687	0.275	0.786	0.838	34.605	.000
	GDP	0.848	1.867	0.077			
	Population	-2.338E-05	-0.496	0.625			
	Precipitation	655.826	2.104	**0.048**			

APPENDIX C:

Regression Analysis of Monthly Weather on Interaction of Monthly Apparel Retail and Wholesale sales.

Table C1.

Regression analysis of monthly average temperature on interaction of monthly apparel retail and wholesale sales.

Month	Variables	β	t value	p-value	R^2	F	Sig.
January	Constant	4071.804	0.381	0.708	0.898	31.625	.000
	GDP	0.380	1.508	0.149			
	Population	-1.804E-06	-0.079	0.938			
	Wholesale Sales	-0.012	-0.011	0.991			
	AvgTemp	-51.288	-0.171	0.867			
	Wholesale.Avg	0.005	0.160	0.875			
February	Constant	3992.934	0.569	0.577	0.948	65.814	.000
	GDP	0.386	1.457	0.162			
	Population	1.895E-05	0.879	0.391			
	Wholesale Sales	-0.747	-1.043	0.311			
	AvgTemp	-153.334	-0.860	0.401			
	Wholesale.Avg	0.020	1.010	0.326			
March	Constant	2742.399	0.203	0.841	0.940	56.026	.000
	GDP	0.836	2.325	0.032			
	Population	-1.816E-05	-0.600	0.556			
	Wholesale Sales	-0.024	-0.018	0.985			
	AvgTemp	68.009	0.216	0.831			
	Wholesale.Avg	-0.001	-0.027	0.979			
April	Constant	-2410.542	-0.135	0.894	0.936	52.352	.000
	GDP	0.833	3.258	0.004			
	Population	-1.980E-05	-0.903	0.378			
	Wholesale Sales	0.383	0.199	0.844			
	AvgTemp	200.115	0.611	0.549			
	Wholesale.Avg	-0.013	-0.341	0.737			
May	Constant	-1251.097	-0.061	0.952	0.950	67.920	.000
	GDP	0.537	2.041	0.056			
	Population	-5.117E-06	-0.245	0.809			
	Wholesale Sales	0.510	0.228	0.822			
	AvgTemp	97.344	0.297	0.770			
	Wholesale.Avg	-0.007	-0.183	0.856			

June	Constant	49721.285	2.003	0.060	0.946	62.677	.000
	GDP	0.507	1.506	0.150			
	Population	-2.374E-05	-0.924	0.368			
	Wholesale Sales	-4.725	-1.742	0.098			
	AvgTemp	-604.552	-1.794	0.090			
	Wholesale.Avg	0.073	1.894	**0.074**			
July	Constant	108159.225	4.385	0.000	0.969	111.255	.000
	GDP	1.143	5.997	0.000			
	Population	-5.473E-05	-3.243	0.005			
	Wholesale Sales	-9.214	-3.886	0.001			
	AvgTemp	-1302.746	-4.073	0.001			
	Wholesale.Avg	0.124	3.866	**0.001**			
August	Constant	29495.350	1.030	0.317	0.945	62.130	.000
	GDP	0.713	3.286	0.004			
	Population	-4.022E-05	-2.255	0.037			
	Wholesale Sales	-1.212	-0.437	0.668			
	AvgTemp	-242.211	-0.638	0.531			
	Wholesale.Avg	0.019	0.525	0.606			
September	Constant	42976.057	1.404	0.177	0.855	21.281	.000
	GDP	0.833	2.754	0.013			
	Population	-4.047E-05	-1.518	0.146			
	Wholesale Sales	-2.248	-0.795	0.437			
	AvgTemp	-469.491	-1.087	0.292			
	Wholesale.Avg	0.033	0.799	0.435			
October	Constant	7182.854	0.235	0.817	0.882	26.806	.000
	GDP	0.669	2.277	0.035			
	Population	-3.712E-05	-1.427	0.171			
	Wholesale Sales	0.593	0.232	0.819			
	AvgTemp	87.314	0.166	0.870			
	Wholesale.Avg	-0.008	-0.189	0.852			
November	Constant	10436.248	1.512	0.148	0.961	89.805	.000
	GDP	0.587	3.237	0.005			
	Population	-4.500E-05	-2.746	0.013			
	Wholesale Sales	1.039	1.546	0.139			
	AvgTemp	84.469	0.588	0.564			
	Wholesale.Avg	-0.014	-0.924	0.368			
December	Constant	29110.251	1.464	0.161	0.528	4.028	.013
	GDP	1.569	2.583	0.019			
	Population	0.000	-2.660	0.016			
	Wholesale Sales	1.479	0.655	0.521			

	AvgTemp	312.368	0.651	0.523
	Wholesale.Avg	-0.034	-0.595	0.559

Table C2.

Regression analysis of monthly maximum temperature on interaction of monthly apparel retail and wholesale sales.

Month	Variables	β	t value	p-value	R^2	F	Sig.
January	Constant	12418.844	0.816	0.425	0.901	32.770	.000
	GDP	0.448	1.757	0.096			
	Population	-8.444E-06	-0.366	0.719			
	Wholesale Sales	-0.766	-0.503	0.621			
	MaxTemp	-214.354	-0.657	0.520			
	Wholesale.Max	0.022	0.608	0.551			
February	Constant	5415.096	0.643	0.528	0.948	66.131	.000
	GDP	0.377	1.409	0.176			
	Population	1.889E-05	0.874	0.394			
	Wholesale Sales	-0.913	-1.044	0.310			
	MaxTemp	-147.793	-0.881	0.390			
	Wholesale.Max	0.019	1.030	0.316			
March	Constant	2218.937	0.139	0.891	0.941	57.768	.000
	GDP	0.836	2.374	0.029			
	Population	-1.844E-05	-0.621	0.542			
	Wholesale Sales	-0.031	-0.020	0.984			
	MaxTemp	65.225	0.223	0.826			
	Wholesale.Max	-0.001	-0.021	0.983			
April	Constant	5690.271	0.288	0.777	0.932	49.510	.000
	GDP	0.857	3.259	0.004			
	Population	-2.202E-05	-0.979	0.341			
	Wholesale Sales	-0.493	-0.230	0.821			
	MaxTemp	40.056	0.137	0.893			
	Wholesale.Max	0.003	0.104	0.918			
May	Constant	-4660.636	-0.260	0.798	0.950	68.174	.000
	GDP	0.549	2.109	0.049			
	Population	-5.032E-06	-0.241	0.812			
	Wholesale Sales	0.902	0.455	0.655			
	MaxTemp	126.720	0.532	0.602			
	Wholesale.Max	-0.011	-0.415	0.683			
June	Constant	61649.277	2.874	0.010	0.958	81.293	.000
	GDP	0.581	2.007	0.060			

	Population	-2.838E-05	-1.299	0.210			
	Wholesale Sales	-6.297	-2.696	0.015			
	MaxTemp	-645.439	-2.592	0.018			
	Wholesale.Max	0.080	2.853	**0.011**			
July	Constant	92741.669	4.562	0.000	0.971	119.404	.000
	GDP	1.135	6.227	0.000			
	Population	-5.234E-05	-3.264	0.004			
	Wholesale Sales	-7.630	-3.864	0.001			
	MaxTemp	-938.942	-4.161	0.001			
	Wholesale.Max	0.087	3.832	**0.001**			
August	Constant	25215.019	0.904	0.378	0.944	60.994	.000
	GDP	0.697	3.188	0.005			
	Population	-3.953E-05	-2.185	0.042			
	Wholesale Sales	-0.807	-0.307	0.763			
	MaxTemp	-157.500	-0.502	0.622			
	Wholesale.Max	0.012	0.399	0.694			
September	Constant	41138.054	1.220	0.238	0.836	18.318	.000
	GDP	0.830	2.688	0.015			
	Population	-4.130E-05	-1.488	0.154			
	Wholesale Sales	-2.254	-0.726	0.477			
	MaxTemp	-365.372	-0.905	0.377			
	Wholesale.Max	0.028	0.721	0.480			
October	Constant	16818.417	0.579	0.570	0.885	27.692	.000
	GDP	0.731	2.679	0.015			
	Population	-4.273E-05	-1.696	0.107			
	Wholesale Sales	-0.051	-0.020	0.984			
	MaxTemp	-58.960	-0.144	0.887			
	Wholesale.Max	0.003	0.071	0.944			
November	Constant	11968.561	1.590	0.129	0.958	82.928	.000
	GDP	0.571	3.117	0.006			
	Population	-4.339E-05	-2.586	0.019			
	Wholesale Sales	0.833	1.087	0.292			
	MaxTemp	32.789	0.255	0.802			
	Wholesale.Max	-0.007	-0.518	0.611			
December	Constant	34430.974	1.327	0.201	0.519	3.886	.015
	GDP	1.613	2.547	0.020			
	Population	0.000	-2.535	0.021			
	Wholesale Sales	0.715	0.233	0.819			
	MaxTemp	121.058	0.234	0.818			
	Wholesale.Max	-0.011	-0.182	0.858			

Table C3.

Regression analysis of monthly minimum temperature on interaction of monthly apparel retail and wholesale sales.

Month	Variables	β	t value	p-value	R^2	F	Sig.
January	Constant	1113.139	0.176	0.862	0.898	31.780	.000
	GDP	0.350	1.389	0.182			
	Population	1.944E-06	0.086	0.933			
	Wholesale Sales	0.208	0.354	0.727			
	MinTemp	34.931	0.143	0.888			
	Wholesale.Min	-0.003	-0.098	0.923			
February	Constant	2228.670	0.405	0.690	0.947	64.191	.000
	GDP	0.409	1.547	0.139			
	Population	1.712E-05	0.797	0.436			
	Wholesale Sales	-0.480	-0.927	0.366			
	MinTemp	-135.389	-0.737	0.471			
	Wholesale.Min	0.018	0.866	0.398			
March	Constant	4066.756	0.393	0.699	0.937	53.570	.000
	GDP	0.829	2.250	0.037			
	Population	-1.747E-05	-0.562	0.581			
	Wholesale Sales	-0.080	-0.083	0.935			
	MinTemp	44.254	0.138	0.892			
	Wholesale.Min	0.001	0.032	0.975			
April	Constant	-8818.421	-0.602	0.555	0.941	56.985	.000
	GDP	0.821	3.368	0.003			
	Population	-1.791E-05	-0.853	0.405			
	Wholesale Sales	1.109	0.721	0.480			
	MinTemp	420.632	1.202	0.245			
	Wholesale.Min	-0.035	-0.906	0.377			
May	Constant	9052.206	0.442	0.663	0.950	68.335	.000
	GDP	0.531	1.992	0.062			
	Population	-6.394E-06	-0.308	0.761			
	Wholesale Sales	-0.584	-0.262	0.796			
	MinTemp	-86.175	-0.208	0.837			
	Wholesale.Min	0.015	0.322	0.751			
June	Constant	25407.166	1.083	0.293	0.940	56.077	.000
	GDP	0.243	0.691	0.498			

	Population	-2.728E-06	-0.101	0.921			
	Wholesale Sales	-1.445	-0.590	0.562			
	MinTemp	-382.884	-0.977	0.342			
	Wholesale.Min	0.034	0.795	0.437			
July	Constant	108411.088	3.384	0.003	0.960	85.761	.000
	GDP	1.093	5.036	0.000			
	Population	-5.348E-05	-2.724	0.014			
	Wholesale Sales	-9.404	-3.103	0.006			
	MinTemp	-1575.623	-3.158	0.005			
	Wholesale.Min	0.153	3.094	**0.006**			
August	Constant	15410.140	3.465	0.003	0.943	78.781	.000
	GDP	0.659	3.434	0.003			
	Population	-3.679E-05	-2.155	0.044			
	Wholesale Sales						
	MinTemp	-68.706	-1.157	0.262			
	Wholesale.Min	0.004	1.883	**0.075**			
September	Constant	38691.535	1.550	0.139	0.875	25.277	.000
	GDP	0.789	2.695	0.015			
	Population	-3.691E-05	-1.463	0.161			
	Wholesale Sales	-1.874	-0.814	0.426			
	MinTemp	-516.941	-1.206	0.243			
	Wholesale.Min	0.035	0.838	0.413			
October	Constant	-3090.773	-0.155	0.878	0.887	28.326	.000
	GDP	0.583	2.166	0.044			
	Population	-3.058E-05	-1.272	0.220			
	Wholesale Sales	1.198	0.704	0.490			
	MinTemp	334.810	0.761	0.457			
	Wholesale.Min	-0.025	-0.665	0.515			
November	Constant	9482.742	1.672	0.112	0.964	97.223	.000
	GDP	0.578	3.276	0.004			
	Population	-4.464E-05	-2.818	0.011			
	Wholesale Sales	1.109	2.164	0.044			
	MinTemp	144.343	0.974	0.343			
	Wholesale.Min	-0.021	-1.384	0.183			
December	Constant	29714.825	2.046	0.056	0.541	4.246	.010
	GDP	1.574	2.675	0.015			
	Population	0.000	-2.806	0.012			
	Wholesale Sales	1.520	1.007	0.327			
	MinTemp	427.435	0.989	0.336			
	Wholesale.Min	-0.047	-0.933	0.363			

Table C4.

Regression analysis of monthly precipitation on interaction of monthly apparel retail and wholesale sales.

Month	Variables	β	t value	p-value	R^2	F	Sig.
January	Constant	2215.374	0.525	0.606	0.901	32.776	.000
	GDP	0.307	1.241	0.231			
	Population	7.136E-06	0.310	0.760			
	Wholesale Sales	-0.029	-0.079	0.938			
	Precipitation	-565.964	-0.507	0.618			
	Wholesale.Prec.	0.080	0.591	0.562			
February	Constant	-2287.557	-0.462	0.650	0.946	62.466	.000
	GDP	0.471	1.667	0.113			
	Population	8.171E-06	0.385	0.705			
	Wholesale Sales	0.294	0.684	0.503			
	Precipitation	1429.138	0.691	0.499			
	Wholesale.Prec.	-0.163	-0.745	0.466			
March	Constant	4466.794	0.555	0.586	0.933	50.452	.000
	GDP	0.779	2.088	0.051			
	Population	-1.441E-05	-0.458	0.652			
	Wholesale Sales	0.107	0.173	0.865			
	Precipitation	205.681	0.083	0.935			
	Wholesale.Prec.	-0.052	-0.214	0.833			
April	Constant	13715.345	2.229	0.039	0.926	44.744	.000
	GDP	0.994	3.604	0.002			
	Population	-2.938E-05	-1.228	0.235			
	Wholesale Sales	-0.847	-1.635	0.119			
	Precipitation	-1677.260	-1.066	0.300			
	Wholesale.Prec.	0.189	1.050	0.307			
May	Constant	8812.224	2.330	0.032	0.956	78.002	.000
	GDP	0.585	2.408	0.027			
	Population	-1.363E-05	-0.678	0.506			

	Wholesale Sales	-0.187	-0.760	0.457			
	Precipitation	-901.181	-1.650	0.116			
	Wholesale.Prec.	0.111	1.775	**0.093**			
June	Constant	-3286.768	-0.610	0.550	0.957	79.230	.000
	GDP	0.380	1.374	0.186			
	Population	-9.939E-06	-0.478	0.638			
	Wholesale Sales	1.290	3.063	0.007			
	Precipitation	2702.990	2.105	0.050			
	Wholesale.Prec.	-0.301	-2.331	**0.032**			
July	Constant	3215.124	0.917	0.371	0.967	106.582	.000
	GDP	1.161	5.949	0.000			
	Population	-5.384E-05	-3.121	0.006			
	Wholesale Sales	0.641	2.237	0.038			
	Precipitation	3049.551	3.188	0.005			
	Wholesale.Prec.	-0.260	-2.691	**0.015**			
August	Constant	11978.583	2.291	0.034	0.942	58.293	.000
	GDP	0.630	2.822	0.011			
	Population	-3.508E-05	-1.796	0.089			
	Wholesale Sales	0.170	0.341	0.737			
	Precipitation	-349.469	-0.163	0.873			
	Wholesale.Prec.	0.025	0.129	0.898			
September	Constant	13671.022	2.116	0.049	0.835	18.262	.000
	GDP	0.654	2.393	0.028			
	Population	-3.097E-05	-1.177	0.254			
	Wholesale Sales	-0.176	-0.426	0.675			
	Precipitation	-1143.560	-0.636	0.533			
	Wholesale.Prec.	0.078	0.444	0.662			
October	Constant	16369.264	3.745	0.001	0.899	32.106	.000
	GDP	0.681	3.039	0.007			
	Population	-2.904E-05	-1.288	0.214			
	Wholesale Sales	-0.526	-1.373	0.187			

	Precipitation	-2242.344	-1.663	0.114			
	Wholesale.Prec.	0.214	1.720	0.103			
November	Constant	9073.594	4.113	0.001	0.974	133.869	.000
	GDP	0.521	3.931	0.001			
	Population	-4.068E-05	-3.229	0.005			
	Wholesale Sales	0.902	7.051	0.000			
	Precipitation	1673.828	3.860	0.001			
	Wholesale.Prec.	-0.169	-3.981	**0.001**			
December	Constant	35816.424	3.768	0.001	0.580	4.962	.005
	GDP	1.351	2.318	0.032			
	Population	0.000	-2.540	0.021			
	Wholesale Sales	0.840	1.281	0.216			
	Precipitation	533.341	0.378	0.710			
	Wholesale.Prec.	-0.130	-0.822	0.422			

VITA

Md. Tahmidul Islam Molla completed his Master's from University of Missouri (MU) in May, 2016. Earlier on, he has completed his Bachelor of Science in Textile Technology with major in Garments Technology from Bangladesh University of Textiles, the only university of its kind in the country in June 2011. Later, he has completed his MBA with major in Quantitative Business Analysis and minor in Marketing at Institute of Business Administration, Jahangirnagar University from January 2012 to April 2014. To articulate his profession, he worked as a Teaching Assistant from fall 2014 to spring 2016 at MU. Prior to that he worked as a lecturer in Green University of Bangladesh from spring, 2012 to summer, 2014. He also worked as a Merchandiser in Opex and Sinha Textile Group which is one of the largest and export oriented apparel industries in Bangladesh from April, 2011 to December, 2011. Md. Tahmidul Islam Molla received ITAA Sara Douglas Fellowship for Professional Promise from International Textile and Apparel Association (ITAA) and Adeline M. Hoffman Scholarship from the College of Human Environmental Sciences at MU for his exceptional academic records. He has demonstrated excellent leadership skills through his involvement with different organizations. His research interest include global textile and apparel industry, global apparel supply chain, wearable technology, apparel manufacturing technology, operations management, international trade analysis and sourcing strategies.