ON WEATHER SENSITIVITY IN RETAIL INDUSTRY

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ABSTRACT

Weather affects four basic purchasing decisions: what, where, when and in what quantity to buy. Even though retail sector is not traditionally perceived as weather sensitive sector, results of studies show that weather has significant effect on store traffic and sales of many product categories and store types. That is why further studies and discussions on weather sensitivity in retail are needed. The paper gives an overview of theories on the nature and magnitude of weather effects on consumer spending and retail sales. Further is given the review of study results on weather sensitivity in retail and weather derivatives are presented as a new tool of protection against adverse weather effects. The purpose of the paper is to raise awareness about weather risk in retail.

KEYWORDS: Weather Risk, Weather Sensitivity, Retail, Weather Derivatives

INTRODUCTION

Weather determines what shall we wear and eat, how shall we travel, where shall we spend our holiday, even what shall we do every single day. Furthermore, weather affects four basic purchasing decisions: what, where, when (Agnew and Thornes, 1995) and in what quantity to buy (Kirk, 2005). Retail sector is not traditionally perceived as weather sensitive sector, so there are only a handful of authors who studied weather sensitivity in retail. Weather sensitivity or weather exposure can be defined as sensitivity of sale, production or costs to meteorological elements such as temperature, sunshine, rainfall, snowfall, wind, etc. If volatility of output of certain sector is caused by changes in weather, sector is said to be weather sensitive. Uncertainty in future cash flows as a result of uncertainty of future weather is defined as weather risk. Lazo et al. (2011) conducted a national study on weather sensitivity of the whole U.S. economy and found that 2.3% of retail output and 2.2% of wholesale output are weather sensitive. The overall weather sensitivity of the U.S. economy amounts to 3.4%. Retail sector shows low relative weather sensitivity compared to mining, agriculture and energy sectors. However, assessed by absolute terms, retail sector shows greater sensitivity than traditionally perceived weather sensitive sectors which offers a sound argument for weather risk management in retail.

Perceptions of weather effects on retail sales are somewhat divided. Many retail managers often blame weather for poor sales, but only some actively try to manage weather risk exposure given that many retailers offer diversified assortments thus mitigating weather effect on sales. That is why weather risk in retail needs to be further studied and discussed. The purpose of the paper is to give theoretical background as well as empirical findings on weather sensitivity in retail and to provide firm foundation for further studies on weather sensitivity in retail.

The rest of the paper is organized as follows. Next section describes the theories on the nature and magnitude of weather effects on consumer spending and retail sales.

Third section gives an overview of relevant empirical studies on weather effects in retail. Fourth section discusses the need for weather risk management in retail and proposes weather derivatives as potential risk mitigating tool. Fifth section gives concluding remarks.

THE THEORIES OF WEATHER EFFECTS ON CONSUMER SPENDING AND RETAIL SALES

The theories of weather impact on the consumer spending and retail sales can be divided into two groups. First group includes theories that explain the nature of the impact i.e. why and how weather affects the consumption and sale. Second group includes theories that explain the magnitude of the impact i.e. to what extent weather affects the consumption and sale. Furthermore, the impact of weather depends on whether the observed product shows strong seasonality in sales and whether it is a product that one really needs or would just like to have.

The Theories Regarding the Nature of Weather Effects on Consumer Spending and Retail Sales

According to Steele (1951) and Murray et al. (2010) four theories can be defined regarding the nature of weather effects on retail sales. According to the first theory, weather can create such conditions that consumers feel uncomfortable to leave their homes and go to the store. Cold temperatures and precipitation my hinder travel, keeping consumers away from stores. The results of a survey conducted among consumers show that snow acts as the strongest disincentive on consumers - 45% of respondents state they will not go shopping when snowing, 37% of respondents will not go shopping when raining, 35% will not go shopping in severe cold and 30% will not go shopping in excessive heat (Kirk, 2005). Starr-McCluer (2000) calls such impact of weather "the convenience effect" and states that excessive cold and heavy rain reduce sales of products purchase of which is easily deferrable, such as furniture and apparel. Moreover, research shows that rain has negative impact on shopping centre attendance (Parsons, 2001).

According to the second theory, weather can physically prevent consumers from going shopping. For example, heavy snowfall can result in such effects. Because certain weather hampers traffic mobility, the occurrence of adverse weather will not have the same impact on all stores but the impact will depend on the location of the store (Agnew and Thornes, 1995; Ryski, 2011). Poor weather can have adverse effect on the number of shoppers in large format food stores (supermarkets and hypermarkets) located on the edges of urban areas and, on the contrary, favorable effect on the small neighborhood stores (Agnew and Thornes, 1995).

The third theory suggests that weather has a psychological effect on consumers that causes changes in their shopping behavior. It is known that low levels of humidity, high levels of sunlight, high pressure and high temperature are associated with good mood and that people in positive mood are more likely to self-reward and to spend more money. Results of Murray et al. (2010) confirm that sunlight has positive effect on consumer spending, whereas Sun et al. (2009) found that bad weather characterized by low temperatures, decreasing sunlight and increasing precipitation has favorable effect on negative hedonic consumption (consumption of alcohol and cigarettes).

The forth theory suggests that weather does not affect the sale of all product categories in the same way but the impact depends on the special characteristics of the product category. Certain weather can have positive effect on sale of one group of products and simultaneously negative or neutral effect on other group of products. For example, temperature has positive effect on sales of ice creams and soft drinks, rainfall has positive effect on sales of umbrellas and raincoats, snow and frost have positive effect on sale of salt for gritting roads, etc. Thus it is incorrect to make deductive conclusions about weather sensitivity of certain types of stores (Starr-McCluer, 2000) or certain categories of products (Agnew and Thornes, 1995; Agnew and Palutikof, 1999) based on the weather sensitivity of the total national retail sales or total store sales.

The sales of weather sensitive products oscillate during the year depending on the season and weather. For example, food and drink products are largely purchased in the summer, whereas clothing products largely in the winter (Roslow et al., 2000). Parsons (2001) argues that the seasonal effect on sales is manifested as the product-based influence

(e.g., sunscreen sales in the summer, heaters sale in the winter) and as the weather-based influence (if low temperatures enhance sales, the effect of weather will be stronger in winter because it is colder in winter). Results of empirical studies show that a large number of products entail seasonality in sales, such as soft drinks (Agnew and Thornes, 1995; Blom, 2009); beer (Silm and Ahas, 2004); clothing (Bahng and Kincade, 2012); car batteries (Kirk, 2005); herbs, vegetables and flowering annual plants (Behe et al., 2012) and building materials (Starr-McCluer, 2000). As the main causes of seasonality authors state weather and holidays.

The Theories Regarding the Magnitude of Weather Effects on Consumer Spending and Retail Sales

Kirk (2005) and Niemira (2005) suggest three theories that explain the magnitude of weather effects on consumer spending and retail sales. According to the first theory weather has temporary impact and adverse weather merely delays the sales in time but does not impact the overall consumption. First theory can be referred to as the Purchase Timing Theory according to which reduced sales in the current period will be offset by sales increase in future periods. First theory explains well the sale of products use of which is seasonal, so the beginning and the end of season are defined by the appropriate weather conditions. For example, lawn mowers and gardening tools are commonly purchased early in the spring before the start of the gardening season. However, if warm temperatures and rain occur later than usual, the sale of gardening tools will also occur later than usual (Murray et al., 2010). In other words, the sales will be postponed to a later period but will not be permanently lost. Deviation from the usual weather also delay the sales of seasonal garments (Bahng and Kincade, 2012) and durable goods such as cars, furniture, consumer electronics and building materials (Starr-McCluer, 2000).

According to the second theory, adverse weather leads to a permanent loss of sales. The sales occur neither in the current nor in the future periods but completely fail. Second theory can be referred to as the Permanent Impact Theory and explains well the effects of weather on sales of products that are mostly bought impulsively. Research results of Agnew and Thornes (1995) and Ramanathan and Muyldermans (2010) suggest that the refreshing drinks are bought impulsively during the hot weather. Accordingly, Blom (2009) confirmed there is no lagged effect of temperature on the out-of-store sales of soft drinks. More generally, it can be argued that weather has instantaneous and permanent effect on sales of products that are consumed in rather short period of time, i.e. non-durables, such as food and gasoline (Starr-McCluer, 2000).

Third theory suggests that weather has far more significant role in the overall economy than is stated by the previous two theories. According to the third theory, the economic downturns occur in the years with unfavorable weather conditions. Third theory can be referred to as the Weather/Consumption Cycle and applies to the countries with large shares of weather sensitive industries, such as agriculture, in total national output. For example, results of study conducted for Morocco show that absence of rain is associated with diminishing of national output (Dischel, 2002). However, when considering weather effects in retail, one can expect first two theories to prevail.

Kirk (2005) further explains that when considering the magnitude of the weather impact on consumption and sale, one needs to distinguish between a "need" and a "want" product. Need products are necessary products purchase of which cannot be deferred, whereas want products are the ones consumers would like to have. The car battery is an example of a need product and electronic appliances are an example of want products. Kirk (2005) concludes that seasonal need items are the most weather sensitive product categories that show the greatest volatility in sales year after year. Ryski (2011) agrees that the magnitude of weather impact on sales depends on the necessity of having a certain good, but uses the terms "necessities" and "deferrable purchases" instead. According to Ryski (2011) store traffic and sales can be relatively

unaffected by weather conditions if retailer offers what customers need. However, it should be kept in mind that purchase of almost any item can be deferred, at least over the very short term. All food products are an example of products purchase of which cannot be deferred, at least not for a long time. But that does not mean that food retailers are unaffected by bad weather. Precisely because purchase cannot be deferred, customers are more inclined to shop in smaller neighborhood stores. On the other hand, garments can be seen as both need and want items with easily deferrable purchase over a short term. Kirk (2005) argues that age and gender of customers affects the perception of clothing as a need or a want product. Older shoppers and males are more likely to wait with the purchase of seasonal garments until the appropriate weather occurs. As opposed to them, younger shoppers and females buy early in the season.

THE REVIEW OF STUDIES ON WEATHER EFFECTS IN RETAIL

Adverse weather is often blamed for poor store traffic and low sales revenue, but despite that the problem of weather risk in the retail remains insufficiently studied subject in scientific researches. Below is given an overview of empirical studies that examined the impact of weather in retail.

Starr-McCluer (2000) examined the effects of temperature on total U.S. retail sales. The analysis was performed at the aggregate level of sales and further refined by the type of retail capacity. The results show a noticeable seasonality in sales, both at the aggregate level and at the level of specific retail stores types. Aggregate sales peak in November and December which can be attributed to holidays. Car sales reach peak in May and June, and bottom in December and February. Construction equipment sales are the highest in the period from May to August, and the lowest in January and February. Gasoline stations stores peak in July and August during the summer vacation. It is noticeable that the seasonality of sales is often caused by weather. On the other hand, food products show relatively balanced sales during the year with a slight increase during the holiday season in December. The results of regression analysis show that temperature has both current and lagged effect on sales. The unusually low temperatures cause drop in total national retail sales in the current month and sales growth in the next two months which indicates existence of wash-out effects in retail. Likewise, unusually warm temperatures cause an increase in total retail sales in the current month and a decrease in the following month. Results also show that weather effect is not the same in all types of retail stores but it depends on the store assortment.

Agnew and Palutikof (1999) examined the effect of temperature, sunlight and precipitation on the total U.K. retail sales and sales of specific product categories: clothing and footwear, fruit and vegetables, beer and wine. Separate regression models were defined for each month of the year and results show that the sign of the impact of weather variables and the proportion of sales volatility explained by weather variables are not constant throughout the year, but vary between months and product categories.

Agnew and Thornes (1995) conducted a survey study among British food retailers and results show that weather sensitivity depends on the type of store. During heavy rain, wind, snow or excessive heat, consumers prefer to shop in local neighborhood stores. Further on, results imply seasonality in sales but with peaks and bottoms occurring in different periods for different food categories. Dairy products show increase in sales during the summer months. Fruit and vegetable sales peak during the spring and summer months, followed by a sharp drop in autumn months. Sales of bakery products reach their high in August, whereas sales of meat products reach their peak during the holiday season in December and their minimum in summer. The respondents in the survey perceive temperature and sunshine as the most important weather variables affecting the sale of food products. On the other hand, retail managers believe that rain, wind, humidity, fog and frost have minimal impact on food sales. Moreover, retail managers perceive beverages, especially soft drinks, and ice

cream as product categories particularly sensitive to weather. Some notice that during the summer when temperature rises above 20°C, the demand for soft drinks increases by 40%.

Steele (1951) studied the impact of snowfall, rainfall, temperature, wind speed and sunshine on the sale of department stores in the period of seven weeks before Easter. The results comply with the insights of Niemira (2005) that earlier in the year Easter occurs, lesser is the positive holiday effect on sales. In other words, there will be an increase in sales, but the increase will be smaller in comparison with the increase in sales when Easter comes later in the year. Temperature and sunshine show positive impact, whereas rain, wind and snow show negative impact. Among the analyzed variables, snow has the strongest impact on department store sales.

Parsons (2001) studied the effect of weather on shopping center attendance in New Zealand. Dependent variable was total daily number of visitors and following weather variables were observed as independent variables: maximum daily temperature, total daily rainfall, sunshine hours and relative humidity. Only the colder part of the year from September to February was observed. Results show that temperature and rainfall have negative impact on number of visitors, whereas sunshine hours and humidity do not show significant effect at all. Obtained rain effect is expected and compliable with aforementioned convenience effect of Starr-McCluer (2000). However, temperature effect is contrary to expectations, especially because analysis covered colder half of the year, so results should be taken with precaution and further studies on the subject are needed.

Behe et al. (2012) studied the impact of weather conditions on the sale of spring herbs, vegetables and flowering annuals in the period from April to June. Sales data were collected from a retail chain that owns 42 stores in the U.S.A and two regression models were defined: one that describes the impact of weather on the sales of herbs and vegetables and the other that describes the impact of weather on the sales of flowering annuals. The impact of following weather variables was analyzed: maximum daily temperature, minimum daily temperature, rainfall and solar radiation. The results of both models show positive impact of maximum temperature and negative impact of minimum temperature and solar radiation, whereas rain shows no significant effect on sales of herbs, vegetables and flowering annuals.

Bahng and Kincade (2012) studied the effect of temperature on the sale of female garments. Sales of garments are generally affected by calendar seasons, whereas the sales of female garments are additionally complicated by frequent changes in fashion trends (Bhardwaj and Fairhurst, 2010). The results indicate that weather defines the beginning and the end of a season and that transitional (spring and fall) selling seasons last up to 12 weeks, while summer and winter selling season can last up to 20 weeks. Further on, drastic changes in temperature result in an increase of seasonal garments sales. For example, a sharp drop in temperature during the autumn and winter season is associated with an increase in sales of winter clothing items. Temperature value of 0°C acts as a critical threshold level. Accordingly, a strong increase in temperature during the spring and summer season is associated with an increase in sales of lighter garments. Analysis implies that unusual weather conditions can delay the beginning of a selling season. For example, colder than usual March defers sales of female spring garments until the more usual spring temperatures prevail.

Conlin et al. (2007) also studied the impact of weather on the sales of apparel, but not on the in-store sales yet on the catalog sales. Results show that low temperatures are associated with high return rate. The lower the temperature on the day of placing an order, the greater is the likelihood that the customer will return the product. Such results can be explained by the psychological effect of weather on customers and imply that low temperature has negative effect on customers` mood making them more indecisive.

Murray et al. (2010) further investigated the effects of weather on consumer spending assuming mediating

influence on mood. The study builds on the results of Underwood et al. (1973) who found that people buy more when are in good mood because they are prone to self-rewarding. Murray et al. (2010) observed the impact of temperature, rainfall, snowfall, sunshine hours, wind speed, humidity and air pressure on daily sales of specialized tea store. Results show that only temperature, snow, sunlight and humidity have significant impact on the sales of tea, negative in sign, whereas other observed weather variables have no significant effect on sales. Given that tea is a product category that is largely consumed and purchased when weather is cold, results are expected. It is reasonable to expect increase in tea sales as temperature and humidity fall. Likewise, negative impact of snow on tea sales is in compliance with findings of Steele (1951) and Ryski (2011) that heavy snowfall impedes traffic mobility and discourages people from going shopping. To test whether mood mediated the impact of weather on consumer spending, Murray et al. (2010) conducted a longitudinal questionnaire study among buyers as well. Respondents were asked to answer questions about their mood, consumption and purchase of tea during the 20 day period in March. Based on the panel regression analysis, authors confirm that high levels of sunlight and low levels of relative humidity have positive impact on the mood of consumers which in turn has positive impact on retail sales of tea.

The variability in weather conditions can cause two types of risk to which retailers are exposed when planning sales: the risk of over-stocking and the risk of under-stocking (Agnew and Thornes, 1995). If occurrence of unusual weather causes sales to decline, there is a risk of excess stocks resulting in lack of shelf space and price reductions. Items with short shelf life such as fruits, vegetables and other fresh products are particularly exposed to risk of over-stocking. If occurrence of unusual weather causes sales to rise, there is risk of insufficient stocks resulting in lost sales, poor store image and possibly loss of customers. For example, unanticipated excessive heat would cause insufficient stocks of beverages.

WEATHER RISK MANAGEMENT IN RETAIL WITH WEATHER DERIVATIVES

Retailers often blame the weather for poor sales, but the review of literature found a handful of studies that analyze the impact of weather in retail. Such discrepancy can be explained by the fact that many retailers are non-specialized and offer diverse assortment of products which results with diversified and thus mitigated effects of weather on retail sales. Myers (2008) states that product line diversification is one of the basic tools for weather risk management in practice. Advantages of product line diversification are that it is easy to implement and that it is inherent in operations of many retailers. At the same time, product line diversification possesses many disadvantages compared to the other weather risk mitigating tools. The main disadvantage of product line diversification is risk retention within the company as opposed to the risk transfer tools that allow for risk transfer to other parties able to manage it more effectively.

Recent literature proposes weather derivatives as sophisticated protection against non-catastrophic weather risk (Brockett et al., 2005). Weather derivatives are financial contracts traded on derivatives markets, designed to provide indemnity in the case of adverse weather and as such serve as hedge against weather risk. The underlying asset of weather derivatives is weather index and, since weather is not a physical good, there is no spot market for weather indices. However, even though weather cannot be physically traded, weather derivatives market allows for exchange of financial exposure to weather (Lazibat and Stulec, 2011). The purpose of weather derivatives application is to smooth revenues, cover excess costs, reimburse lost opportunity costs, stimulate sales and diversify investment portfolios (Leggio, 2007). Weather derivatives are primarily hedge against non-catastrophic weather risk, i.e. small deviations from usual weather such as colder than usual summer or warmer than usual winter. Beside temperature deviations, weather derivatives can provide hedge against deviations from usual rainfall and snowfall, wind speed, number of sunshine hours, days in which frost or fog were recorded, etc.

Several cases of weather derivatives application in retail have been recorded in practice. Manufacturer and retailer of winter apparel Weatherproof Garment Company bought the protection against warm winters in the form of weather derivative (Morrison, 2009). Canadian snowmobile manufacturer and retailer Bombardier used weather derivatives to cover the costs of promotional campaign. It promised its customers a discount of $1,000 if the snowfall in certain parts of the country does not reach a predetermined level (Myers, 2008). Bombardier's goal was to protect customers from the risk of a mild winter and a perception of wasted money. To cover the cost of price reductions, Bombardier bought the weather derivative with snowfall as underlying weather index. Similarly, tire manufacturer Michelin guaranteed its buyers of winter tires a refund in the amount of $50 if the average winter temperature would not fall beneath 7°C. A refund was financed from indemnity paid by the weather derivative (Huault and Rainelle, 2011).

CONCLUSIONS

Results of many empirical studies show that weather significantly affects store traffic and retail sales. Further on, results imply that weather sensitivity is not uniform but varies between months, product categories and store types. That is why deductive conclusions about weather sensitivity cannot be made. Assessment of weather sensitivity should rather be carried out for each product category and store type separately.Having understood the nature and magnitude of weather impact on sales of certain product categories and store types, retailers may implement the appropriate strategy of protection against adverse weather conditions. Lowering the product price is effective in order to achieve planned sales when adverse weather occurs early in the season. Price reductions can also be effective when adverse weather occurs late in the season, as to avoid the storage costs until the next year. In case of favorable weather conditions, retailers may consider additional marketing activities to inform or remind consumers where they can buy necessary products.

Many retailers are unaware of weather effects on their sales or are under impression that weather exposure cannot be managed. However, even though weather cannot be managed, one can manage i.e. trade its financial exposure to weather. Weather derivatives, a new form of financial derivatives, offer a flexible risk mitigating solution. Indemnities provided by weather derivatives serve to reduce the volatility i.e. uncertainty of sales revenues. Several examples of weather derivatives usage as coverage of costs of promotional campaigns are recorded in practice as well.   It can be argued that ever more pronounced climatic change that causes weather variability and economic crisis that forces companies to strengthen their revenues management will positively contribute to applications of weather risk management tools in retail, foremost of weather derivatives.

Further research on weather effects on consumer spending and retail sales are needed as to provide more comprehensive insights on weather risk in retail. Moreover, academics and experts on weather risk management should continue to educate retail managers about weather risk and tools of weather risk management.

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