

What Are the Impacts of Weather-Induced Mood in The Impulse Consumption Retail Activity in Brazil? Considering Online and Physical Environments?

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Abstract

Beautiful sunny day and happiness. Cloudy rainy day and bad mood. This paper examines the relation between meteorological factors with the purchase decision making at the retail segment in Rio de Janeiro. To review correlation and causality between meteorological factors such as humidity, average temperature, wind speed and precipitation, with the purchase decision making at the online and physical environments retail segment in Rio de Janeiro, using three years of daily observations of the official climate agency and a convenience store sales data are the main goals of this study. If usually is made the link of sunny day to happy beautiful moments and grey raining days to the opposite, what are the impacts of weather-induced mood in the impulse consumption in Brazil, especially at Rio de Janeiro city considering the retail sector?

Keywords: weather-induced mood, consumer behavior, purchase decision, impulse consumption, tropical country.

1. Introduction

Happiness and impulse to spend. Many classical business and economic theories disconsider these factors relation and assume that the agents are perfectly rational, always behaving in order to perfectly maximize their decisions and patrimony (Varian, 2012). No correlation between mood and decision making would be observed if taken as irrevocative true, being many times disregarded the idea that personal psychology can be harmful at the moment of making the best decisions by individuals, given the plenty of information available and maximization goals perfectly rational and intrinsic to human conduct (Pech and Milan, 2009). At the rationality concept it is considered the set of values and actions socially taken as coherent, following the probability theory and logic, with low or no influence by external variables, predictable with well known empirical observations. Meanwhile, psychology as a science has an extensive history with tangencies at economic studies and during the 1930's John Maynard Keynes described what he called the animal spirit, a counterpoint to the classical and perfectly rational homo economicus (Keynes, 1936), being one of the precursors in taking light at the behavioural economics that laid foundations so further studies could identify how people think and decide in the real world. Keynes concludes that the replacement of the perfectly rational homo economicus by an agent consistently affected by bias, mood and limited knowledge would represent an important step for deeper research in which the real world could be better understood, adding factors like mood and its impacts on purchase decisions, for example.

But how does weather impact people's mood? Many studies correlate these factors, bringing the concept of weather-induced mood, representing the mood induced by the external environment weather factors such as precipitation, temperature, wind velocity, humidity and other, influencing behaviour outcomes. The consideration of this effect is observed in several researches like the assets pricing literature, for example. Diverse articles review the effect that mood induced by weather has on stock returns, corroborating hypothesis that stock returns are positively related to happiness and sunny days (Saunders, 1993; Kamstra et al., 2003; Hirshleifer and Shumway, 2003; Goetzmann and Zhu, 2005; Goetzman et al., 2014). All these authors conclude that weather-induced mood affects behavior, with sunny hot days related to good humor and more propention to trade in the stock market, which in turn influences financial market dynamics and the stock market itself byond econometric prevision for stock returns. Also regarding weather and agents' behaviour, Apergis, Artikis and Mamatzakis (2011) correlated the propention of bank managers to approve or not loans and to commercialize financial products to variables such as temperature and precipitation, concluding that the results of temperature shocks on bank loans were negative, while the impacts of snow and precipitation

were positive as another effect of weather-induced mood. In parallel, to deeper review the impacts of weather-induced mood outside the context of financial markets and explore the consequences of weather patterns at the retail activity represents an interesting potential channel, to be investigated whether weather conditions tend to affect mood and actions of the decision maker in terms of acquisitions at the retail segment.

The author of this study have a previous research approved to be part of the British Academy of Management (BAM) 2021 Conference in which the influences of weather-induced mood at the purchase decision considering the retail activity in Brazil was the main focus, implying an association between weather conditions and its mood-influencing driving to purchase. However, on that case he considered temperature and precipitation level during 5 years and the implications by correlation and causality in sales at a construction articles street store in Rio de Janeiro and perceived that one of the limitations of the study was driven by the fact that in general construction articles tends to be a programmed acquisition and consequently the impact of mood on its purchase tends to be lower in comparison to impulse consumption goods. To cover this gap, the author considered the same hypothesis that good weather conditions, represented by sunny hot days, positively affect retail sales, with this parallel for the opposite too, but regarding data, it's was taken three years of secondary data from a convenience street store located in Rio de Janeiro, in which its mainly commercialized alcoholic drinks, snacks and candies, and also weather historical data for the same city and period extracted from Instituto Nacional de Meteorologia (INMET), the official temperature and precipitation measure in the country. Does the consumer feel good-humored and intend to do more acquisitions on a sunny hot day? Is the opposite also true, with negative effects on sales on a cold rainy day? Since the considered convenience store has physical and online sales with delivery, a split between these kind of sales was done to review if are there differences at consumer behaviour at the store of buying online. The research suggested that in fact weather impacts people's mood and by consequence their behaviour and to deeper review what are the impacts of weather-induced mood as a specific behaviour and its impacts at decision making process at the impulse consumption retail activity in Brazil, taking temperature, precipitation, wind, humidity, quantity and amount of sales transactions on a daily basis for three years is the main goal of this paper. In comparison to the same author's previous review considering construction material articles, in general demanded under specific situations when constructing or repairing something, the sales data from a convenience store would better represent impulse consumption, more affected to mood and intention to buy without a previous specific need, with the additional variables of being online or presential acquisitions.

From the results of this investigation it was possible to observe that the temperature variation and humidity have more causality relation with the online sales two days after observed, probability related to the tropical climate of Rio de Janeiro city, since hotter and humid days result in a natural consumption of products than can reduce the warm sensation and

people can avoid walking in the street to avoid the sun, generating a greater consumption of drinks, as detailed at the table 5 with the results analysis. Meanwhile, the variation of wind has a considerable causality relation with the online sales just five days after observed, as pointed by the Granger test, in which each variable and its variations were tested using 15 days gap. Regarding the weather variable precipitation, a relevant causality relation was observed with the online sales from 10 days after its observation, which may be related to long periods of continuous rain that normally occur in the city of Rio de Janeiro in specific seasons. In the same way, the variation in precipitation presented a causality relation only from 14 days after observed. In general terms, it is important to highlight that only online sales or ticket online suffered causality from weather variables, indicating a sensitivity that makes sense when looking at the variables' dispersion graphs.

Following the introduction, this article has a Section 2 of a literature review starting from general authors regarding behavioural finance and mood related to purchase decisions, going deeper to weather-induced mood and decision making, besides a Section 3 with the models and data sets; to close in a Section 4 with results and discussion followed by a conclusion Section.

2. Literature Review

The human being is distinguished from other animals by its ability to reason logical solutions to problems that do not escape its domain, being the concept of rationality attributed to social action: when acting and interacting, individuals have coherent plans and try to maximize the satisfaction of their preferences while minimizing the costs involved, as part of a sociological theory, proposing to explain social and political behavior, assuming that people act rationally (Baert, 1997). The theory of rational choice assumes that individual action is instrumental in a double sense: on the one hand, the individual is always in search of determined goals by choosing the most appropriate means, and on the other, once reaching the goal, it takes maximum advantage of it. Thus, the theory of rational choice considers that individuals have the ability to make associations between the means, available and known, and the ends they aim for. Therefore, rational choices are approaching an optimum point, despite their ability to achieve this degree of satisfaction (Higgins, 2005).

On the other hand, the human mind has a limited capacity to solve problems with high complexity, so shortcuts are sought that end up limiting access to potentially contradictory, rational and structured information, culminating in possible irrational choices (Thaler, 1985).

People decide based on habits, personal experience and simplified practical rules, accepting satisfactory solutions, with diverse difficulties in balancing short and long term interests and being strongly influenced by emotional factors and the behavior of others (Ávila and Bianchi, 2015). The path of new variables regarding human behaviour and decision making brought by Simon (1959) with new variables at that time such personal perceptions, history, culture and mood, served as an important step so diverse studies could be developed in the area.

On that sense, Fernandes and Veiga (2006) conducted a research in which the goal was to observe the impulse consumption behaviour in contexts of virtual and real, physically present acquisitions. The authors considered a sample of 254 people of distinct ages, social classes and sexes living in Lisbon, Portugal. At the study, they used a scale for measuring buying impulsivity developed by Youn and Faber (2000) in which the factors (i) positive emotions, (ii) mood management, (iii) cognitive deliberation, (iv) aloofness about the future and (v) impulse to buy were considered and observed at the sample, with results reflecting significant relations between impulsive acquisitions and the five independent variables of the scale. As expected, a positive relation was found, for example, regarding impulsive buying reduction and aging in the physician environment, with young people appearing as more impulsive, in counterpoint to a virtual environment, where the impulse to buy measured was distinguishable lesser in the younger part of the sample. Positive emotions and mood also positively impacted the propention to buy in all ages.

Kacen and Lee (2002) define impulsiveness in the purchase decision as a buying imbued with sudden, urgency and hedonism, deprived of all information, perfectly rationality and choice of alternatives. It is an unplanned purchase, characterized by being a quick decision, having a subjective content in favor of immediate possession of something. Hoch and Loewenstein (1991) describe that impulse purchase as a behavior with a greater arousal and less mental deliberation at the decision making process and more irresistible buying behavior compared to planned purchase behavior, with the individuals generally emotionally drawn to the object and to immediate gratification.

A brief comparison is important between planned purchase and impulse purchase. Buyers are divided in terms of how much rational planning they do before a purchase decision making. Solomon (1997) points that there are references, which customers know in advance what specific products and brands they will buy; the partial references, recognizing that they need certain products, but they don't decide on any specific brand until they are in the store, and impulsive shoppers do not make any kind of prior planning. Dittman (2005) states that on many occasions purchases are made for psychological benefits, more than economic or utilitarian as the perfectly rational and utility maximizer homo economicus. The author relates the main factors related to the impulsivity at the purchase decision, such as mood, age, identity, amount of money available and ways to pay. Weather-induced mood is the focus of this research.

People find themselves subject to making decisions taking into account their mood and context. An important question worth examination is whether mood, induced by the external environment, influences economic outcomes. In the asset pricing literature, as mentioned, numerous papers explore the effect that weather-induced mood has on stock returns, and show that stock returns are positively related to the level of sunshine that investors are exposed to (Saunders, 1993; Kamstra, Kramer, and Levi, 2003; Hirshleifer and Shumway, 2003).¹ These studies conclude that weather-induced mood affects individual level economic behavior, which in turn influences financial market dynamics. The economic implications of sunshine exposure, however, have seldom been studied outside of the context of financial markets, with application in many sectors.

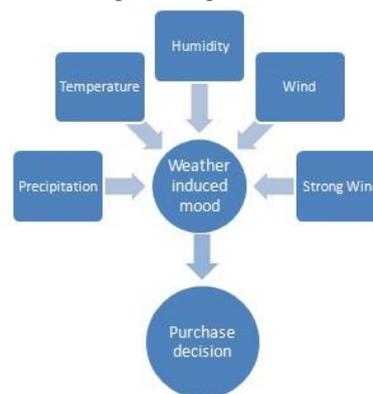
A sunny day, characterized by the incidence of sunlight, no precipitation and warm temperatures, is directly related to positive feelings and good humor (Chen et al., 2016). The authors conducted a research in which they examined the influences of weather-induced mood on patent registration by inventors in the United States of America, cross relating information regarding sunny days at the place each inventor lives and number and value of patents registered. They could clearly observe that those inventors exposed to a higher quantity of sunshine during the period created patents with higher market valuation and more forward citations. In addition, the authors observed that inventors exposed to more sunny days engage in greater specialization rather than experimentation.

3. Methodology

To comply with the study, weather variables and sales data were observed on a daily basis, with a period from January 1st of 2018 to December 31th of 2020. The information collected was rain precipitation in millimeters, average temperature in Celsius degrees, wind speed in meters per second, strong wind speed in meters per second, humidity in percentage, sales volume in money quantity and average sales ticket in local currency (reais, R\$) on each day that comprises the mentioned period. Additionally to the weather variables themselves, it was also considered at the analysis of the variation of these variables from one day to the other, to review if a weather change has also impacts as a new variable. Weather data were collected at the previously mentioned official meteorology Rio de Janeiro agency, INMET, the public reference for climate and weather data in the city. Sales money quantity and average ticket information were collected from a small sized convenience store located in Rua Visconde de Pirajá number 44, south zone of the city of Rio de Janeiro, using their internal enterprise resource planning (ERP) software. Since all of them are secondary data, it was not possible to perform an audit of the data, thereby, it was assumed that the information collected is true and

reflects the reality at the time it was recorded and to carry out the studies, considering also that all the used reports can be fully presented since no non disclosure agreement was demanded by the company data and the weather historical information of INMET is freely open.

Figure 1: Model representing the research questions with weather-induced mood and impacts at purchase decision.

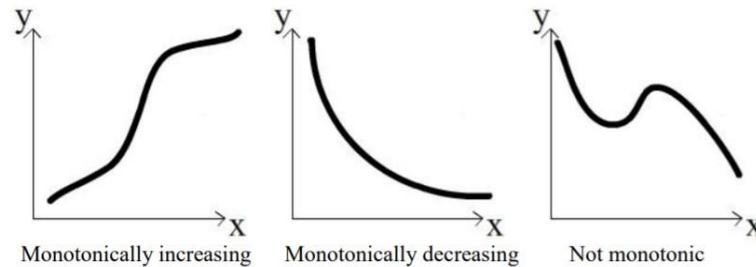


Source: Author's own elaboration.

To calculate an eventual correlation, a precondition the referred data must be treated on the concept of covariance and, subsequently, on the concept of correlation. Besides that, association and linearity are key concepts to understand correlation. In statistical terms, two variables are associated when they have similarities in the distribution of their scores. More precisely, they can be associated through the distribution of frequencies or by sharing variance and in the case of Pearson's correlation (r) this last parameter is valid, that is, it is a measure of the shared variance between two variables. On the other hand, the linear model assumes that the increase or decrease of a unit in variable “x” generates the same impact in “y”.

Considering the possibility that the investigated data does not meet Pearson's assumptions, the statistical literature recommends the use of Spearman's rank correlation (de Winter et al, 2016). To understand Spearman's correlation it is necessary to know what a monotonic function is. A monotonic function is one that either never increases or never decreases as its independent variable increases. The following image illustrates monotonic functions:

Figure 2: Monotonic Functions



Source: Schober et al (2018)

In monotonically increasing, the “x” variable increases the “y” variable never decreases. In monotonically decreasing, the “x” variable increases and the “y” variable never increases. At a non monotonic function, the “x” variable increases while the “y” variable sometimes decreases and sometimes increases (Schober et al, 2018). Spearman’s correlation coefficient is a statistical measure of the strength of a monotonic relationship between paired data (Spearman, 1904). In a sample it is denoted by and is by design constrained by the following formula:

$$- 1 \leq r_s \leq 1$$

Formula 1: Spearman’s correlation coefficient

The Spearman’s correlation coefficient interpretation is similar to that of Pearson’s coefficient and it means that the closer is number one to the stronger the monotonic relationship (Schober et al, 2018). Correlation is an effect size and so can be used to describe the strength of the correlation using the following guide for the absolute value of:

Table 1: Example of a Conventional Approach to Interpreting a Correlation Coefficient

Absolute Magnitude of the Observed Correlation Coefficient	Interpretation
0.00–0.10	Negligible correlation
0.10–0.39	Weak correlation
0.40–0.69	Moderate correlation
0.70–0.89	Strong correlation
0.90–1.00	Very strong correlation

Source: Schober et al, 2018

Nonetheless, significant correlation does not directly mean causality, so the Granger test was added as part of a necessary method to verify if the data reflects causality between the mentioned variables of weather and purchase. In particular, Granger test has the goal of evaluating the significance of an independent variable into another dependent variable in a vector autoregression (VAR) (Granger 1969). The parameter “order” (o) indicates the quantity of variables from “ y_{t-1} ” to “ y_{t-o} ” and “ X_{t-1} ” to “ X_{t-o} ” that will be added to the

autoregression. Then, the significance will be determined if a new variable from “X” optimizes the forecast of the VAR. As a prerequisite, the test de Dickey-Fuller was done to verify the stationarity of the time series used, confirming it, as done. Normality test was done and since it was not observed at the variables, Spearman was used to verify correlation.

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4. Results and Discussion

The results show a low correlation between the proposed variables, using the parameter of Schober et al (2018) as a reference, as can be seen in table below:

Table 2: Spearman Correlation Matrix.

NR	VARIABLE	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	Precip	1													
2	Var_Precip	,356**	1												
3	Temp	-,257**	,004	1											
4	Var_Temp	-,376**	-,324**	,255**	1										
5	Wind	,213**	,083*	-,186**	-,290**	1									
6	Var_Wind	,079**	,142**	,063*	-,158**	,511**	1								
7	Str Wind	,280**	,135**	-,206**	-,258**	,900**	,462**	1							
8	Var_Str Wind	,072*	,208**	,097**	-,087**	,480**	,887**	,539**	1						
9	Hum	,469**	,170**	-,268**	-,415**	,051	,064	,009	,020	1					
10	Var_Hum	,154**	,389**	-,121**	-,607**	,071*	,133**	,041	-,003*	-,034	1				
11	Online Sales	,018	-,008	,005	,012	-,018	,044	,001	,041	-,003	-,034	1			
12	Physic Sales	,031	-,053	,205**	,034	,065*	,021	,042	,026	-,034	-,067*	,460**	1		
13	Online Tkt	-,036	-,013	-,002	,045	-,037	,038	-,028	,025	,027	-,049	,600**	,310**	1	
14	Physic Tkt	-,037	,016	,010	-,013	,054	,026	,069*	,033	-,043	-,085**	-,011	,310**	,553**	1

** The correlation is significant at the 0.01 level (2 ends). * The correlation is significant at the 0.05 level (2 ends).

	Moderate Correlation
	Strong Correlation
	Very Strong Correlation

Source: Author's own elaboration.

According to table 1w2 above, there is a moderate positive correlation between precipitation and humidity (with $R = 0.469$ and $p < 0.01$), that is, when precipitation occurs in the city of Rio de Janeiro, the humidity in the region also increases, a characteristic of a country with a tropical climate. However, no significant correlations were found between weather variables and the volume of physical or online sales and the average ticket of physical or online sales.

One approach in examining the relationship between interacting variables is to look at the causality among these variables. Granger (1969) designed a statistical test, called the

“Granger causality test,” using a series of t tests and F tests to determine whether one time series is useful in predicting another time series.

$$y_t = \alpha_0 + \sum_{i=1, \dots, p} \alpha_i y_{t-i} + \sum_{j=1, \dots, q} \beta_j x_{t-j} + \varepsilon_t$$

Formula 2: Granger Test

As previously mentioned, the first columns “X” and “Y” represent the independent variables (weather) and dependent (sales) used at the results at the lines. The column F-Granger shows the statistics “F” of the test with the liberty grades. All the tests were made considering as parameters the order 1 to order 15, since order 0 is not possible at the Granger test as it is explained by Layton (1984). These parameters 1 to 15 means that the correlation observed at the variables regarding sales can be affected by the observation of weather 1 or 15 days before, since it was used daily observations.

Table 3: Granger Causality Test.

Order	x	y	F-Granger	P-value
2	VarTemperature	Ticket Online	3.1104	0.0448*
2	Humidity	Ticket Online	4.4251	0.0121*
5	VarWind	Online Sales	2.2621	0.0459*
14	VarPrecipitation	Online Sales	1.9668	0.0169*
15	VarPrecipitation	Online Sales	1.7671	0.0338*
10	Precipitation	Ticket Online	1.9383	0.0363*
11	Precipitation	Ticket Online	1.7961	0.0495*
12	Precipitation	Ticket Online	1.9141	0.0286*
13	Precipitation	Ticket Online	1.9245	0.0235*
14	Precipitation	Ticket Online	1.8405	0.0284*
15	Precipitation	Ticket Online	1.7759	0.0326*

* $p < 0.05$

Source: Author’s own elaboration.

From the data above, it was possible to observe that the temperature variation and humidity have causality relation with the online ticket sales 2 days after observed, that may be related to the tropical climate of Rio de Janeiro city, when hotter and humid days can generate a greater consumption of drinks, as detailed at the table 5. Meanwhile, the variation of wind has causality relation with the online sales 5 days after observed.

Regarding the weather variable precipitation, this presented a causality relation with the online ticket sales from 10 days after its observation, which may be related to long periods of continuous rain that normally occur in the city of Rio de Janeiro. In the same way, the variation in precipitation presented a causality relation only from 14 days after observed.

5. Conclusion

During the past years it was observed an interesting movement regarding adding irrationality and subjectivism at the consumer behavior studies, in counterpoint to the perfectly rational *homo economicus* (Loewenstein, 2000). Considering for example the Nobel prize in economic sciences of the past five years, three of them are related to psychology economy or behavior studies: Oliver Hart and Bengt Holmström for their work in contract theory, Richard H. Thaler for his contributions to behavioural economics, Paul R. Milgrom e Robert B. Wilson for improvements in auction theory, respectively in the years of 2016, 2017 and 2020. Preceding them many other researches were also awarded by Nobel prize in behavioral studies, being the most prominent Herbert Simon, Daniel Kahneman and Vernon Smith. To observe emotional variables is on a path to diagnose its influence on consumer judgments and the decision making process being possible to aggregate cognitive-based models of affective states, thus expanding the ability to analyze these, which ends up providing the description of consumer behavior more consistent and reliable.

The main objective of this study was to review through a quantitative research and bibliographical review if the weather-induced mood has impacts at Brazilian people behavior when making their online and physical purchase decisions making process, taking analysis of a three years daily basis data of average temperature, wind velocity, strong wind, precipitation and humidity, number of purchase transactions and average ticket in terms of money amount spent in purchase transactions at the related convenience store located in Rio de Janeiro. The mentioned sample was treated considering Spearman correlation, besides the normally tests of Kolmogorov-Smirnov and Shapiro-Wilk, which results shows non significant correlations between weather variables and online sales, indicating that the relationship between these variables is not obvious and requires the use of more complex statistical methods. Thus, the Granger causality tests were performed and their results indicated causality relation between the climatic variables and online sales, 2, 5 and 10 days after they were observed, since we used 15 days lag at Granger test. When reviewing the results above, it is not possible to observe linear relationships between the weather variables and the average online and physical sales tickets. Meanwhile, when comparing both, it is possible to observe that the average ticket for online sales may has a more dispersed distribution than the average ticket for physical sales, a

fact that may indicate a greater sensitivity of online sales to weather variables, although this sensitivity does not have a linear relationship.

Comprising mood, in this case weather-induced mood, as one of the factors that consistently affects people's behaviour and decision making process represents an interesting advance at the theory, the main goal investigated at the research, considering the retail sector in an emerging country. Shopping to review if the impacts are distinct between physical and online acquisitions. The results represent new and important steps at the area and given the general acceptance of the importance regarding considering mood at purchase decision and real human behavior studies, further researches are recommended using same constructs to go deeper in this subject at the retail sector, complementing the numerous studies at the financial market, taking into consideration for example distinct kind of retailers, stores placed in shopping centers, stores with delivery or in places in which temperature variation and precipitation levels have more amplitude.

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