CONSUMERS' SENTIMENTS IN ONLINE REVIEWS AND THE FIRM'S IDIOSYNCRATIC STOCK RETURNS: DYNAMIC PANEL DATA ANALYSIS AND A MODERATED MEDIATION INVESTIGATION

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Summary:

Online consumer product reviews influence firm financial performance, particularly idiosyncratic stock returns. However, empirical results remain limited. Furthermore, no study has examined moderated mediation in this relationship. Using a generalized method-of-moments estimators (GMM system estimators) applied to unbalanced dynamic panel data, our results showed on one hand that star rating plays a mediating role in the relationship between sentiment and idiosyncratic stock returns. On the other hand, our results also indicate that this mediation is moderated by brand maturity. This study will increase awareness among managers and firms listed on the stock exchange about the power of online consumer reviews on the joint effect of review sentiments and numerical characteristics.

Keywords: online reviews, idiosyncratic stock return, star rating, sentiments, moderate mediation

Introduction

Over time, consumers have understood marketing techniques and trust traditional media (TV advertising, newspapers, and radio) less and less. They prefer to search for their product on the internet. In the search for the ideal product or service, they fall on other customer reviews and the impact of these reviews is undeniable. For this, companies' marketing messages for their brands have lost their reach to the detriment of the characteristics of online consumer reviews that have become almost a conviction for consumers (Zablocki and al., 2018). Product or service value is therefore linked to the consumers' judgments. As a result, review characteristics are perceived as elements that accelerate or slow down the future sales of these brands, for instance, in terms of sales (Hu and al., 2008). Several empirical studies (BabićRosario and al., 2016; Cheng and Huang, 2019; Chevalier and Mayzlin, 2006; Dellarocas and al., 2007; Zhang and Lin, 2018) have validated the hypothesis of the influence of online consumer review characteristics on sales. The marketing literature shows that the results of these studies are sometimes divergent, as they do not fit together. It has mostly reported the effect of review metrics on accounting aspects such as revenue per room and weekly revenue. On marketing aspects, reports have essentially been on sales rankings and the number of reviews. However, few studies have analyzed the influence of textual reviews, for example, sentiments polarity, which is an important dimension allowing us to grasp the full impact of online reviews (Li and al., 2019). In addition, to our knowledge, except for the studies of Luo (2007) and McAlister and al. (2012), there are no studies, which relate review characteristics and firm financial consequences. Thus, our study proposes to understand how investors in the stock market deal with the sentiments embedded in online reviews. From the perspective of the admission of the hypothesis of online consumer review characteristics influence on sales, the review sentiments are interpreted as catalysts that affect firms. The idiosyncratic stock return is one of the measures of a firm's financial performance; we can assume that through this process, review sentiments will have an impact on the latter. In addition, the influence of these sentiments on the idiosyncratic stock return depends on other product intrinsic and/or extrinsic factors (Li and al., 2019). For example, studies by Ye and al. (2009) have shown that star rating and financial performance are positively correlated. Zhang and al. (2014) show that the sentiments contained in the reviews influence the star rating value of these reviews. The combination of these two results allows us to state that the sentiments contained in reviews affect a firm's financial performance through the star ratings of these reviews. It is therefore essential to understand how the textual and numerical contents of reviews intertwine to influence a firm's idiosyncratic stock return in order to allow them to better highlight these informational parameters.

The objective of this empirical paper is, on one hand, to analyze the mediating effect of star rating on the relationship between review sentiments and firm idiosyncratic stock return. On the other hand, this paper seeks to test the moderating role of brand maturity in this relationship.

In the rest of this study, we will discuss (1) the theoretical framework and the hypotheses (2) the methodology (3) the results, and finally (4) the discussion and contributions of this study.

1- Theoretical framework and research hypotheses

The conceptual framework of our study (see Figure 1 in Appendix) incorporates the multiattribute choice theory model based on various works (Archak and al., 2011; Roberts and Urban, 1988) and the information processing theory of Miller (2002). According to the latter, consumer information processing does not only respond to the products' attribute signals. Depending on whether the information is quantitative or qualitative, they are processed differently and the components received often interact within the processing system.

Consumer reviews are information that provide a sense of trust to potential customers (Gauri and al., 2010). The review star rating refers to its numerical value. It is also a characteristic which promotes the interpretation of a consumer's overall appreciation towards a product through an evaluation. Review star rating is usually presented in the form of voting a five (5) point scale represented by stars (Cadario, 2014). Through the rating, reviews are seen as elements that influence the firm performance. Öğüt and Taş (2012), in their study carried out on the hotel industry, showed that a good review rating generates significant and differentiated growth in terms of revenue per room and inversely. This result implies that the review's rating is not only an objective indicator of product intrinsic quality but also constitutes a tool, which makes it possible to convince other potential customers. These are the firms' stock buyers who could trust the rating as a product quality indicator and resulting satisfaction. The Higher the review ratings, the more likely these ratings are to generate and be associated with an increase in demand and inversely (Ye and al., 2011). Following the same logic, we assume that products are perceived positively, and reviews are highly rated. We expect these high ratings to have a positive influence on the firm's idiosyncratic stock return. Indeed, high ratings lower users' perceived risk, increase the product's credibility for sale and thus boost the future cash flow. We, therefore, make the hypothesis that:

H1: Reviews star rating has a positive impact on a firm's idiosyncratic stock return.

Other studies have shown that in information processing, numerical and textual reviews can jointly or separately influence decisions (Gan and al., 2017). Indeed, on the one hand, review ratings are considered as influencing the firm's performance (Öğüt and Taş, 2012). Firm promotion or life can be affected by favorable (positive sentiment) or unfavorable (negative sentiment) reviews (Li and al., 2019; Zheng and al., 2018). Ye and al. (2011) reveal that positive sentiments boost sales while negative sentiments are detrimental to them. As for the overall sentiment, which corresponds to the dominant sentiment, it exerts a positive or negative influence according to the predominance of positive and negative sentiments in the review (Wang and al., 2017). The majority of studies have shown that overall sentiment has a positive influence on sales (Li and al., 2019). On the other hand, studies such as those by Villarroel Ordenes and al. (2017) have argued that the review rating value gives feedback on the sentiment contained in that review. In other words, the sentiment contained in reviews affects the value of the review rating (Gan and al., 2017). All these results highlight the idea of a potential interaction between review sentiments and review ratings and their influence on sales. According to Li and al. (2019), such an interaction lies in the possibility that review ratings totally or partially mediate the relationship between the sentiments contained in the reviews and the sales. By the same logic, we expect the review ratings to mediate the influence of sentiments (positive, negative, and overall) on the firm's idiosyncratic stock return. We make the assumptions that:

- H2: Positive sentiments positively influence review ratings
- H3: Overall sentiments positively influence review ratings
- H4: Negative sentiments have a negative effect on review ratings

H5: *Review rating mediates the relationship between the sentiments contained in the reviews and the firm's idiosyncratic stock return.*

Moreover, brand age is a determining factor in its growth. It reveals an effect on a firm's acquired maturity (St-Pierre and al., 2010). Just as in the firm's case, two currents contradict each other according to Rossi (2016). Some argue that too old brands or firms are less able to

respond to new challenges because it will have negative effects on their performance. For others, young brands or firms perform well because decision-makers monitor growth by deferring their judgments to the successes or failures of older ones. However, the existing empirical literature indicates that brand or firm age and its profitability move in opposite directions (Dang and al., 2020). For example, Fizaine's (1968) studies have shown that as firms age their growth rates decline. For Alla (1974), the profitability of companies decreases with age. Based on this argument, we expect a negative relationship between brand age and a firm's idiosyncratic stock returns. We, therefore, propose the following hypothesis:

H6: Brand maturity negatively influences sentiments' effect on a firm's idiosyncratic stock return through the review rating. This influence is even greater if the brand is more mature.

2- Research Methodology

The sentiments contained in online reviews submitted by consumers on the Amazon France website constitute our research field as compared to Hu et al. (2014), and Lee et al. (2019) who used Amazon America. These are the sentiments extracted from the online reviews on 14 brands including a French umbrella brand listed on the stock exchange. The choice of the Amazon France website is justified by two arguments. First, it is one of the most used online shopping sites in France. Secondly, the navigation structure of the site is well designed with all relevant brand information (price, brand sales rankings, customer reviews, ratings, review volume, usefulness...) conveniently displayed so that searching and collecting is simple. This reduces the possibility of errors in data collection. Using the python programming language, 3,190 reviews were scraped over a daily period from October 9, 2007, to December 31, 2019 on 14 brands. Then, the verbatims were analyzed by the Linguistic Inquiry and Word Count (LIWC version 2015) software developed to analyze sentimental writing. In our case, it calculates the probability of the sentiments contained in a comment. "Positive sentiment", indicates the positive sentiment, and "Negative_sentiment", is a negative sentiment. The overall sentiment, "Overall sentiment" is calculated according to the formula of Ludwig and al. (2013) (see Equation 1 in Appendix). The data on the umbrella brand's stock price as well as the market index (CAC40) were obtained from Yahoo Finance. The values of the mediator variable "Star rating" are derived from reviews' numerical characteristics. Usefulness, Saving rate, and Income are used as control variables. The data for the last two variables come from INSEE. Finally, the dichotomous moderator variable "Brand maturity" determines the level of brand maturity measured by the age of these companies until 2019. It takes the value"1" if the brand is more mature and "0", otherwise. For the mediation test, we followed the method of Baron and Kenny (1986) and for the moderation test, we opt for the multi-group analysis method (Aiken and al., 1991). In order to determine the nature of the mediation, we calculated the share of indirect effects in the total effects. Indeed, in the first step, the coefficients of the indirect effects by the Sobel test (1982) then we determined the ratios of the indirect effects to the total effects.

In this paper, we consider an idiosyncratic stock return as a measure of firm financial performance with reference to the study of Luo (2007). Following the finance literature and according to Ang and al. (2006), Campbell and al. (2001), and Xu and Malkiel (2003) firm stock return (RE_{it}) is composed of the market return ($a_{it}RM_{it}$) and the firm's idiosyncratic return ($RIBE_{it}$). Indeed, the idiosyncratic return is the part of the component explained by marketing signals, for example, the firm's actions, team management, customer satisfaction, advertising campaigns... (Aaker and Jacobson, 1994; Lev, 2004). Thus, we can write:

 $RE_{it} = a_{it}RM_{it} + RIBE_{it}$ Equation (2)

Where t =1,..., T, the time expressed in days, and i=1...I the number of firms. According to Luo

(2007), Bansal and Clelland (2004) as well as Fama et French (1993) we determine the idiosyncratic return and then we obtain:

 $RIBE_{it} = RE_{it} - \hat{a}_{it}RM_{it}$ Equation (3) Thus, in this study, stock prices are used to calculate idiosyncratic stock returns to ensure rigorous results (Luo, 2007) and calculated weekly averages for each variable. The resulting research model incorporates a first difference in unbalanced panels to address the potential endogeneity problem. The GMM system estimator of Arellano and Bond (1991) which is used for instrumenting the lagged endogenous variable of two and more is the follows:

 $\Delta RIBE_{it}$, = $b\Delta RIBE_{it-1} + \Delta\beta X_{it} + \Delta\mu_{it}$ Equation (4) The GMM system is implemented in STATA following the recommendations of Roodman (2009) and the heteroscedasticity problem is corrected by integrating the "robust" option.

3- Results

Tables 1 and 2 present respectively the results of descriptive statistics and correlation between variables. It does not present any multicollinearity problems. Table 3 presents the results of the first stage of the mediation analysis validation proposed by Baron and Kenny (1986). The analysis of the models (1a-1b-1c) shows that the sentiments contained in reviews directly affect the star rating according to our predictions in hypotheses H2, H3, and H4. Thus, these hypotheses are validated. Table 4 shows the results of the last two stages of mediation analysis validation according to Baron and Kenny (1986). These are analysis results of the effects of sentiments and/or the star rating on a firm's idiosyncratic stock return. To do this, we used the dynamic panel model to account for unobserved product heterogeneity, time, individual, and sector effects (Li and al., 2019). The AR(1) and AR(2) p-values show that we accept the presence of an AR(1) effect and the absence of an AR(2) effect of residuals. Furthermore, Sargan's overidentification tests are valid, because Prob > Chi2 = 1.000. In model (2), unlike the control variables "Usefulness" and "Income" which are negatively significant, the variable "Saving rate" and the primary difference variable "d.RIBE" are positive and significant with p < 0.001. Model (3) highlights the negative influence of "Brand maturity" on "RIBE". Model (4) demonstrates that the mediating variable "Star rating" is positive and significant ($\beta = 0.008$ and p < 0.05) on the idiosyncratic stock return "RIBE", which validates our hypothesis H1.

Models (5a-5b-5c) present the results of the direct effects of the variables "Overall sentiment", "Positive sentiment" and "Negative sentiment" on "RIBE" respectively at 5%, 1% and 10% significances. Thus, the combination of models (1a-1b-1c) and (5a-5b-5c) allows us to conclude that the "Star rating" mediates the relationship between the "Overall sentiment" and the "RIBE" only at a significance level of 5%. At 1%, the "Star rating" mediates the relationship between the "Positive_sentiment" and the "RIBE". For the "Negative_sentiment", the mediation of the "Star_rating" exists only from a significance level of 10%. This result attests the "Star rating" mediating role. Hypothesis H5 is therefore validated. The reading of model (6) reveals that in the presence of the mediating variable "Star rating", "Overall sentiment", "Positive sentiment" the variables and "Negative sentiment" are all significant at 1%. In contrast, the ratios of the coefficients of the indirect effects to the total effects for these variables are close to 100%, which means that sentiments totally transmit their effects to the "RIBE" through the "Star rating". The mediation is therefore complete. Table 5 reports the results of the moderation analysis of the "Brand maturity" variable. The combination of models (3) and (7a-7b) shows that the Brand maturity influences both the RIBE and the Star rating. The "Brand maturity" is therefore a quasi-moderating variable according to Sharma and al. (1981). From the reading of Table 5, we notice a negative significance at 5% of the variable "Star rating" when the brand is more mature and another one at 10% when the latter is less mature. Also, the β coefficient of the "Star_rating" for more mature brands ($\beta = -0.080$) is lower than that for less mature brands ($\beta = -0.056$). The coefficients are different and significant, which means that mediation in the two samples is not the same. It is different according to the level of brand maturity and therefore confirms that there is a moderation in mediation. Thus, hypothesis H6 is validated.

4- Discussion and research contributions

The purpose of our study was to examine the mediating effect of the rating on the relationship between review sentiments (positive, negative, and overall) and the firm's idiosyncratic stock return. On the other hand, the aim was to determine the moderating role of brand maturity in this relationship. The results show significant links and have theoretical, methodological, and managerial implications.

4-1 Theoretical implications

Beyond being one of the few studies to demonstrate the relationship between sentiment reviews and a firm's idiosyncratic stock return, our study sheds light on the reviews' numerical and textual characteristics. It shows that the textual content of the reviews as well as their numerical content should be considered simultaneously. This study adds to the marketing literature the analysis of moderated mediation. The originality of this study also shows that contrary to previous beliefs, brand maturity does not benefit performance.

4-2 Methodological implications

The main methodological contribution of this work lies in the analysis of sentiments and emotions using LIWC software, which was initially designed for psychological study. Moreover, it allows a joint analysis between reviews' numerical and textual determinants.

4-3 Managerial implications

Firms listed on the stock exchange have no control over the content of online reviews of their brand. These reviews can create agility or inconvenience to business efficiency and as well reduce or amplify the financial performance of these companies. Consumers have always relied on online reviews as an important source of information for their purchasing decisions (Chevalier and Mayzlin, 2006). They pay more attention to the textual content than to the numerical characteristics of these reviews. For this reason, managers need to be more aware of the power of online consumer reviews. In this case, the joint effect of the sentiments of the reviews and the digital characteristics.

Reviews can strengthen or improve the role of managers to better manage consumer dissatisfaction on the one hand. Indeed, dissatisfaction expressed by negative reviews amplifies brand's bad perception and further threatens firm's performance. It is therefore vital to monitor and detect these negative sentiments in reviews in order to mitigate them through prompt responses or product recalls, etc. On the other hand, managers need to manage these brands by taking into account their maturity which is detrimental to performance. This requires innovation or new designs. All this has an influence on the value of the company.

Despite the validity of our results, our study has limitations for future research. Further studies may test the effect of other moderating variables such as the nature of the products (hedonic vs. utilitarian). Additional studies on other firms listed on the stock exchange and brands need to be conducted to validate our results. Also, performance is far from being a universal construct. The performance indicator used in the studies is not a surrogate and may reveal distinct strategies, characteristics or firm behaviors. Therefore, the specification of the measure can lead to a difference in the results.

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Appendixes





The Ludwig et al. (2013) formula for determining overall sentiment (GLOB) in a notice is as follows: Equation (1)

$$GLOB_{it} = \frac{\sum_{i=1}^{n} POST_{itT} - \sum_{i=1}^{n} NEG_{itT}}{\sum_{i=1}^{n} N_{itT}} + \frac{\left[\frac{\sum_{i=1}^{n} POST_{itC} - \sum_{i=1}^{n} NEG_{itC}}{\sum_{i=1}^{n} N_{itC}}\right]}{2}$$

 $GLOB_{it}$ represents the overall sentiment of review (i) at time (t);

 $\sum_{i=1}^{n} POST_{itT}$, the sum of words containing positive sentiments in the title (T) of review (i) at time (t);

 $\sum_{i=1}^{n} NEG_{itT}$, sum of words containing negative sentiments in the title (T) of review (i) at time (t);

 $\sum_{i=1}^{n} N_{itT}$, total number of words contained in the title (T) of review (i) at time (t). The subscript (C) denotes the review body and the calculation of sentimental content are the same as in the title (T) but noted respectively $\sum_{i=1}^{n} POST_{itC}$; $\sum_{i=1}^{n} NEG_{itC}$ et $\sum_{i=1}^{n} N_{itC}$

Variable	Obs	Mean	Std. Dev.	Min	Max
RIBE	1403	49.734	69.15	-125.074	198.04
Star_rating	1403	4.288	1.104	1	5
Overall_sentiment	1403	.468	.345	859	.994
Positive_sentiment	1403	.283	.209	0	1
Negative_sentiment	1403	.034	.06	0	.756
Usefulness	1403	.407	.419	0	1
Saving_rate	1403	.144	.006	.133	.166
Income	1403	.336	.275	3	1.046
Brand_maturity	1403	97.03	60.176	7	290

Tableau 1. Descriptive Statistics

Table	au 2. Correlat	ion variable							
Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
(1) RIBE	1.000								
(2) Star_rating	-0.115***	1.000							
(3) Overall_sentiment	-0.172***	0.186***	1.000						
(4) Positive_sentiment	0.088***	0.187***	0.265***	1.000					
(5) Negative_sentiment	0.055**	-0.166***	-0.390***	-0.319***	1.000				
(6) Brand_maturity	-0.220***	0.107***	0.121***	-0.015	-0.026	1.000			
(7) Usefulness	-0.021	0.015	-0.005	0.002	0.038	0.042	1.000		
(8) Saving_rate	0.120***	-0.009	0.088***	-0.087***	0.014	0.125***	0.178***	1.000	
(9) Income	-0.103***	0.013	-0.014	0.005	-0.016	-0.026	0.000	-0.269***	1.000
*** <0.01 ** <0.05 *	<01								

*** p<0.01, ** p<0.05, * p<0.1

Table N°3: Mediation analysis of sentiments on star_rating						
	(1a)	(1b)	(1c)			
Variable	Star_rating	Star_rating	Star_rating			
Overall_sentiment	0.184***					
	(0.027)					
Positive_sentiment		0.198***				
		(0.026)				
Negative_sentiment			-0.168***			
			(0.026)			
Usefulness	0.044	0.028	0.049			
	(0.056)	(0.056)	(0.056)			
Saving_rate	-0.033	-0.002	-0.018			
	(0.029)	(0.029)	(0.029)			
Income	0.005	0.011	0.005			
	(0.027)	(0.027)	(0.027)			
Constant	-0.015	-0.010	-0.017			
	(0.033)	(0.033)	(0.033)			
Observations	1,403	1,403	1,403			
Number of id	14	14	14			
R-squared	0.034	0.040	0.029			
Prob > F	0.0496	0.0042	0.0173			

Table N°3: Mediation	analysis	of sentiments or	n star_rating
	(1a)	(1b)	(1c)

Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

	2		_ 0				
	(2)	(3)	(4)	(5a)	(5b)	(5c)	(6)
Variable	RIBE						
d.RIBE	1.278***	1.273***	1.282***	1.282***	1.277***	1.279***	1.288***
	(0.032)	(0.032)	(0.032)	(0.032)	(0.032)	(0.032)	(0.034)
Star_rating			0.008**				0.009**
			(0.003)				(0.004)
Overall_sentiment				0.007**			0.014***
				(0.003)			(0.004)
Positive_sentiment					-0.008***		-0.009***
					(0.003)		(0.003)
Negative_sentiment						0.006*	0.011***
						(0.003)	(0.004)
Brand_maturity		-0.026***					-0.028***
		(0.006)					(0.006)
Usefulness	-0.016***	-0.016***	-0.016***	-0.015**	-0.016***	-0.017***	-0.016**
	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)
Saving_rate	0.108***	0.110***	0.108***	0.107***	0.109***	0.109***	0.111***
	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)	(0.009)
Income	-0.034***	-0.036***	-0.033***	-0.035***	-0.035***	-0.034***	-0.037***
	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.006)
Constant	-0.010***	0.003	-0.010***	-0.010***	-0.010***	-0.009***	0.003
	(0.003)	(0.004)	(0.003)	(0.003)	(0.003)	(0.003)	(0.004)
Observations	1.403	1.403	1.403	1.403	1.403	1.403	1.403
Number of id	14	14	14	14	14	14	14
p-value AR(1)	0.050	0.019	0.034	0.029	0.022	0.038	0.001
p-value AR(2)	0.255	0.033	0.217	0.279	0.338	0.225	0.515
p-value Sargan	1.000	1.000	1.000	1.000	1.000	1.000	1.000

Table 4: Mediation analysis of sentiments and/or star_rating on RIBE

Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

	Brand_maturity				
	More	Less			
Variable	(7a)	(7b)			
	RIBE	RIBE			
Star_rating	-0.080**	-0.056*			
	(0.036)	(0.031)			
Usefulness	-0.114*	-0.083			
	(0.067)	(0.073)			
Saving_rate	0.076**	0.408***			
	(0.031)	(0.044)			
Income	-0.028	-0.102***			
	(0.031)	(0.037)			
Constant	-0.191***	0.282***			
	(0.040)	(0.042)			
Observations Number of	667	736			
id	14	14			
R-squared	0.022	0.153			
Prob > F	0.000	0.000			

Table N°5: Moderation of brand maturity on the relationship between Star_rating and RIBE

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1