Deeper Into the Retailing Sector

Roberto Minini
Luigi Noto
Bernardo Principi
Anna Russo
Martina Totaro

BEMACS
Bocconi University
Milan, Italy
November 29, 2020

Executive Summary

This study explores how strategic exploitation of marketing resources can increase firm value in the non-manufacturing sector, specifically in the retailing sector. The study is motivated by previous research which reveals that most non-manufacturing firms concentrate their efforts on marketing-related strategies rather than on Research & Development since R&D can create a competitive advantage for manufacturing and IT sector firms, but the same is not true for non-manufacturing ones. According to our expectations, retailing firms can invest into marketing and advertising to increase firm value. Our study will be carried out using statistical methods for modeling marketing instruments in order to capture as much information as possible and to be able to derive strategies that will enable our firm to achieve a (sustainable) competitive advantage.

Motivation

Our study is inspired by previous findings by Yew Kee Ho, Hean Tat Keh, and Jin Mei Ong. In their paper *The Effects of R&D and Advertising on Firm Value: An Examination of Manufacturing and Nonmanufacturing Firms*[1], the authors explore the effects of investments into R&D and advertising on both manufacturing and non-manufacturing firms to understand how different combinations of these investments can impact firm value. They conclude that, as per the resource-based view of the firm, each firm should invest in resources that will leverage their comparative strengths: advertising for non-manufacturing firms and R&D for manufacturing firms.
As our focal variable of interest, we chose marketing spending for customer acquisition and retention (MKT), with the aim to explore the relationship between marketing spending and firm value.
In our study we will explore whether there is an analogous relationship in retailing (a narrower sector than non-manufacturing[1]) to the one found in literature between firm value, R&D and marketing spending.
We have chosen firm value (FV) as dependent variable. It is computed with *Tobin's Q* (Formula 1. All formulae are found in the appendix).
When considering financial metrics, we must also point out that they will ensure to capture both immediate and future firm performance, as marketing has long term impact and therefore lagged effects that we must consider to be able to understand future changes in performance.
The choice of firm value as dependent variable (instead of firm-related variables such as sales or assets) is justified as marketing-related actions influence firm value both directly and indirectly. For instance, previous studies have shown how the presence of a Chief Marketing Officer has an average positive impact on firm value. For advertising (a marketing-related tool), it positively impacts firm value both directly (through increased sales and therefore profits) and indirectly (through increased intangible value of firm, which contributes to overall firm value).
Moreover, the use of marketing metrics does not favor communication with CFOs and CEOs, which means that other variables must be used to effectively communicate within the firm. This is particularly due to the delicate nature of the financial implications of marketing, as marketing is still perceived and counted as a cost in the accounting system.

Variable Construction

As the first step of our model development, we create some additional variables to make our research and findings clearer and more precise. We will build the following variables.

- **Total Sales** (TSALES) in each year (Formula 2).
  We compute the number of firms competing in the market and the total sales in the retailing sector for each year.
- **Total Profit** (TPROFIT) in each year (Formula 3).
  We compute the total profit in the retailing sector for each year.
- **Market Share** (MARKET_SHARE) for each firm in each year (Formula 4).
  We compute a measure of market share percentage of each firm. We will then use this measure to construct HHI.
- **Herfindhal-Hirschman Index** (HHI) in each year (Formula 5).
  This is a measure for the degree of competition within the industry.[1] Moreover, HHI can also be used to avoid omitted variable bias.[3]

[1]The retail sector is a subset of the non-manufacturing sector, according to the paper classification[1] based on industrial classification standards[2].

- **Firm Size** (FIRMSIZE) for each firm in each year (Formula 6).
  We chose sales instead of total assets as they are less affected by firms' accounting policies. We use log(SALES) instead of the SALES variable as this is common practice in marketing research in order to avoid scaling issues.[1] Previous studies support the modified Schumpeterian hypothesis that the relative innovative advantage of large and small firms is determined by the extent to which a market is characterized by imperfect competition. The results of this paper suggest that large firms have a relative advantage in markets with imperfect competition, while small firms have the relative advantage in markets closer to the competitive model. Based on the historical values of HHI, provided in the descriptive statistics paragraph, the retail sector seems to resemble the second case, even though we note that this sector is a larger agglomerate of many sectors, that may have different characteristics.[4]
- **Market Growth** (MKGROWTH) in each year (Formula 7).
  This variable should be interpreted in relative terms: we will interpret market growth in a certain year by comparing it with the value found for the previous year.
- **Strategic Emphasis (SE)** (S_EMPHASIS) for each firm in each year (Formula 8).
  We calculate this variable to understand the extent to which a firm allocates its resources in brand building (i.e., advertising) compared to innovation (i.e., R&D).
- **Advertising Intensity** (AD_INTENSITY) and **Marketing Intensity** (MKT_INTENSITY) for each firm in each year (Formulas 9 and 10).
  The first describes, relatively, how much each firm invests in advertising for each year. As mentioned in previous studies, we use advertising expenses to sales since the amortization rate used for capitalized advertising expenditure is subjective.[1] The second variable describes how much each firm invests in marketing and customer acquisition and retention for each year, relatively to the number of sales.
  The paper[1] we refer to only provides such a measure in relation to advertising, but we believe there is an added value to consider both advertising and marketing expenditure as it will provide more detailed results in terms of managerial implications.
- **R&D Intensity** (RD_INTENSITY) for each firm in each year (Formula 11).
  This is a measure of the relative investment into R&D for each firm at each year.
  The measure is given by R&D spending divided by sales and is intended to be a proxy for the ratio of capitalized R&D to sales,[1] since we are not able to compute it, due to the lack of an economically driven amortization rate[5].
- **Leverage Ratio (proxy)** (LEVERAGE) for each firm in each year (Formula 12).
  We compute a variant of the leverage ratio, i.e., a proxy for total-debt-to-total-assets ratio,[6] since the variable DEBT in the dataset represents the long-term debt of each firm in each year.
- **Firm Sales Growth** (FIRM_GROWTH_SALES) for each firm in each year (Formula 13).
  We measure the one-year firm growth for each firm in each year by computing the one-year variation in the log-levels of the SALES variable.
- **Marketing Spending Lagged Variables** (LAG_MKT_1, LAG_MKT_2, LAG_MKT_3) for each firm in each year (Formulas 14, 15 and 16).
  We include some lagged variables for marketing spending in our model as marketing investments have an impact in the company beyond the immediate result and can continue to sustain firm value for several years. Since MKT is our focal variable, we compute the 1-year, 2-year and 3-year marketing spending (MKT) lagged variables in order to incorporate marketing lagged effects in our models. We compute them up to the three-year lag as suggested in the referenced literature.[1]
- **3-year Marketing Spending Growth** (MKT_GROWTH) for each firm in each year (Formula 17).
  This variable will tell us whether a firm has decided to allocate more, less or the same funds in marketing activities compared to 3 years prior and we suppose that it might indicate whether firms are attributing a higher or lower importance to marketing over time.
- **Year Dummy Variables** (YEAR_t, $t \in$ Years) for each year.
  We employ year dummies to account for market-wide effects, such as the Credit Crunch crisis of 2007-2009.

Finally, we must account for the fact that not all the companies compete in the retailing sector in all the years from 2000 to 2015 (the data shows that every year there are firms that enter and exit the market, some even repeatedly) and this might lead to some missing values when creating lagged variables or variables computed with them.

Descriptive Statistics

We refer to Tables 1, 2 and 3 and Figures 1 and 2 in the Appendix. After filtering our initial dataset including firms in different industries and isolating the retail sector data (2054 observations, accounting for 13.43% of the

original dataset), we split the observations in four 4-year periods ranging from 2000 to 2015 and separately compute univariate descriptive statistics, in order to focus on trends on both the cross-sectional and the time-series components of the panel data.
We observe that the number of observations varies across the four time periods, thereby indicating the presence of an unbalanced panel, i.e. a dataset in which at least one experimental unit is not observed every period.
All the firms in the sample have positive marketing spending and advertising spending over all periods expect the first period, in which a very small percentage of firms (0.33%) presents zero advertising spending.
The opposite trend is observed in the case of R&D spending: many firms have zero R&D spending (95.35% on average) and the proportion increased over time (from 93.98% in the 2000-2003 period to 97.32% in the 2012-2015 period).
This result clearly evidences that retailing firms have a strong inclination to invest in marketing and advertising activities as opposed to R&D.
From Graphs 1, we can note that the number of firms competing in the industry has been decreasing over time: in particular, we observe a steady drop from the years 2005 to 2008, while during the same time interval the HHI index significantly increased above 1500, before decreasing again to a level between 1100 and 1200, which signifies a very competitive market.
Furthermore, we observe that the total sales of the firms in the industry have been increasing quite linearly over time, and the same can be said about their total profits aside from two years.
However, the shrinkage observed from 2007 to 2009 is likely not a good indicator for the trends of the industry, as this period corresponds to the global financial crisis which affected all firms' activities, not just retailing ones.
We decided to compare the median and the mean of some variables of interest in order to identify some trends in the industry and detect the presence of outliers which may influence our results. Moreover, we will to plot the value of these measurements together with the values of the first and the third quartiles for each year, to easily visualize the inter-quartile range and understand how spread the data is.
From the graphs in Figure 2, we deduce the following.

- Firm value (FV) has been growing slightly over time, aside for a drop probably caused by the financial crisis, and in the end just increased a little on average from 2000 and 2015.
  The mean and minimum value are quite similar over the four time periods, whereas the maximum value in the first period is much higher than the corresponding values in the subsequent periods, thus leading to a substantially higher standard deviation (approximately 8 times higher), given the similarity in the means and minimum values in the four subsamples.
  This clearly emphasizes the presence of one or a few outliers from 2000 to 2003. Thus, we analyze the period 2000-2003 more closely and we note an unusually high mean value in 2001, which is not reflected in the median and is thus likely to indicate the entrance in the market of one or few very valuable competitors, which however seem to have quickly abandoned the competition. Another plausible explanation for this outlier could be related to an issue in the recording of data.
- Marketing spending (MKT) shows positive trends in the mean, the standard deviation and the maximum value, pointing out that the amounts spent on marketing activities by the retailing firms are more spread apart, where the dispersion is mainly driven by the fact that some firms are investing substantially more than others. However, we also must account for some unusual negative minimum values in the first two periods which, without further information about how the data has been collected, cannot be properly explained for since it is difficult to interpret the nature of these non-positive values, i.e. whether they are due to errors in data recording or might offer a meaningful insight. Moreover, the gap between the first and the third quartile has widened, indicating that different firms have different budget allocations for these operations. Moreover, we can notice that over time the mean is significantly higher than the median and the third quartile, thereby indicating a skewed distribution.
- Advertising spending (AD) has also been growing quite linearly over time, and in the last years firms seem to have allocated increasingly more resources to these operations, as can be observed by the steady increase in the values of the third quartile. As before, being the mean substantially higher than the median and the third quartile, we note the presence of a skewed distribution.
- R&D (RD) does not seem to play a crucial role in this industry: in fact, the median of this measure is zero in all years, while there has been a steady increase in the mean over time. Therefore, we might suppose that there are few firms that are increasing their investing activities in R&D so much as to drive the mean significantly further away from the median in each year. This is in fact confirmed by a closer inspection of the data, which reveals that over 90% of the firms are not investing in R&D while on the contrary in 2015 there was a single firm investing over $12,000 million in this field (and only another firm investing more than $1 million).
- Leverage Ratio (LEVERAGE) was slightly decreasing before the financial crisis and slightly growing after that period. Furthermore, the values seem quite spread between the firms and there is not a clear trend which might

help us to predict whether in the future firms will aim to increase, decrease or maintain this ratio.
– Market share (MARKET_SHARE) in percentage is lower than 0.6% for approximately 75% of the firms in all given years, whereas the mean is higher than this value, thereby indicating a skewed distribution.

Model Development and Estimation (FE Panel Data Regression)

Recalling that our focal variable is MKT, we add some control variables to our model, which will provide many benefits for our analysis.
Firstly, if the hypothesized relationships are still significant after adding the controls, alternative explanations involving the control variables can be ruled out: otherwise, the model suffers from endogeneity. Introducing control variables is therefore fundamental, as it will allow us to be confident of the causality (as opposed to mere correlation) between our variables of interest and firm value, which means we can direct our firm towards a specific marketing strategy and be sure it will have positive effects on firm value.
Secondly, introducing control variables will allow us to improve the precision of the estimated coefficients: we introduce the additional variables in the model with the premise that they are important explanatory variables for the dependent variable.
Thirdly, previous research suggests that excluding relevant controls from the model creates more bias than including irrelevant ones – that is, if the irrelevant variables are uncorrelated with MKT.[7]
Starting from the given dataset and the variables we constructed based on the underlying theory and previous literature, we start the regression diagnostic, to identify which variables have to be excluded from the model, despite being theoretically informative in explaining firm value, because of issues with the regression assumptions. We build a correlation matrix to single out pairs of highly correlated variables, which would otherwise cause multicollinearity issues: we identified several highly correlated variables and decided which ones to keep according to their theoretical relevance and contribution to our dependent variable.
First, we understand that the lagged marketing expenses are highly correlated between each other and with MKT, and accordingly decide to select only the latter as it is our focal variable and appears to contain the most relevant and up-to-date information. Additionally, S_EMPHASIS, RD_INTENSITY and AD_INTENSITY are linearly dependent, since the former is a linear combination of the other two. Since including all of them in the model would violate the linear regression assumptions, we prefer to keep the two intensity variables as opposed to only S_EMPHASIS as they will allow us to perform a more detailed analysis. Lastly, we note that MKT is also highly correlated with the following variables: ASSETS, DEBT, PROFIT, PROFIT_CASH, SALES, MARKET_SHARE (all with a correlation of at least 0.9). Therefore, we remove all these variables and keep only MKT, which will largely encapsulate the same information because of the high correlation.

Model (1)

As a consequence of our selection, our first model is built from the following variables: FV as dependent variable, and as independent variables we have MKT, AD, RD, MKT_INTENSITY, AD_INTENSITY, RD_INTENSITY, FIRMSIZE, HHI, FIRMRISK, LEVERAGE, FIRM_GROWTH_SALES, MKT_GROWTH, the square of MKT and two interaction effect variables, one between MKT and FIRMRISK and one between MKT and LEVERAGE, in order to capture non-linearities.
Model (1):

$$\begin{aligned}\mathrm{FV}_{it} = \alpha_i + \beta_1 \mathrm{MKT}_{it} + \beta_2 \mathrm{AD}_{it} + \beta_3 \mathrm{RD}_{it} + \beta_4 \mathrm{MKT\_INTENSITY}_{it} + \beta_5 \mathrm{AD\_INTENSITY}_{it} + \beta_6 \mathrm{RD\_INTENSITY}_{it} \\ + \beta_7 \mathrm{FIRMSIZE}_{it} + \beta_8 \mathrm{HHI}_{it} + \beta_9 \mathrm{FIRMRISK}_{it} + \beta_{10} \mathrm{LEVERAGE}_{it} + \beta_{11} \mathrm{FIRM\_GROWTH\_SALES}_{it} \\ + \beta_{12} \mathrm{MKT\_GROWTH}_{it} + \beta_{13} \mathrm{MKT}_{it}^2 + \beta_{14} \mathrm{MKT}_{it} \cdot \mathrm{FIRMRISK}_{it} + \beta_{15} \mathrm{MKT}_{it} \cdot \mathrm{LEVERAGE}_{it} + \sum_{t \in \mathrm{Years}} \delta_t \mathrm{Year}_t + \epsilon_{it}\end{aligned}$$

Previous studies suggest that non-manufacturing firms (such as in the retail industry, which we focus on) have an interest in investing in marketing-related expenditures as they are the main drivers of firm value, whereas they should have no interest in nurturing RD as it is unrelated with their competitive advantage. This is because retail firms' core business involves high levels of communication with their final customers, a process which is fundamental for firms to eventually create value for customers, and for customers to create value for firms in return.
Therefore, retail firms have an interest in investing into this critical relationship in order to nurture and expand their customer base. Provided that firms have limited resources, they are better off investing them into marketing-related

activities as opposed to research and development, as R&D is not involved in their core business. Therefore, to further research the conclusions brought about by previous literature,[1] we have an interest in including in our model both marketing and R&D related independent variables, and we expect the sooner to be more correlated with the dependent variable, FV, than the latter, which we include in the model exactly to prove its little worth to retail firms in comparison to marketing-related investments. To satisfy our need for variables describing marketing activities, we will include in our model the MKT, AD, MKT_INTENSITY, and AD_INTENSITY variables. This will give us a detailed perspective on the framework of the industry and will allow us to provide precise recommendations to our firm, such as increasing solely advertising investments or solely customer acquisition and retention investments. On the other hand, we believe including RD and RD_INTENSITY will suffice to demonstrate the low significance of RD for retailing firms.
FIRMRISK (included in the dataset) and LEVERAGE (previously discussed) are included in the model to account for the financial situation of the firms in the retailing industry.
FIRM_GROWTH_SALES and MKT_GROWTH (both previously explained) are included because we expect the growth of the firms with respect to the previous year to capture a "momentum effect" (growing firms tend to keep growing) and the backward-looking 3-year change in firms' marketing spending to have an impact on the current value of the company.
We introduce the interaction effects between MKT and LEVERAGE, and between MKT and FIRMRISK because we are interested in exploring whether riskier or more leveraged firms find any benefit in investing into marketing during difficult times, or whether this could be harmful and perceived as a negative signal by investors, especially as marketing is sometimes wrongfully perceived as a cost rather than a long-term investment into the firm.
Finally, we will include year-fixed effect in our model to be able to control for economy-wide effects due to time-dependent changes and different economic conditions, such as the Credit Crunch which affected the economy between 2007 and 2009.
We model a panel data regression, which will allow us to account for the time-dependent nature of our data. After observing that the Hausman test performed with the above variables gives a p-value less than any commonly chosen significance level (Figure 3), we use the fixed-effect panel data regression and we will continue to do so throughout further developments and model comparisons.
From the Stata output (Figure 4) we can see that Model (1) is jointly statistically significant and at least one firm-specific time-independent fixed effect is significantly different from 0. However, some variables have VIFs much higher than 10, thereby indicating the presence of a multicollinearity issue.

Model (2)

Based on the previous considerations, we decide to eliminate AD, RD, FIRMSIZE and HHI, since their effects are already partially controlled by the previously created variables AD_INTENSITY and RD_INTENSITY, whereas it is important to keep FIRMRISK and LEVERAGE because they control for the impact of different forms of risk on market value, which is an input to the FV variable. Moreover, we once again underline that many observations have R&D equal to zero and therefore this variable might not improve the model. The interaction terms have very high VIFs, but at the same time we prefer to keep an interaction term involving a variable measuring risk. As a result, we remove the interaction term involving risk measure with higher VIF, i.e. $\text{MKT} \cdot \text{LEVERAGE}$, and the squared term MKT^2.
Based on the above considerations, we proceed with the estimation of Model (2).
Model (2):

$$\begin{aligned}\text{FV}_{it} = \alpha_i + \beta_1 \text{MKT}_{it} + \beta_2 \text{MKT\_INTENSITY}_{it} + \beta_3 \text{AD\_INTENSITY}_{it} + \beta_4 \text{RD\_INTENSITY}_{it} \\ + \beta_5 \text{FIRMRISK}_{it} + \beta_6 \text{LEVERAGE}_{it} + \beta_7 \text{FIRM\_GROWTH\_SALES}_{it} \\ + \beta_8 \text{MKT\_GROWTH}_{it} + \beta_9 \text{MKT}_{it} \cdot \text{FIRMRISK}_{it} + \sum_{t \in \text{Years}} \delta_t \text{Year}_t + \epsilon_{it}\end{aligned}$$

From the Stata output (Figure 5) we observe that Model (2) is jointly statistically significant, at least one firm-specific time-independent fixed effect is significantly different from 0 and all VIFs are higher than 10 except one, the one for the interaction term mkt*firmrisk, which however is only slightly higher than 10. Moreover, the focal variable mkt is not statistically significant.

Model (2) on the cleaned dataset (dataset after winsorization)

Recalling our observations about potential outliers in the descriptive statistics paragraph and noticing that there may be a few extreme outliers that might significantly affect the model estimation, we decide perform a winsorization on the dataset. The outliers for each variable are defined as the points farther away at least 1.5 times (chosen critical value) the variable interquartile range from the variable median.[8]
From the Stata output (Figure 6), we can see that the F-statistic has a value of 33.87, hence the overall model is significant. In this case, the within, between and overall R^2 (0.3345, 0.0596, 0.1730, respectively) are significantly higher than the previous cases and the VIFs are all lower than 10, thereby confirming that the original data contain some noise that negatively affects performance and that Model (2) provides a good explanation of firm value.

Model Interpretation

We now proceed with the interpretation of the coefficients obtained in our focal model, i.e. Model (2) on the cleaned dataset.
Our focal variable, MKT, is statistically significant and has a coefficient of 0.00017, as we expected. Proportionally, this means that an increase of 1000 million dollars in marketing spending increases firm value by 0.17. The t-test associated with this variable reveals that the variable is statistically significant at 0.05 significance level, hence the coefficient is statistically different from 0.
MKT_GROWTH is statistically significant has a coefficient of 0.14 and is thus positively related to firm value, confirming our expectations. Indeed, expecting that mkt is positively correlated with fv, we also expected that marketing growth over time must positively impact the firm value.
MKT_INTENSITY is statistically significant and has a coefficient of –3.02. This means that, given previous variables' interpretation (i.e., marketing growth and marketing) where we considered absolute values, here by considering variables in relative terms with MKT_INTENSITY, and assuming that firms grow, we should never get an increase in marketing spending greater, in proportion, than the increase sales. Hence, the negative coefficient is fully justified: marketing can be increased but never more, in proportion, to the increase in sales. The variable AD_INTENSITY has a negative coefficient for similar reasons, even though it is significant just at a 0.1 level.
RD_INTENSITY has a coefficient of 0 and is indicated as omitted, thus research and development does not have an influence on firm value. Considering the winsorization procedure performed before, this signals that the original dataset contained very few observations with positive R&D, that therefore, even if included in the estimation, would not have contributed much. We previously mentioned how in the paper "The Effects of RD and Advertising on Firm Value: An Examination of Manufacturing and Nonmanufacturing Firm" it is found that research and development does have a weaker effect in the non-manufacturing sector. Our model confirms these findings apply in a narrower non-manufacturing sector.
FIRMRISK is statistically significant (even though only at a 0.1 level) and has a value of -3.19. This shows that the riskiness associated with one firm does decrease the firm value of such a firm. Similar results were found in previous literature.[1]
LEVERAGE has a coefficient of –0.17. However, it is not statistically significant, since the observed value of the t-statistics for this variable is –1.20, which implies a p-value of 0.229, which is well above any standard level of significance.
As we expected, FIRM_GROWTH_SALES is statistically significant and is positively related to firm value. A one-unit increase in this variable generates an increase of 1.19 in firm value, confirming our intuition about the "momentum effect".
The interaction effect between marketing spending and firm risk is significant and has a coefficient of –0.004.
The dummy variables for the years 2004, 2006, 2013 and 2014 have coefficients which are not statistically significant. The dummy variables for the other years have proved to be significant. All years lead are associated with negative coefficients.
The model outputs also reveal that panel data considering fixed effects is more appropriate than the one with random effects. We can see that the observed F-statistics that all $u\_i = 0$ is 12.68 which leads to rejection of the null hypothesis.
The VIFs reveal that there are no serious multicollinearity problems. VIFs go from a minimum of 1.47 to a maximum of 8.19, and in general are all lower than 10. We initially choose to include three interaction terms:

- We added the MKT squared interaction term to capture possible non linearities in the model.
- We also added the interaction effect between MKT and FIRMRISK. With this term we would like to figure out if increasing marketing spending would be a good move while the firm is experiencing financial distress. Of course,

we expected to obtain a negative coefficient as marketing is not the correct tool through which to take actions to recover a firm from financial distress.
- The third interaction term is MKT · LEVERAGE. As for FIRMSRISK, also leverage is an indicator of a firm's financial situation. When a firm's leverage value is critical, investors expect the firm to do strategic moves to weaken financial distress. For this reason, we expect a negative coefficient for this interaction term, which would imply that increasing marketing spending is not the best move to recover a firm from financial distress (but it would indeed lower the firm value).

As a matter of fact, in the final model we only keep the interaction effect involving mkt and firm risk, which is shown to be significant and to have a negative coefficient, as we expected.
From the margins plot we can better understand the interaction effect between marketing spending and firm risk. In Figure 7 we can see the average marginal effect of marketing spending on firm value at different levels of firm risk. More precisely, we can see the average value of the derivative of marketing spending computed at different values of firm risk ranging from the lowest value (.0027) to 99th percentile (.06327).
A strictly decreasing trend is found and we can clearly see that, as firm risk increases, the marginal contribution of marketing spending diminishes. This means that the positive effect of marketing spending is weaker for higher values of firm risk.
The points with the highest firm risk are also the ones with the largest confidence intervals. This is probably due to the fact that firms with high firm risk are relatively rare in the dataset, as we can see from the histogram in Figure 8.

Managerial Implications

From results of the final chosen model, we understand that while the effect of marketing alone can be hard to quantify, it certainly has a positive impact on firm value. Marketing intensity, additionally, is quite critical, so we may focus on it when evaluating new marketing strategies. To be complete, we highlight that before investing in marketing, firms should be aware that the results of this investment will be harvested on a long-term basis, and that the short-term costs might initially be higher than what the advantages appear to be. Risk management is also central to our managerial suggestions, as managers should closely take it into consideration when they decide to work on increasing firm value. This is because increased marketing actions may not be able to compensate for the negative effects generated by high firm risk. Overall, the best strategy we can recommend is to first ensure firms' stability, and then to invest in marketing strategies to lay the ground for future increase in firm value. Hence, we can recommend pursuing marketing actions for acquiring and retaining consumers only when firms are financially stable. After this point is reached, firms implementing advertising strategies may foster the increase in sales, which from our analysis (and specifically from the results of FIRM_GROWTH_SALES) would result in a further increase in firm value.
Since marketing and marketing growth have a positive effect, firms should take this into account when deciding for their spending on marketing strategies for customer acquisition and retention. These investments have the potential to lead to an increase in sales and an augmented loyalty to the brand, which according to our model will, in turn, increase the value of the firm in the future.
However, we should make sure to keep the ratio of marketing spending to sales under control. Indeed, based on our model estimates, pushing this ratio too high would harm firm value. If the ratio increases, and sales remain constant, it means more is being spent on marketing without a consequent increase in sales. As we expect, such scenario would decrease firm value.
Lastly, firms in the retail sector should try, whenever possible, to reduce their riskiness since it has a negative effect on firm value, which could be due to the fact that investors prefer to invest in safer firms. According to our model, this may lead to lower purchases of shares by the public and a consequent decrease in stock value. Therefore, attempting to keep risk low will have significant positive impacts, too.

References

[1] Yew Kee Ho, H. T. Keh and Jin Mei Ong. *The effects of R&D and advertising on firm value: an examination of manufacturing and nonmanufacturing firms*. IEEE Transactions on Engineering Management, vol. 52, no. 1, pp. 3-14, Feb. 2005, doi: 10.1109/TEM.2004.839943.

[2] Division of Corporation Finance: Standard Industrial Classification (SIC) Code List. U.S. Securities and Exchange Commission.

[3] A. S. Leahy. *Advertising and Concentration: A Survey of the Empirical Evidence*. Quarterly Journal of Business and Economics, vol. 36, no. 1, 1997, pp. 35–50. JSTOR.

[4] A. Zoltan J. and David B. Audretsch. *Innovation, Market Structure, and Firm Size*. The Review of Economics and Statistics, vol. 69, no. 4, 1987, pp. 567–574. JSTOR.

[5] B. Lev and T. Sougiannis. *The capitalization, amortization, and value-relevance of R&D*. Journal of Accounting and Economics, Volume 21, Issue 1, February 1996, Pages 107-138, doi: 10.1016/0165-4101(95)00410-6.

[6] Total-Debt-to-Total-Assets Ratio, Investopedia.

[7] M. Klarmann and S. Feurer. *Control Variables in Marketing Research*. Marketing ZFP 40(2):26-40, doi: 10.15358/0344-1369-2018-2-26.

[8] J. W. Tukey. *The Future of Data Analysis*. The Annals of Mathematical Statistics Vol. 33, No. 1 (Mar., 1962), pp. 1-67.

Appendix

Variable formulas

Let Firms_t be the set of firms in retailing sector in year t and $\text{Years} = \{2000, ..., 2015\}$.

$$\text{FV} = \frac{\text{Market Value} + \text{Preferred Stock} + \text{Debt}}{\text{Total Assets}} \tag{1}$$

The choice to use *Tobin's Q* is motivated by marketing theory: first, it is a good measure of the premium that the market is willing to pay either above or below the replacement costs of a firm's assets. Thus, it can capture possible above-normal returns expected from a firm's current assets.

$$\text{TSALES}_{i\bar{t}} = \sum_{i \in \text{Firms}_{\bar{t}}} \text{SALES}_{i\bar{t}} \tag{2}$$

for any $i \in \text{Firms}_{\bar{t}}$, for any $\bar{t} \in \text{Years}$. It is easy to see that for any $\bar{t} \in \text{Years}$, we have $\text{TSALES}_{i\bar{t}} = \text{TSALES}_{i'\bar{t}}$ for any $i, i' \in \text{Firms}_{\bar{t}}$.

$$\text{TPROFIT}_{i\bar{t}} = \sum_{i \in \text{Firms}_{\bar{t}}} \text{PROFIT}_{i\bar{t}} \tag{3}$$

for any $i \in \text{Firms}_{\bar{t}}$, for any $\bar{t} \in \text{Years}$.
It is easy to see that for any $\bar{t} \in \text{Years}$, we have $\text{TPROFIT}_{i\bar{t}} = \text{TPROFIT}_{i'\bar{t}}$ for any $i, i' \in \text{Firms}_{\bar{t}}$.

$$\text{MARKET\_SHARE}_{it} = \frac{\text{SALES}_{it}}{\text{TSALES}_{it}} \tag{4}$$

for any $i \in \text{Firms}_t$, for any $t \in \text{Years}$.

$$\text{HHI}_{i\bar{t}} = \sum_{i \in \text{Firms}_{\bar{t}}} (\text{MARKET\_SHARE}_{i\bar{t}} \cdot 100)^2 \tag{5}$$

for any $i \in \text{Firms}_{\bar{t}}$, for any $\bar{t} \in \text{Years}$.
It is easy to see that for any $\bar{t} \in \text{Years}$, we have $\text{HHI}_{i\bar{t}} = \text{HHI}_{i'\bar{t}}$ for any $i, i' \in \text{Firms}_{\bar{t}}$.

$$\text{FIRMSIZE}_{it} = \log(\text{SALES}_{it}) \tag{6}$$

for any $i \in \text{Firms}_t$, for any $t \in \text{Years}$.

$$\text{MKGROWTH}_{i\bar{t}} = \log(\text{TSALES}_{i,\bar{t}}) - \log(\text{TSALES}_{i,\bar{t}-1}) \tag{7}$$

for any $i \in \text{Firms}_{\bar{t}}$, for any $\bar{t} \in \text{Years}$.
It is easy to see that for any $\bar{t} \in \text{Years}$, we have $\text{MKGROWTH}_{i\bar{t}} = \text{MKGROWTH}_{i'\bar{t}}$ for any $i, i' \in \text{Firms}_{\bar{t}}$.

$$\text{S\_EMPHSASIS}_{it} = \frac{\text{AD}_{it} - \text{RD}_{it}}{\text{ASSETS}_{it}} \tag{8}$$

for any $i \in \text{Firms}_t$, for any $t \in \text{Years}$.

$$\text{AD\_INTENSITY}_{it} = \frac{\text{AD}_{it}}{\text{SALES}_{it}} \tag{9}$$

for any $i \in \text{Firms}_t$, for any $t \in \text{Years}$.

$$\text{MKT\_INTENSITY}_{it} = \frac{\text{MKT}_{it}}{\text{SALES}_{it}} \tag{10}$$

for any $i \in \text{Firms}_t$, for any $t \in \text{Years}$.

$$\text{RD\_INTENSITY}_{it} = \frac{\text{RD}_{it}}{\text{SALES}_{it}} \tag{11}$$

for any $i \in \text{Firms}_t$, for any $t \in \text{Years}$.

$$\text{LEVERAGE}_{it} = \frac{\text{DEBT}_{it}}{\text{ASSETS}_{it}} \tag{12}$$

for any $i \in \text{Firms}_t$, for any $t \in \text{Years}$.

$$\text{FIRM\_GROWTH\_SALES}_{it} = \log(\text{SALES}_{i,t}) - \log(\text{SALES}_{i,t-1}) \tag{13}$$

for any $i \in \text{Firms}_t$, for any $t \in \text{Years}$.

$$\text{LAG\_MKT\_1}_{it} = \text{MKT}_{i,t-1} \tag{14}$$

for any $i \in \text{Firms}_t$, for any $t \in \text{Years}$.

$$\text{LAG\_MKT\_2}_{it} = \text{MKT}_{i,t-2} \tag{15}$$

for any $i \in \text{Firms}_t$, for any $t \in \text{Years}$.

$$\text{LAG\_MKT\_3}_{it} = \text{MKT}_{i,t-3} \tag{16}$$

for any $i \in \text{Firms}_t$, for any $t \in \text{Years}$.

$$\text{MKT\_GROWTH}_{it} = \frac{\text{MKT}_{i,t} - \text{MKT}_{i,t-3}}{\text{MKT}_{i,t-3}} \tag{17}$$

for any $i \in \text{Firms}_t$, for any $t \in \text{Years}$.

Descriptive statistics: tables and graphs

Table 1: Descriptive statistics from 2000 to 2007

	Years 2000 - 2003					Years 2004 - 2007				
Variable	Obs	Mean	Std. Dev.	Min	Max	Obs	Mean	Std. Dev.	Min	Max
FV	598	1.69244	8.35717	0.0033749	203.298	537	1.52725	1.083267	0.0177206	7.92063
MKT	598	1013.14	3480.49	-17.66899	43943	537	1553.39	5544.068	-51.39999	68297
AD	598	82.6452	182.984	0	1310	537	133.711	304.5657	0.05	2200
RD	598	2.28485	21.1425	0	269.326	537	4.60856	50.89077	0	818
SALES	598	5054.61	20140.3	1.22	257157	537	7844.72	30709.77	0.632	375376
PROFIT	598	371.765	1401.19	-533.271	17001	537	648.625	2256.244	-124.465	24784
LEVERAGE	598	0.15747	0.17766	0	1.31669	537	0.13517	0.175353	0	2.20245
MARKET_SHARE	598	0.67%	2.68%	0.00015%	34.42%	537	0.74%	2.90%	0.000057%	33.64%

Table 2: Descriptive statistics from 2008 to 2015

	Years 2008 - 2011					Years 2012 - 2015				
Variable	Obs	Mean	Std. Dev.	Min	Max	Obs	Mean	Std. Dev.	Min	Max
FV	471	1.12273	0.84614	0.0177642	6.59554	448	1.58579	1.26579	0.0074867	8.64282
MKT	471	2025.95	7595.582	0.779	82899	448	2586.75	8959.01	9.578	94415
AD	471	152.993	363.4289	0.04	2500	448	195.922	438.374	0.129	3800
RD	471	15.7462	172.6534	0	2909	448	73.5641	825.736	0	12540
SALES	471	10331.9	40946.67	0.387	444948	448	13822.2	48744.1	47.546	483521
PROFIT	471	812.201	3026.524	-208.4	32752	448	1120.29	3607.21	-1134	34612
LEVERAGE	471	0.12128	0.145897	0	0.63452	448	0.15805	0.1863	0	1.35668
MARKET_SHARE	471	0.85%	3.37%	0.00003%	35.15%	448	0.89%	3.15%	0.0029%	32.36%

Table 3: Proportions of nulls over time

	Years 2000 - 2003	Years 2004 - 2007	Years 2008 - 2011	Years 2012 - 2015
# mkt=0	0	0	0	0
% mkt=0	0.00%	0.00%	0.00%	0.00%
# ad=0	2	0	0	0
% ad=0	0.33%	0.00%	0.00%	0.00%
# rd=0	562	510	448	436
% rd=0	93.98%	94.97%	95.12%	97.32%

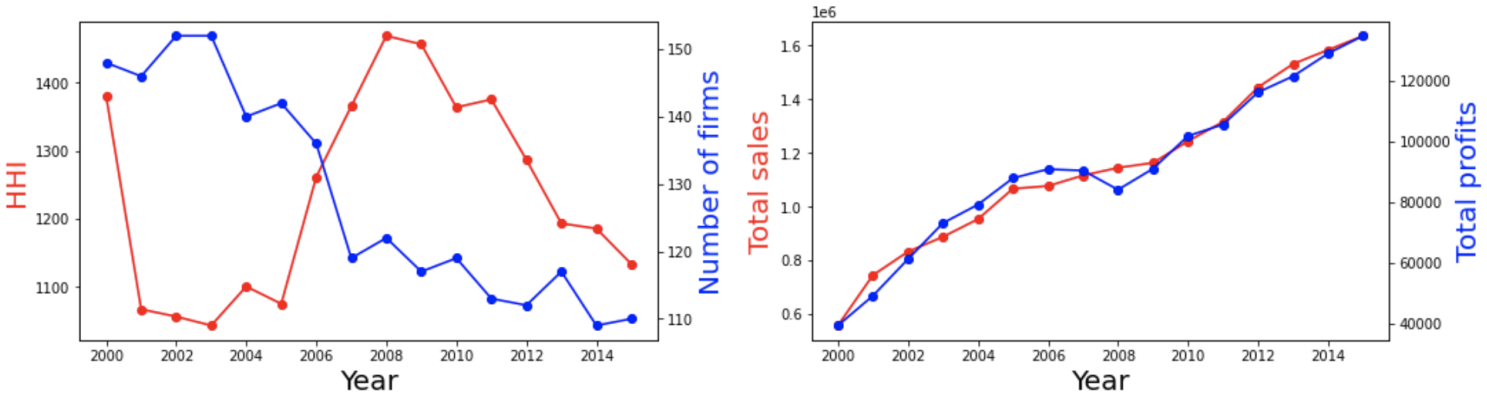

Figure 1: Graphs 1

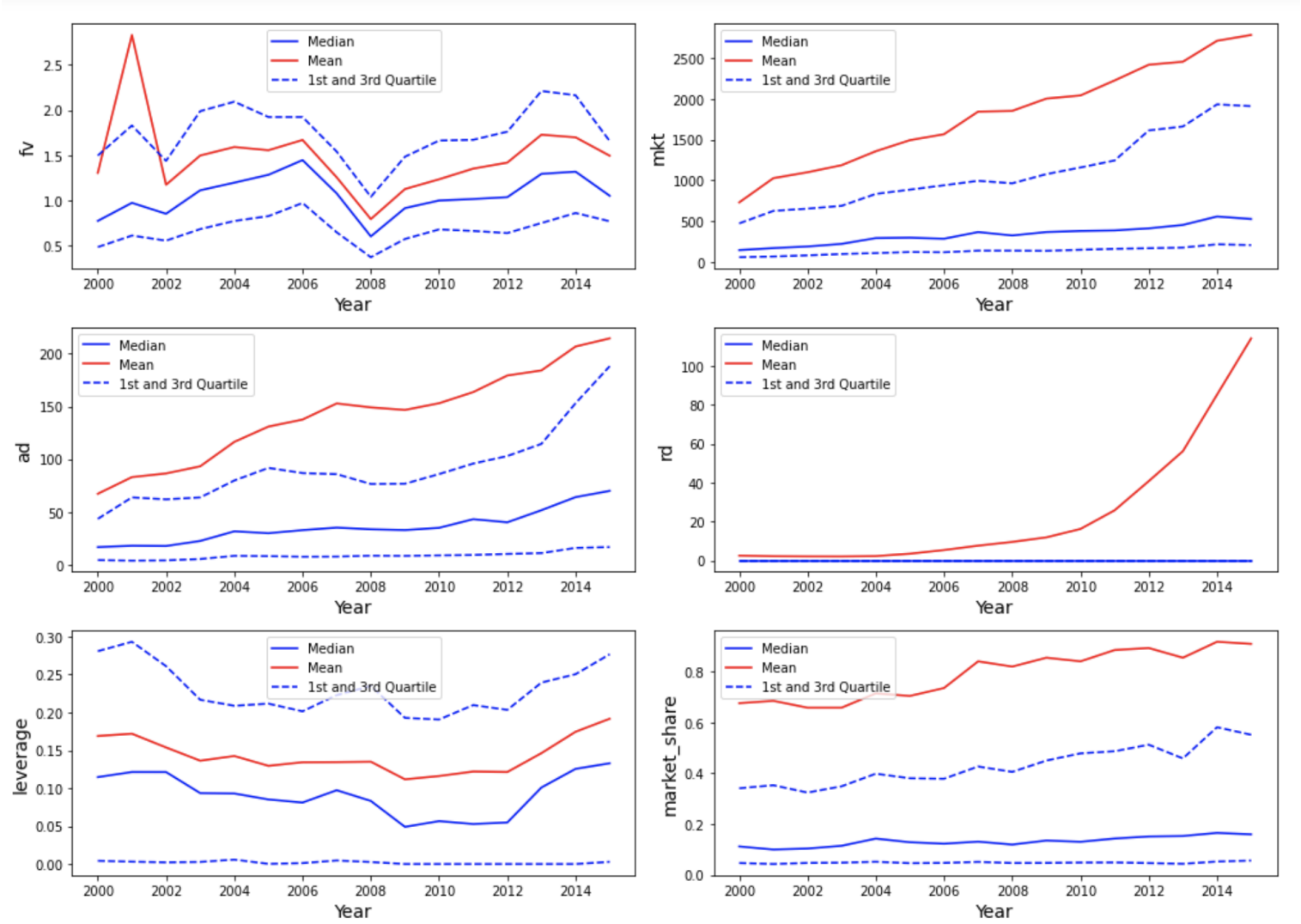

Figure 2: Graphs 2

Model Estimation and Interpretation: Stata outputs

```
                 b = consistent under Ho and Ha; obtained from xtreg
  B = inconsistent under Ha, efficient under Ho; obtained from xtreg

    Test:  Ho:  difference in coefficients not systematic

                chi2(20) = (b-B)'[(V_b-V_B)^(-1)](b-B)
                         =      101.64
              Prob>chi2 =      0.0000
              (V_b-V_B is not positive definite)
```

Figure 3: Hausman Test

```
       panel variable:  id (unbalanced)
        time variable:  year, 2000 to 2015, but with gaps
                delta:  1 unit

Fixed-effects (within) regression               Number of obs      =     1,262
Group variable: id                              Number of groups   =       186

R-sq:                                           Obs per group:
     within  = 0.2491                                         min =         1
     between = 0.0027                                         avg =       6.8
     overall = 0.0532                                         max =        13

                                                F(26,1050)         =     13.40
corr(u_i, Xb)  = -0.3181                        Prob > F           =    0.0000

------------------------------------------------------------------------------
          fv |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
         mkt |   .0000267   .0000534     0.50   0.618    -.0000782    .0001315
          ad |  -.0005133   .0003017    -1.70   0.089    -.0011053    .0000787
          rd |  -5.38e-07   .0000971    -0.01   0.996    -.0001911      .00019
mkt_intensity |  -1.939351   .5074147    -3.82   0.000    -2.935013   -.9436883
ad_intensity |   -8.32857   2.171587    -3.84   0.000    -12.58971   -4.067426
rd_intensity |   2.773425   4.217908     0.66   0.511    -5.503063    11.04991
    firmsize |  -.1413565   .0967835    -1.46   0.144    -.3312675    .0485545
    firmrisk |  -1.977504   1.303819    -1.52   0.130    -4.535891     .580882
    leverage |   .5758866   .1929611     2.98   0.003     .1972534    .9545197
firm_growth_sales |   .8712257   .1720321     5.06   0.000     .5336598    1.208792
   mkt_growth |   .0037462   .0154087     0.24   0.808    -.0264891    .0339816
              |
 c.mkt#c.leverage |   .0001126   .0000711     1.58   0.113    -.0000269    .0002521
              |
 c.mkt#c.firmrisk |  -.0003545   .0007789    -0.46   0.649    -.0018828    .0011737
              |
  c.mkt#c.mkt |  -3.24e-10   3.20e-10    -1.01   0.312    -9.53e-10    3.05e-10
              |
         year |
         2004 |  -.0721207   .0871739    -0.83   0.408    -.2431757    .0989342
         2005 |  -.1041977   .0882569    -1.18   0.238    -.2773778    .0689824
         2006 |  -.1032489   .0908098    -1.14   0.256    -.2814383    .0749404
         2007 |  -.4503079   .0962016    -4.68   0.000    -.6390771   -.2615386
         2008 |  -.7825892   .1041925    -7.51   0.000    -.9870383     -.57814
         2009 |  -.4685142   .1020321    -4.59   0.000    -.6687241   -.2683043
         2010 |  -.4230798   .0998626    -4.24   0.000    -.6190328   -.2271267
         2011 |  -.3887263   .0999923    -3.89   0.000    -.5849337   -.1925189
         2012 |  -.2299876   .1034987    -2.22   0.026    -.4330754   -.0268998
         2013 |  -.0400914    .105583    -0.38   0.704    -.2472692    .1670864
         2014 |  -.0746932    .109594    -0.68   0.496    -.2897414     .140355
         2015 |  -.3208244   .1144836    -2.80   0.005     -.545467   -.0961818
              |
       _cons |   3.403501    .725885     4.69   0.000     1.979151    4.827852
-------------+----------------------------------------------------------------
     sigma_u |  .94231809
     sigma_e |  .59194825
         rho |  .71704432   (fraction of variance due to u_i)
------------------------------------------------------------------------------
F test that all u_i=0: F(185, 1050) = 10.72                 Prob > F = 0.0000
```

```
    Variable |       VIF       1/VIF
-------------+----------------------
         mkt |     75.81    0.013191
          ad |      5.95    0.167934
          rd |      1.78    0.563367
mkt_intens~y |      5.85    0.170909
ad_intensity |      2.28    0.438070
rd_intensity |      1.35    0.742993
    firmsize |     14.89    0.067164
    firmrisk |      3.44    0.291006
    leverage |      2.35    0.424983
firm_growt~s |      1.49    0.671776
  mkt_growth |      1.12    0.889443
      c.mkt#|
  c.leverage |     33.66    0.029710
      c.mkt#|
  c.firmrisk |     14.33    0.069772
 c.mkt#c.mkt |     13.99    0.071474
        year |
        2004 |      1.85    0.539863
        2005 |      1.90    0.527500
        2006 |      1.94    0.516746
        2007 |      1.87    0.534243
        2008 |      2.07    0.484197
        2009 |      2.04    0.490950
        2010 |      1.86    0.536819
        2011 |      1.89    0.530163
        2012 |      1.85    0.540980
        2013 |      1.89    0.528354
        2014 |      1.84    0.544414
        2015 |      1.87    0.533413
-------------+----------------------
    Mean VIF |      7.74
```

Figure 4: Model (1)

```
       panel variable:  id (unbalanced)
        time variable:  year, 2000 to 2015, but with gaps
                delta:  1 unit

Fixed-effects (within) regression               Number of obs     =      1,262
Group variable: id                              Number of groups  =        186

R-sq:                                           Obs per group:
     within  = 0.2380                                         min =          1
     between = 0.0092                                         avg =        6.8
     overall = 0.0644                                         max =         13

                                                F(21,1055)        =      15.69
corr(u_i, Xb)  = -0.3182                        Prob > F          =     0.0000

------------------------------------------------------------------------------
          fv |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
         mkt |  -7.64e-06   .0000124    -0.62   0.537    -.0000319    .0000166
mkt_intensity |  -1.699453   .4927418    -3.45   0.001    -2.666318   -.7325877
ad_intensity |  -9.824514    2.13871    -4.59   0.000    -14.02112   -5.627904
rd_intensity |   -1.99965   3.745868    -0.53   0.594     -9.34985     5.35055
    firmrisk |  -1.925114   1.295363    -1.49   0.138    -4.466895    .6166673
   leverage |   .7633766   .1742968     4.38   0.000     .4213688    1.105384
firm_growth_sales |   .8057997   .1705929     4.72   0.000     .4710598     1.14054
   mkt_growth |  -.0004578    .015428    -0.03   0.976    -.0307309    .0298152
              |
 c.mkt#c.firmrisk |  -.0007843   .0007682    -1.02   0.307    -.0022918    .0007231
              |
         year |
         2004 |  -.0917999    .087288    -1.05   0.293    -.2630778     .079478
         2005 |  -.1282079   .0877255    -1.46   0.144    -.3003443    .0439284
         2006 |   -.140778   .0888958    -1.58   0.114    -.3152107    .0336547
         2007 |  -.4971557   .0924469    -5.38   0.000    -.6785564   -.3157549
         2008 |  -.8253345   .0985172    -8.38   0.000    -1.018646   -.6320226
         2009 |   -.502617   .0972647    -5.17   0.000    -.6934713   -.3117627
         2010 |  -.4638425    .095513    -4.86   0.000    -.6512596   -.2764254
         2011 |  -.4354736   .0944222    -4.61   0.000    -.6207502   -.2501969
         2012 |  -.2805209   .0967183    -2.90   0.004     -.470303   -.0907389
         2013 |  -.0934095   .0978588    -0.95   0.340    -.2854295    .0986104
         2014 |  -.1297879   .0998589    -1.30   0.194    -.3257326    .0661568
         2015 |  -.3763527    .102123    -3.69   0.000      -.57674   -.1759653
              |
         _cons |   2.370516   .1515754    15.64   0.000     2.073092    2.667939
-------------+----------------------------------------------------------------
       sigma_u |  .94735473
       sigma_e |  .59489313
           rho |  .71719369   (fraction of variance due to u_i)
------------------------------------------------------------------------------
F test that all u_i=0: F(185, 1055) = 10.99                 Prob > F = 0.0000
```

Variable	VIF	1/VIF
mkt	9.24	0.108188
mkt_intens~y	5.53	0.180893
ad_intensity	2.08	0.481414
rd_intensity	1.08	0.926132
firmrisk	3.33	0.299926
leverage	1.75	0.572373
firm_growt~s	1.37	0.729986
mkt_growth	1.12	0.892139
c.mkt#		
c.firmrisk	10.12	0.098851
year		
2004	1.38	0.722656
2005	1.38	0.725041
2006	1.39	0.720805
2007	1.34	0.746722
2008	1.56	0.642321
2009	1.43	0.697806
2010	1.31	0.765430
2011	1.32	0.756671
2012	1.27	0.784996
2013	1.26	0.791315
2014	1.27	0.788885
2015	1.31	0.762793
Mean VIF	2.47	

Figure 5: Model (2)

```
       panel variable:  id (unbalanced)
        time variable:  year, 2000 to 2015, but with gaps
                delta:  1 unit
note: rd_intensity omitted because of collinearity

Fixed-effects (within) regression               Number of obs      =      1,608
Group variable: id                              Number of groups   =        240

R-sq:                                           Obs per group:
     within  = 0.3345                                         min =          1
     between = 0.0596                                         avg =        6.7
     overall = 0.1730                                         max =         13

                                                F(20,1348)         =      33.87
corr(u_i, Xb)  = -0.1311                        Prob > F           =     0.0000

------------------------------------------------------------------------------
          fv |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
         mkt |   .0001692   .0000827     2.04   0.041     6.86e-06    .0003314
mkt_intensity |  -3.024467   .4656283    -6.50   0.000    -3.937902   -2.111033
 ad_intensity |  -2.770512   1.675004    -1.65   0.098     -6.05641    .5153868
 rd_intensity |          0  (omitted)
     firmrisk |  -3.196846   1.734748    -1.84   0.066    -6.599945     .206253
    leverage |  -.1733515   .1441673    -1.20   0.229    -.4561682    .1094652
firm_growth_sales |   1.190863   .1648178     7.23   0.000     .8675354    1.51419
   mkt_growth |   .1419416   .0642157     2.21   0.027     .0159679    .2679152
              |
 c.mkt#c.firmrisk |  -.0049318   .0020549    -2.40   0.017    -.0089629   -.0009007
              |
         year |
         2004 |  -.0337341   .0537148    -0.63   0.530    -.1391078    .0716397
         2005 |   -.115336   .0544255    -2.12   0.034    -.2221038   -.0085682
         2006 |  -.0173027   .0562409    -0.31   0.758    -.1276319    .0930265
         2007 |   -.343781   .0593607    -5.79   0.000    -.4602303   -.2273317
         2008 |  -.6070552   .0650702    -9.33   0.000    -.7347051   -.4794052
         2009 |  -.2725615   .0644764    -4.23   0.000    -.3990464   -.1460765
         2010 |  -.3104447   .0627682    -4.95   0.000    -.4335786   -.1873108
         2011 |  -.2951758   .0631484    -4.67   0.000    -.4190556    -.171296
         2012 |   -.196556   .0640182    -3.07   0.002    -.3221421     -.07097
         2013 |  -.0228158   .0655107    -0.35   0.728    -.1513298    .1056983
         2014 |  -.0695603   .0673784    -1.03   0.302    -.2017382    .0626177
         2015 |  -.3114281   .0697164    -4.47   0.000    -.4481925   -.1746637
              |
        _cons |   2.325002   .1274118    18.25   0.000     2.075055    2.574949
-------------+----------------------------------------------------------------
      sigma_u |  .78006374
      sigma_e |  .43870251
          rho |  .75971327   (fraction of variance due to u_i)
------------------------------------------------------------------------------
F test that all u_i=0: F(239, 1348) = 12.68                 Prob > F = 0.0000
```

```
    Variable |       VIF       1/VIF
-------------+----------------------
         mkt |      8.19    0.122112
mkt_intens~y |      8.20    0.121940
ad_intensity |      2.66    0.376057
    firmrisk |      7.45    0.134171
    leverage |      2.00    0.499615
firm_growt~s |      2.03    0.492370
  mkt_growth |      2.50    0.399948
       c.mkt#|
  c.firmrisk |      7.07    0.141415
        year |
        2004 |      1.63    0.614794
        2005 |      1.64    0.611308
        2006 |      1.61    0.619782
        2007 |      1.59    0.627712
        2008 |      1.85    0.539715
        2009 |      1.65    0.606093
        2010 |      1.53    0.654752
        2011 |      1.49    0.671378
        2012 |      1.47    0.678456
        2013 |      1.49    0.671588
        2014 |      1.47    0.679314
        2015 |      1.50    0.667861
-------------+----------------------
    Mean VIF |      2.95
```

Figure 6: Model (2) on cleaned dataset

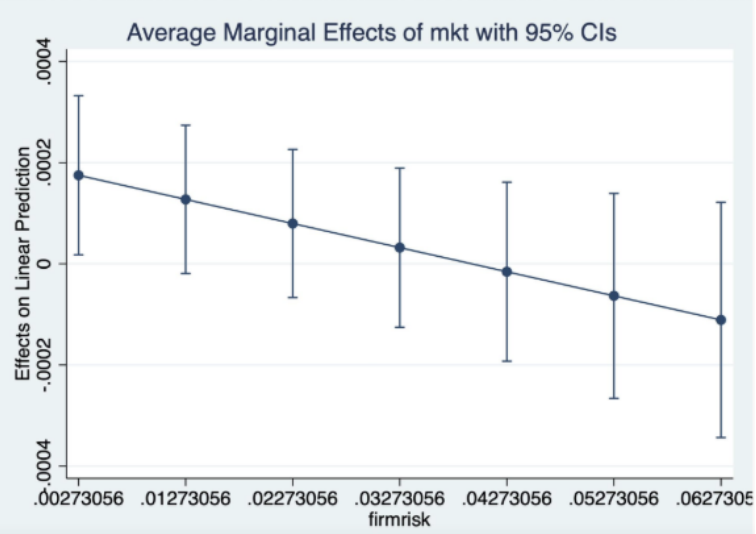

Figure 7: Average Marginal Effects of mkt at different values of firmrisk

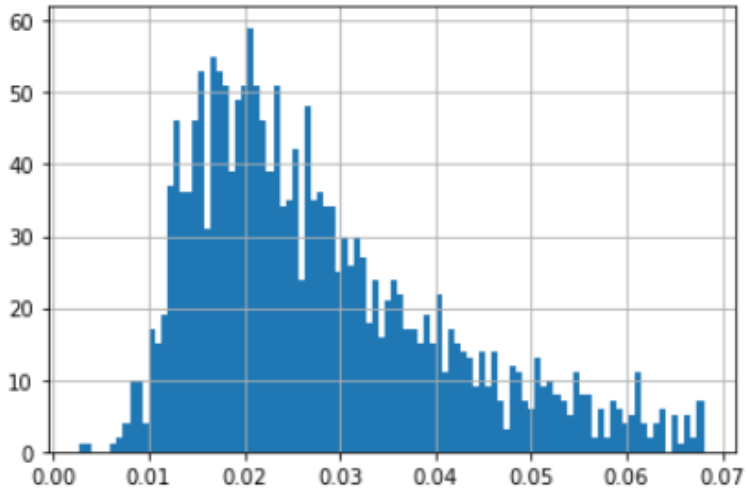

Figure 8: Histogram of the values of firmrisk

Further Analysis: Myopic Management

To further understand the firms' strategic plans in the retailing sector, we also check for the presence of myopic management behaviors among them in the 2001-2015 period. We estimated the following fixed-effect autoregressive panel data forecast models, discussed in "The Theory and Practice of Myopic Management", N. Mizik.

$$\mathrm{ROA}_{it} = \alpha_{\mathrm{ROA},i} + \phi_{\mathrm{ROA}}\mathrm{ROA}_{i,t-1} + \sum_{t\in\mathrm{Years}} \delta_{\mathrm{ROA},t}\mathrm{Year}_t + \epsilon_{\mathrm{ROA},it}$$

$$\mathrm{MKT}_{it} = \alpha_{\mathrm{MKT},i} + \phi_{\mathrm{MKT}}\mathrm{MKT}_{i,t-1} + \sum_{t\in\mathrm{Years}} \delta_{\mathrm{MKT},t}\mathrm{Year}_t + \epsilon_{\mathrm{MKT},it}$$

$$\mathrm{RD}_{it} = \alpha_{\mathrm{RD},i} + \phi_{\mathrm{RD}}\mathrm{RD}_{i,t-1} + \sum_{t\in\mathrm{Years}} \delta_{\mathrm{RD},t}\mathrm{Year}_t + \epsilon_{\mathrm{RD},it}$$

Myopic behaviors are identified if the following conditions are satisfied:
- $\mathrm{ROA}_{it} - \hat{\mathrm{ROA}}_{it} > 0$
- $\mathrm{ROA}_{it} - \hat{\mathrm{MKT}}_{it} < 0$
- $\mathrm{RD}_{it} - \hat{\mathrm{RD}}_{it} < 0$

We found that approximately 20.7% of sample observations are classified as instances in which myopic management potentially takes place.

```
      panel variable:  id (unbalanced)
       time variable:  year, 2000 to 2015, but with gaps
               delta:  1 unit

Fixed-effects (within) regression               Number of obs     =      1,740
Group variable: id                              Number of groups  =        242

R-sq:                                           Obs per group:
     within  = 0.3836                                         min =          1
     between = 0.5520                                         avg =        7.2
     overall = 0.6520                                         max =         15

                                                F(15,1483)        =      61.53
corr(u_i, Xb)  = 0.5025                         Prob > F          =     0.0000

------------------------------------------------------------------------------
         roa |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
  lag_roa_1  |   .6228321   .0216115    28.82   0.000     .5804398    .6652244
             |
        year |
        2002 |   .0177502   .0073021     2.43   0.015     .0034267    .0320738
        2003 |  -.0005378   .0074988    -0.07   0.943    -.0152472    .0141716
        2004 |   .0017651   .0075787     0.23   0.816     -.013101    .0166311
        2005 |   .0007069   .0076389     0.09   0.926    -.0142773    .0156912
        2006 |  -.0024916   .0077671    -0.32   0.748    -.0177272     .012744
        2007 |  -.0159396   .0079898    -1.99   0.046    -.0316122    -.000267
        2008 |   -.031253   .0081376    -3.84   0.000    -.0472154   -.0152906
        2009 |  -.0022214    .008157    -0.27   0.785    -.0182219    .0137791
        2010 |   .0042832   .0082101     0.52   0.602    -.0118214    .0203878
        2011 |   .0022021   .0082012     0.27   0.788    -.0138851    .0182893
        2012 |   .0028373    .008286     0.34   0.732    -.0134161    .0190908
        2013 |  -.0150704   .0083139    -1.81   0.070    -.0313786    .0012378
        2014 |  -.0089352   .0084257    -1.06   0.289    -.0254627    .0075923
        2015 |  -.0086685   .0085658    -1.01   0.312    -.0254709    .0081339
             |
       _cons |   .0479809   .0066775     7.19   0.000     .0348826    .0610791
-------------+----------------------------------------------------------------
     sigma_u |   .1130457
     sigma_e |   .05706052
         rho |   .79695321   (fraction of variance due to u_i)
------------------------------------------------------------------------------
F test that all u_i=0: F(241, 1483) = 5.09                     Prob > F = 0.0000
```

Figure 9: ROA Fixed-effect Autoregressive Model

```
       panel variable:  id (unbalanced)
        time variable:  year, 2000 to 2015, but with gaps
                delta:  1 unit

Fixed-effects (within) regression               Number of obs      =       1,740
Group variable: id                              Number of groups   =         242

R-sq:                                           Obs per group:
     within  = 0.9791                                         min =           1
     between = 0.9993                                         avg =         7.2
     overall = 0.9973                                         max =          15

                                                F(15,1483)         =     4634.55
corr(u_i, Xb)  = 0.9351                         Prob > F           =      0.0000

------------------------------------------------------------------------------
         mkt |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
   lag_mkt_1 |   .9576586   .0037617   254.58   0.000     .9502798    .9650374
             |
        year |
        2002 |     12.178   38.19645     0.32   0.750    -62.74682    87.10282
        2003 |  -11.86812   39.26963    -0.30   0.763    -88.89804     65.1618
        2004 |   41.91731   39.68696     1.06   0.291    -35.93123    119.7659
        2005 |   103.7188   40.00923     2.59   0.010     25.23808    182.1995
        2006 |   101.9949   40.72952     2.50   0.012     22.10131    181.8885
        2007 |   42.95337   41.96094     1.02   0.306    -39.35574    125.2625
        2008 |   21.26975   42.64379     0.50   0.618     -62.3788    104.9183
        2009 |  -17.95977   42.47883    -0.42   0.673    -101.2848    65.36521
        2010 |  -14.90814   42.92873    -0.35   0.728    -99.11563    69.29935
        2011 |    38.5354   43.14057     0.89   0.372    -46.08764    123.1584
        2012 |   50.16712   43.70928     1.15   0.251    -35.57147    135.9057
        2013 |   5.424304   43.94459     0.12   0.902    -80.77586    91.62447
        2014 |   60.96748   44.55357     1.37   0.171    -26.42724    148.3622
        2015 |   74.79643   45.31933     1.65   0.099    -14.10038    163.6932
             |
       _cons |   146.4143   29.65038     4.94   0.000     88.25319    204.5755
-------------+----------------------------------------------------------------
     sigma_u |  488.85681
     sigma_e |   299.0023
         rho |   .72774998   (fraction of variance due to u_i)
------------------------------------------------------------------------------
F test that all u_i=0: F(241, 1483) = 4.55                     Prob > F = 0.0000
```

Figure 10: MKT Fixed-effect Autoregressive Model

```
       panel variable:  id (unbalanced)
        time variable:  year, 2000 to 2015, but with gaps
                delta:  1 unit

Fixed-effects (within) regression               Number of obs      =       1,740
Group variable: id                              Number of groups   =         242

R-sq:                                           Obs per group:
     within  = 0.9960                                         min =           1
     between = 0.9999                                         avg =         7.2
     overall = 0.9975                                         max =          15

                                                F(15,1483)         =    24615.14
corr(u_i, Xb)  = 0.5319                         Prob > F           =      0.0000

------------------------------------------------------------------------------
          rd |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
    lag_rd_1 |   1.389651   .0023023   603.58   0.000     1.385135    1.394167
             |
        year |
        2002 |    .466936   2.971563     0.16   0.875    -5.361979    6.295851
        2003 |    .499356   3.054597     0.16   0.870    -5.492434    6.491146
        2004 |   .9709882   3.086038     0.31   0.753    -5.082475    7.024452
        2005 |   2.138447    3.10975     0.69   0.492    -3.961529    8.238424
        2006 |   2.162278   3.162339     0.68   0.494    -4.040854    8.365411
        2007 |   .9726881   3.252931     0.30   0.765    -5.408148    7.353524
        2008 |   1.103907   3.302289     0.33   0.738    -5.373747    7.581562
        2009 |   .1196907   3.285365     0.04   0.971    -6.324766    6.564147
        2010 |   2.175557   3.318097     0.66   0.512    -4.333107     8.68422
        2011 |   7.058801   3.331762     2.12   0.034     .5233339    13.59427
        2012 |   7.527995   3.370988     2.23   0.026     .9155828    14.14041
        2013 |   4.645996   3.383536     1.37   0.170    -1.991029    11.28302
        2014 |   3.662866   3.428515     1.07   0.286     -3.06239    10.38812
        2015 |  -1.394913   3.485999    -0.40   0.689    -8.232926    5.443099
             |
       _cons |  -1.941974   2.293289    -0.85   0.397     -6.44041    2.556462
-------------+----------------------------------------------------------------
     sigma_u |  2.3486751
     sigma_e |   23.26268
         rho |   .01009071   (fraction of variance due to u_i)
------------------------------------------------------------------------------
F test that all u_i=0: F(241, 1483) = 0.06                     Prob > F = 1.0000
```

Figure 11: R&D Fixed-effect Autoregressive Model