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The Impact of the COVID-19 Pandemic on the Expenditures of Hellenic Supermarket Customers Spending Clusters: An Econometric Analysis

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ABSTRACT

Purpose:
Given the severity and the length of the crisis caused by the COVID-19 pandemic, information on the financial impact of the pandemic becomes useful to enterprises who wish to arm themselves with strategies and policies, designed to combat the effects of similar crises. Such information is particularly useful to grocery retailers, who may need to know the effects of the pandemic on spending behaviour of different spending power classes of consumers. To that end, the study explores the configuration of (supermarket) consumer spending in Greece in relation to the number of: a) reported COVID-19 infections; b) admissions in hospital intensive care units, and: c) number of COVID-19 reported deaths, for the period between February the 26th, 2020 to April 30th, 2021.

Design/methodology/approach:
Methodologically, the paper focuses on an econometric analysis of daily spending reactions of six distinct spending clusters of consumers of Greek nation -wide supermarket chain, measured against official numbers of COVID-19 related metrics in Greece during the period of February 2020- April 2021. The data used, emerged from daily sales records of a national chain of supermarkets in Greece, consisting of 60 stores. Proven econometric causality techniques were used to analyse the data by applying Hsiao's Optimizing Procedure via the "Stepwise Granger Causality", for the statistical tests of possible interactions between variables.

Findings:
The study found a phenomenal effect of the number of reported COVID-19 related deaths on consumers' supermarket spending in Greece. The study revealed the statistically significant effects of the COVID-19 variables on the 6 buyers' clusters. These statistically significant effects have a diachronic behaviour which is varied in relation to the covid variables. The findings indicate that the biggest fluctuations in daily consumer reactions (on reported COVID-19 related variables) occurred in lower spending clusters of consumers, diminished over a period of about 15 days. The study also revealed that consumers' spending reaction on infection case is minimal compared to that of reported deaths, signalling a relative apathy to the number of reported infection cases.

Research limitations/implications:
One basic constraint was the lack of spending data over a longer period of time which would have included the entire pandemic era. Ideally the researchers would prefer to compare customer spending data of several supermarket chains, yet the availability of such data was scarce. The findings also imply that lower spending clusters react more intensively to COVID-19 outcomes and as such marketing efforts to serve these target markets may need to be customized.

Originality/value:
The interpretation of the results reveals that the level of panic that drives reactionary spending appears to be lower in higher spending consumers. This study contributes to theory by appreciating the Greek supermarket customers' psychological reaction to COVID-19 related variables, by not relying on self-reported data. Although the study was not designed to reveal the reasons for this occurrence, the results demonstrated variability

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in the reaction of customer clusters as outcomes of severely negative COVID -19 related reports. The data used were objective and the adopted analysis method was appropriate to the purpose of the study. The paper further suggests that future research could build on this study by: (a) examining causality of variability of customer spending during various phases of the pandemic by applying non-linear and possibly chaotic causality tests on daily data; and (b) identifying the exact threshold of change in consumers' spending patterns on specific product categories, as influenced by reports of COVID-19 related factors.

1. Introductions & purpose of study

The COVID-19 pandemic has so far devastated families, lives, businesses, communities, markets, sectors and economies. According to Congressional Research Service Report: R46270 (2021),the COVID-19 pandemic reduced global economic growth by 3.2% in 2020 and although some signs of gradual recovery were evident in the subsequent years, several advanced economies are estimated to underperform until 2024 due to this pandemic. The cost of human life has also been devastating. The World Health Organization (2022) reported 509,531,232 confirmed cases of COVID-19, including 6,230,357 deaths, by the 28thof April 2022 (i.e. see: https://covid19.who.int). The numbers of reported deaths notably seemed to affect the cognitive and affective state of consumers, and as such, merited empirical investigation. According to Jackson et al (2021: R46270), the COVID-19 pandemic has negatively affected global economic growth, caused a global rise an unemployment and shrank global trade by 5.3% in 2020. Beyond causing a health crisis, the pandemic also severely impacted the spending levels of individuals, as changes in degrees of spending were found to be associated with changes in consumer behavior (Di Grosta et al., 2021).

Given the severity and the length of the crisis, any information on the financial impact of the COVID-19 pandemic is always useful for enterprises, who wish to arm themselves with strategies and policies designed to combat the effects of similar crises. Such information is particularly useful to grocery retailers, who need to know the effects of the pandemic on different income classes of consumers. To that end, an exploration of the configuration of consumer spending in relation to the number of reported number of patients with COVID-19 in intensive care units in hospitals, number if infection cases and COVID-19 attributed deaths, was performed in Greece. The aim of this study is to test the effect of COVID-19 related reported effects (variables) on supermarket spending. We identified spending data of 6 clusters of supermarket levels of spending by Greek customers of a national chain of supermarkets in Greece, during the period of the Corona virus pandemic. There were concerns that the reported number of casualties attributable to COVID-19 infections influenced the psychological motives of customers towards their supermarket spending. Therefore, we were interested to explore real, measurable, long and short term COVID-19 related effects on spending, and in particular how the reported numbers of COVID-19 related deaths affected supermarket spending of consumers in Greece.

2. Framework and conceptualization

Fluctuations on consumer spending due to COVID-19 has been noted is various countries. Chronopoulos et al.(2021) investigated consumer spending in GB between January 1st to April 7th, 2020, the period of the early stages of the outbreak and the pandemic. Their work observed fluctuations of consumer spending after measures related announcements by the British prime minister of that era. Especially in terms of the product category of groceries, consumer spending increased after the World Health Organization announcement declaring the situation to be a pandemic, and after one week of the first lockdown in the UK. Chronopoulos et al.(2021) attribute this result to media reports about stockpiling, leading to *normal* panic behaviour. Overall, their study indicated that over the entire study period consumer spending varied across product categories, UK nations, consumer income levels, gender and age.

Other studies conducted in the US and China, explored consumer spending during the COVID-19 pandemic, revealing very interesting findings. Chen et al (2020) investigated consumer spending in 214 cities in China during the period of January1st to April 14th, 2020, by using daily transaction data on various product categories including among others, groceries and necessities. Their work revealed a dramatic decrease in spending in all sectors during the first 3 months of the pandemic and pointed out that offline consumer spending declined by about 32% on average in China, and regions hit most by the pandemic (i.e. Wuhan) suffered from a reduction in consumer spending as high as 70%. Similarly, Dunn et al (2020) utilized daily transaction data to map the phenomenon of declining consumer spending across several product and service sectors during this pandemic, in the US. They termed this exploration as an estimation of pandemic *effect* (the effect of the pandemic on consumer spending), which they examined in the US by using card payments data. Their study revealed a decline of US consumer spending after the mitigation measures were set in place, by 27.8% with the food/drink service, accommodation, and gas stations being hit the hardest. They also observed that the food and beverage/ groceries sector experienced about 100% increase in sales followed by a dip to below expectations for the month of March 2020. In the US the causal effects of the *pandemic shock* on consumer spending were investigated by Fink and Tillman (2022) who explored how pandemic fatalities affected household

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spending and found that the pandemic shock has a negative effect on household spending. They explained this phenomenon by arguing that driven by fear household voluntarily restrain consumption, especially as household might be expecting an alteration of their future income which motivates them to adjust their spending. Their findings indicated the lower income households bared the consumption burden during the pandemic due to job uncertainty and social distancing and that spending radically declined when bad news was announced (i.e. national emergency). They also found that the surprise increase of the difference of the realized versus expected deaths lead to a sharp drop in spending, and the pandemic shock increased inequalities of household spending during the period of April - October 2020.

Some of the results of the Fink and Tillman (2022) on the pandemic shock, eco work conducted by Di Crosta et al. (2021) on the psychological factors that affected household consumption/spending during this pandemic. Earlier literature suggested that fear affects consumer psychology during crises (Cannito et al., 2020) as well as consumers' disposition towards spending (i.e. see Baker et al, 2020 on Stockpiling during the pandemic). Di Crosta et al (2021) demonstrated that consumer purchase of necessities was predicted by anxiety and Covid-19 related fear, where as consumer behaviour towards non necessities was predicted by depression, although spending on necessities increased in the first week of the lock down. They recommended the further exploration of consumer behaviour at different phases of the COVID-19 pandemic based on actual spending. Our present study attempts to address the research recommendations of Di Crosta et al (2021) by utilizing actual (daily measurements) of consumer spending as a consequence to factors that may affect consumer psychology such as reported infections, deaths and ICU admissions due to this pandemic in Greece. A snapshot of the numbers of the COVID-19 attributable deaths in Greece is presented in Appendix A.

3. Methodological approach

Over the years, the framework for exploring, formulating, measuring, calibrating and finally implementing economic policy measures based on econometric models has evolved. The catalyst was the work of Christopher Sims (1980) who criticized the utilization of large-scale econometric models with too many equations and constraints, arguing in favor of using a simple equation or a model consisting of a few stochastic equations. In attempting to explore the causality of COVID-19 effects to (supermarket) spending, we consider standardized causality techniques based on the works of Sims (1980) and Hsiao (1979).

Based on the above literature, the framework for the formulation of economic policy for two stationary economic variables $\{y_t\}$ and $\{x_t\}$, with endogenous variability could be presented as follows:

- Statistical test for possible diachronic interactions (Granger) between the two variables: announced number of covid-19 related deaths and supermarket spending.
- Formulation and quantification of this interaction. The quantification of the interactions is usually based on the estimation of an autoregressive system of equations with each of the two variables as endogenous and the formulation consists in the specification of the diachronic interactions and the corresponding variance decompositions. The specification of the interactions between the variables $\{y_t\}$ and $\{x_t\}$involves a descriptive approach on how each variable affects the other.
- In Figure 1 seen below, we present the diachronic effect of variable $\{x_t\}$(deaths) on the variability of $\{y_t\}$ (spending), as well as the basic descriptive measures of this effect. These measures include the mean, variance, length and height of the effect as well as the respective decimals.

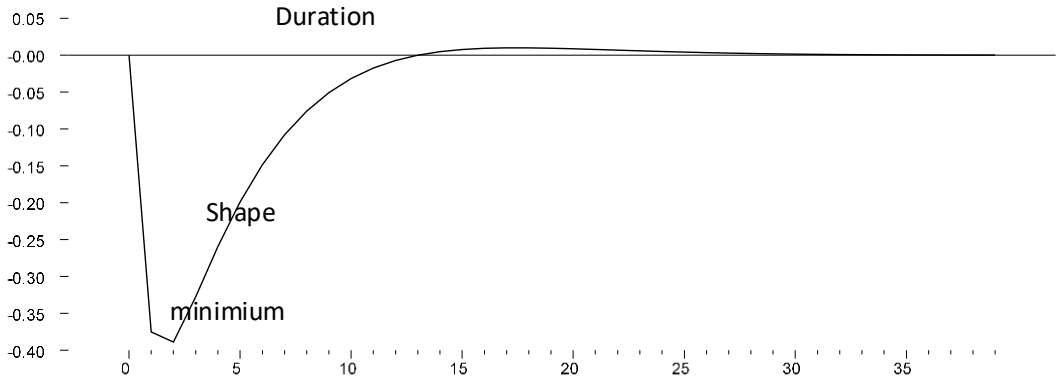

Figure 1. Presentation of a diachronic effect of $\{y_t\}$ on $\{x_t\}$

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We define the 5 clusters of outcomes on the basis of their total annual supermarket spending during the period 26/February/2020- 30/April/2021. These categories follow:

1. Cluster 1= 100-2000 euros
2. Cluster 2= 2001 – 4000
3. Cluster 3= 4001-6000
4. Cluster 4= 6001-8000
5. Cluster 5= 8001- 10000
6. Cluster 6= 10001- 15667.57

3.1 The research design

In this section the method applied to the investigation of the possible feedback effect between supermarket spending and announced COVID-19 related deaths is the standard method of Hiao (1979). The approach of this investigation is econometric, rather than opinion-polled customer self-reported spending, and was based on real sales figures of a nationally wide supermarket chain in Greece, consisting of 60 stores, rather than self-reported data. The supermarket chain begun its operations in 1980 in Crete and currently sustains stores in the entire vicinity of Greece. Various techniques have been proposed in the literature for the performance of statistical tests used to detect the existence of dynamic Granger interactions between two variables. In this paper we followed Hsiao's Optimizing Procedure or the "Stepwise Granger Causality", for the statistical tests of possible interactions between variables. This adoption of this method is justified by the literature, as this is an effective method in detecting the appropriate feedback effect between the considered variables (i.e. see: Granger, 1986; Christiano & Eichnbaum, 1987; Johansen, 1998). For each of the two variables and this method proposes the following procedure (three step procedure):

3.1.1 Control of Granger causality: Step 1

1. We estimate the autoregressive equations for s=1,2

$$(x_t) = \sum_{s=1}^{M} \alpha_s x_{1,t-s} + u_{1t} \quad t = 1,2,3,..T \ (1)$$

where M is the arbitrarily defined maximum number of the terms of the polynomial. In this paper, the maximum length has been set at 14, as we believe that a ten-day lag length is sufficient to include every relevant information on the interaction of the variables (as per the Hsiao, 1979 method). The optimal order of time lags can be determined by minimizing the Forecast Prediction Error, henceforth FPE(M,0):

$$MinFPE(M^*,0) = \frac{T+m+1}{T-m-1}\frac{SSE}{T} (2)$$

$$SSE = \sum_{t=1+M*}^{T} u_{1t}^2 \quad (3)$$

2. For the pair of variables of our model, we estimate the regression: $x_t = \sum_{s=1}^{M^*_i} a_s\, x_{1,t-s} + \sum_{r=1}^{N} b_r y_{1,t-r} + u_{2t}$

and we minimize the $FPE^M(M^*,n^*)$(4)

Where $i \neq j$ and n run from 0 to M. Then we choose n such that the FPE is minimized. Also, M_j^* is the optimal order of x_t selected in step (1).

According to the "Stepwise Granger causality test", the variable y_t causes in the Granger sense the variability of x_t if $FPE^{y,x}(M^*,n^*)$ is lower than $FPE^y(M^*,0)$
or $FPE^{y,x}(M^*,n^*)/FPE^y(M^*,0)<1$.

We followed exactly the same steps from (1) with y_t as the dependent variable and x_t as the independent, in order to define the optimal order of the polynomial (4).

3. After the determination of the optimal orders of M_i^* and n_i^* for $i > 1.2$in the previous steps, a VAR can be estimated:

$$\begin{pmatrix} x_t \\ y_t \end{pmatrix} = \begin{pmatrix} A(L) & B(L) \\ C(L) & D(L) \end{pmatrix} \begin{pmatrix} x_t \\ y_t \end{pmatrix} + \begin{pmatrix} u_t \\ \varepsilon_t \end{pmatrix} \quad (5)$$

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where A(L), B(L), C(L) and D(L) represent the lag polynomials fitted in step (2) above; They are shown as follows:

$$\left.\begin{aligned} A(L) &= \left(a_1 L + a_2 L^2 + \cdots + a_{Mi} L^{M_1^*}\right) \\ B(L) &= \left(b_1 L + b_2 L^2 + \cdots + b_{ni} L^{n_1^*}\right) \\ C(L) &= \left(c_1 L + c_2 L^2 + \cdots + a_{Mj} L^{M_2^*}\right) \\ D(L) &= \left(d_1 L + d_2 L^2 + \cdots + d_{ni} L^{n_1^*}\right) \end{aligned}\right\} \qquad (6)$$

Then the full – information maximum likelihood method (FIML) is used in estimating (5).

3.1.2 Quantification of the interactions between variables: Step 2

The system of equations (5) is estimated using the Generalized Least Squares method. The utilization of data series with different temporal aggregation is very likely to distort the possibility for an effective application of the test described above. This distortion can be stronger if the true interaction between the variables x_t and y_t is realized at a level of high disaggregation. For instance, we can imagine a case of two monthly time series that do not have a causal relationship, however if aggregated at a quarterly level, some form of causality, appears.

Given the fact that quite often, when trying to formulate dynamic interactions between economic variables, data at higher aggregation level are used in lieu of lower, simply because of lack of availability at the desired level. Therefore, there is a high probability that we may end up *detecting* false or non-existent dynamic interactions between the economic variables under investigation.

Given $Z = X\beta + E$ (7)

where Z is the matrix of endogenous variables $\left(x'_t\ y'_t\right)$ and X the matrix of the explanatory variables, as defined in (5) and (6).

If $E = \begin{bmatrix} u_t \\ \varepsilon_t \end{bmatrix}$ then $\sum \begin{bmatrix} \sigma_{11} & \sigma_{22} \\ \sigma_{21} & \sigma_{12} \end{bmatrix}$ and $V = \sum \otimes I_T$ (8)

or

$$V^{-1} = \sum \otimes {I_T}^{-1} \qquad (9)$$

and the Generalized Least Squares estimation function will be:

$$\hat{\beta} = [x' V^{-1} x]^{-1} x' V^{-1} Z \qquad (10)$$

$$V\left(\hat{\beta}\right) = (x' V^{-1} x)^{-1} \qquad (11)$$

3.1.3 Representation of diachronic interactions: Step 3

The representation of the dynamic interactions between variables $\{y_t\}$ and $\{x_t\}$ can be expressed in two ways, either in the form of impulse response functions or via the procedure of variance decompositions. In the case of impulse response functions, the results show the way the interactions between the variables $\{y_t\}$ and $\{x_t\}$ are spread over a time dimension. In the case of variance decomposition analysis, the variance of a variable is broken into the part due to its own internal variability and the percentage due to the causal diachronic interactions with other variables.

4. The findings of the study

In this study we used daily data during the period February 2020-April 2021. The data were made available by supermarket chain and the official site of the Hellenic Ministry of Health. A graphical representation of the diachronic co-variability of the total spending and the number of deaths is presented in figure 2. This figure demonstrates the power of the diachronic co-viability between these 2 variables. The blue line reflects the supermarket spending during the period Feb/20- Apr/21 and the black line reflects the official number of announced deaths due to Covid-19. In this figure we observe the linear correlation between these two variables, specifically the negative interaction of consumer spending and the announcement of deaths. Also, we observe a peak in spending due to the Christmas/holiday season while the numbers of deaths begun to decline. In addition, for the period Oct-Nov/2020 – April 2021, we notice a phenomenal effect of the announcement of deaths on supermarket spending which we tested by applying the Granger causality test method using the approach of Hsiao (1979).

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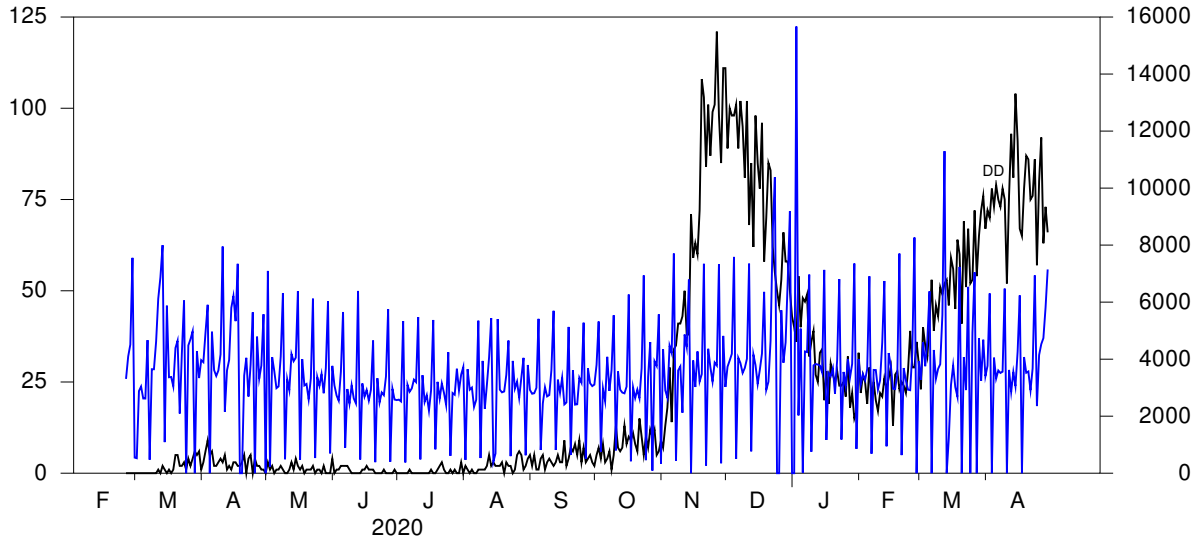

Figure 2. Co-variability between supermarket total spending and Covid-19 related deaths' announcements.

Before applying the causality tests in the supermarket spending data and Covid-19 data set, we investigated the order of integration using the Augmented Dickey Fuller test (ADF) for unit roots (see table 1).

Table 1: ADF test results at levels

	ADF(0)	ADF(1)	ADF(2)	ADF(3)	ADF(4)
Variable					
Cluster 1	-23.1467	-16.1283	-11.2314	-7.86966	-6.66474
Cluster 2	-20.8661	-14.2959	-11.5605	-10.0434	-9.01559
Cluster 3	-24.298	-16.4374	-12.4692	-10.1566	-8.54282
Cluster 4	-21.2029	-15.2209	-12.9163	-11.5194	-10.2196
Cluster 5	-26.3399	-16.2978	-12.258	-9.74952	-7.3791
Cluster 1	-21.8411	-15.5987	-12.787	-10.6767	-9.72488
Total Consumption	-26.9733	-17.9757	-13.5564	-10.4007	-8.29584
Covid-CASES	-4.53388	-3.83302	-2.71976	-2.14949	-1.63451
Covid Deaths	-2.70905	-1.53883	-0.97476	-0.8808	-0.67583
Covid METH	2.562742	1.168468	0.404625	-0.18113	-0.6602

Table 2: ADF test results at first differences

	ADF(0)	ADF(1)	ADF(2)	ADF(3)	ADF(4)
Variables					
Covid-CASES	-25.7272	-14.4505	-10.8972	-9.6127	-9.51275
Covid Deaths	-23.8675	-15.5726	-11.1621	-8.36651	-7.37323
CovidMETH	-16.6848	-9.87127	-8.98986	-9.34969	-7.11977

Table 1 reports the ADF test of the null hypothesis of non stationarity (H0). The number of lags in the ADF egressions is determined on the basis of the Akaike Information Criterion (AIC). The 5% critical value of the ADF test is −3.36.

Table 2 reports the results of the application of the Hsiao causality method and specifically the arithmetic application of formula 13. The numbers in the cells of Table 2 correspond to the ratios:

The numbers in the cells of Table 1 correspond to the ratios:

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$$FPE^{y}(m^{*},0)/FPE^{x}(m^{*},n^{*}) \quad (12)$$

where

$$FPE^{y}(m^{*},0)=\frac{T+m^{*}+1}{T-m^{*}-1}\frac{SSE_1}{T}\,FPE^{y}(m^{*},n^{*})=\frac{T+(m^{*}+n^{*})+1}{T-(m^{*}+n^{*})-1}\frac{SSE_2}{T} \quad (13)$$

$$SSE_1=\sum_{t=1+M}^{T}\hat{u}_{1t}^{2}\;SSE_2=\sum_{t=1+M}^{T}\hat{u}_{2t}^{2} \quad (14)$$

$$x_i-\sum_{s=1}^{m^{*}}\hat{a}_s\,x_{i,t-s}=\hat{u}_{1t}x_i-\sum_{s=1}^{m^{*}}\hat{a}_s\,x_{i,t-s}-\sum_{r=1}^{n^{*}}\hat{b}_r x_{j,t-r}=\hat{u}_{2t} \quad (15)$$

As long as the ratios (12) are greater than 1, we accept that variable $\{x_t\}$ affects in a Granger sense the formulation of the variability of variable$\{y_t\}$.

As long as the ratios (13) are greater than 1, we accept that variable $\{x_t\}$ affects in a Granger sense the formulation of the variability of variable $\{y_t\}$.

Table3. Direct Granger-causality test between Covid Variables and the different clusters of consumption

	LINEAR CAUSALITY					
	Manipulated Variable					
Controlled Variable	Cluster 1	Cluster 2	Cluster 3	Cluster 4	Cluster 5	Cluster 6
Covid-CASES	1.00542	1.00542	1.00542	1.00542	1.16307	1.06307
Covid Deaths	1.02024	1.0024	1.0024	1.2024	1.14500	1.06400
Covid Intensive Care Units	1.9990	2.9990	1.9990	1.93930	1.99815	0.99815

Source: Our Results

Based on the results of Table 3, we can see that there is a causality of announced COVID-19 related deaths on supermarket spending. Using the method of Hsiao (1979) we detect the direct causality of all Covid related variables to the supermarket spending of each cluster of buyers. In Figures 3a-c we can see a diachronic effect between 2 variables. As the graph lines 3a, 3b, 3c, flatten, there is a standard decrease without osculation and cycles. In 3a we can see the effect of 1% of change in the number of COVID-19 infection cases on the 6 buyers' clusters. In 3b we can see the effect of 1% of change in the number of COVID-19 intensive care unit patients, on the 6 buyers' clusters. In 3c we can see the effect of 1% of change in the number of covid-19announced deaths on the 6 buyers' clusters. Finally, in 3d we can see a comparison of the dynamic effects of the of the COVID-19 variables (Cases, Deaths and number of patients in Intensive Care Units) on the six consumption clusters.

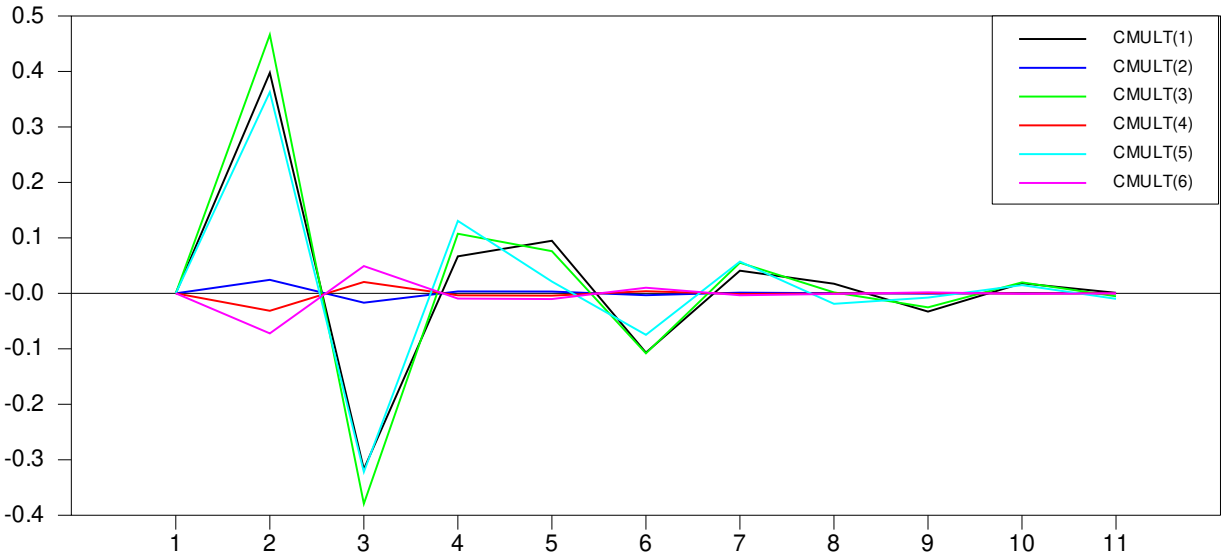

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Figure 3a. The Dynamic Effects of the Announcement of the Number of Covid-19 Infection Cases on the Six Supermarket Spending Clusters

Note: the colored lines in figures 3a, 3b, 3c and 3d mean the following: black=cluster 1, blue=cluster 2, green= cluster 3, red=cluster 4, turquoise= cluster 5 and pink= cluster 6.

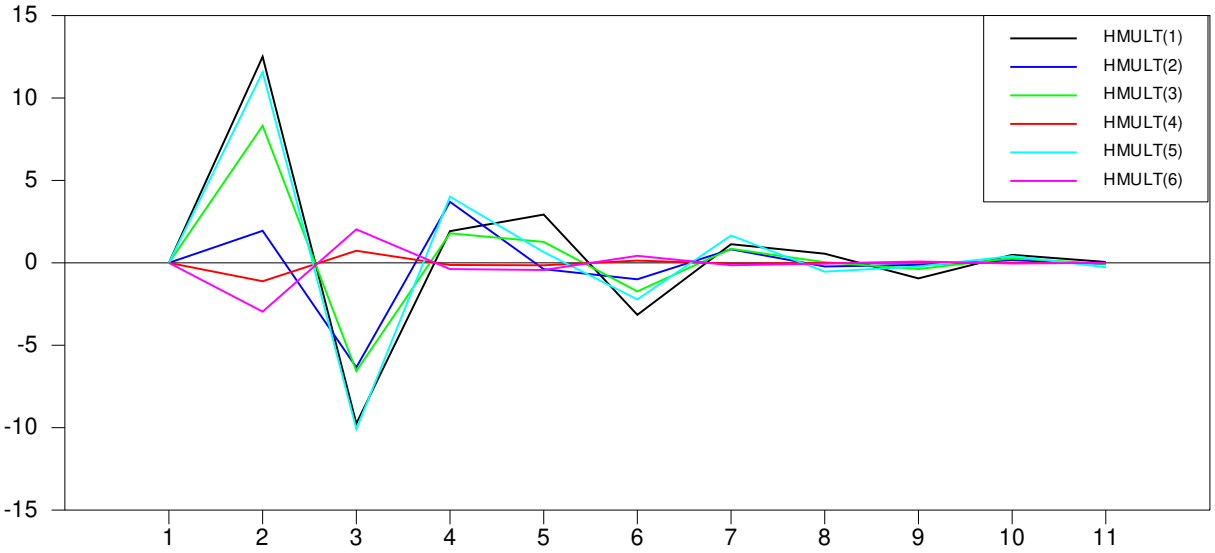

Figure 3b. The Dynamic Effects of the of the Number of Covid-Intensive Care Units on the six consumption Clusters

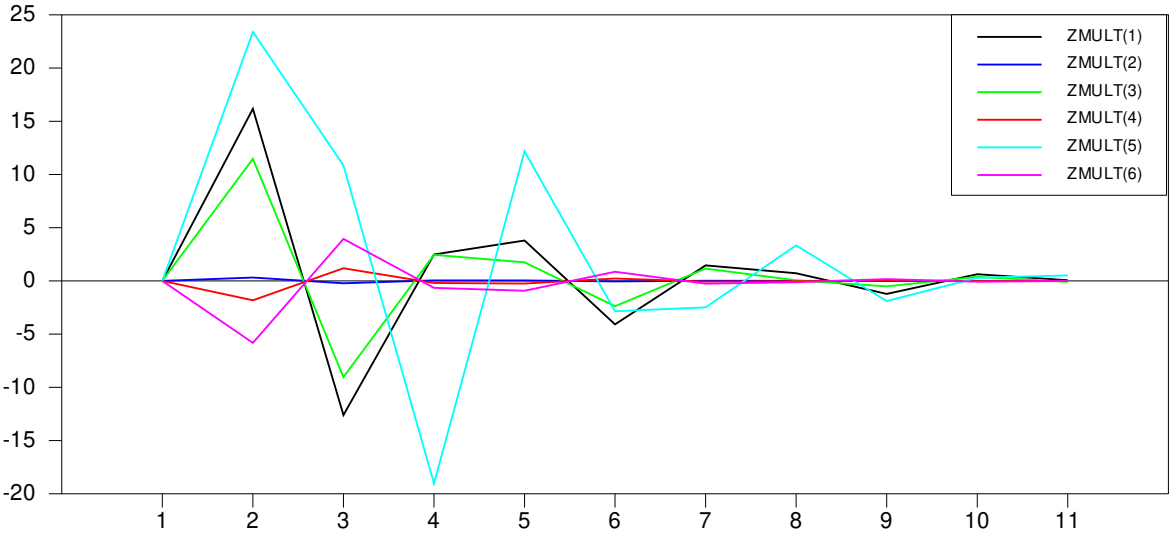

Figure 3c. The Dynamic Effects of the of the Number of Covid-Deaths on the six consumption Clusters

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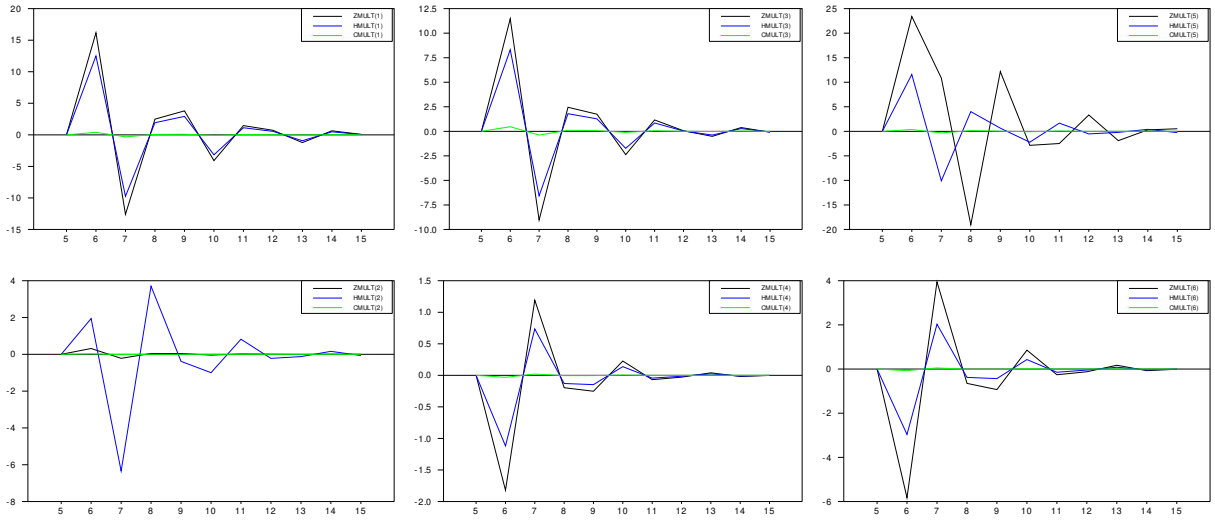

Figure 3d: A Comparison of The Dynamic Effects of the of the Covid Variables (Cases, Deaths and Intensive Care Units) on the six consumption Clusters (green = cases blue=intensive care, black deaths) clusters 1, 2,…6

According to the above estimations, we confirm the statistically significant effects of the Covid variables on the 6 buyers' clusters. These statistically significant effects have a diachronic behavior which varied in relation to the Covid variables. More specifically, the most prominent effect is the one attributed to the number of reported deaths followed by the number of COVID-19 patients admitted to intensive care units and finally by the number of the announced COVID-19 infection cases. The effects of these COVID-19 related variables appear to last for a period of 15 days.

Another finding of the study is related with the shape of the diachronic effects of the Covid variables on the 6 buyers' clusters. These effects are not straight lines, but they follow cyclical patterns which mirror the nature of the data. These data show that the convergence of the effects, includes information which can be used to comprehend the characteristics of the effects of COVID-19 on consumer spending in Greece. For example, as seen in figure 3c, following the reported number of deaths attributable to COVID-19, the 5th cluster of buyers demonstrate an increase in spending which starts to decrease on day 3, and on day 4 it plumets to about 20% lower spending that the average spending of the period. Also, cluster 5 demonstrates the highest reaction to the reported number of deaths compared to clusters 4 and 6. Furthermore, the data indicate that the number of reported deaths impacts consumption spending more than reported infection cases and reported number of patients admitted to intensive care due to COVID-19.

Figure 3d demonstrates unexpected effects of some Covid variables on Greek consumer spending. In principle the number of reported infection cases was expected to bare impact on consumer spending, however the results indicate that consumer spending reaction on infection cases is minimal compared to that of reported deaths, leading us to wonder about the apathy of Greek consumers to such information. Furthermore, clusters 1 and 2 demonstrate similar reactions to the 3 Covid variables. Cluster 3 demonstrated they highest reaction on consumer spending due to reported deaths than any of the other clusters. This cluster is also sensitive to reported number of patients admitted to intensive care units. The results of cluster 4 are rather surprising, as they indicate a reverse of the effects of Covid variables on consumer spending going a lead on the variable of reported number of patients admitted to intensive care units. The most prominent observation regarding the results of clusters 4 and 5 is the fact that number of reported deaths and intensive care unit admitted patients, do not lead consumers to increase their purchases for the first 6 days following the announcements. This data suggest that lower spending clusters (reflecting lower income consumer groups) appear to fear the reported outcomes of COVID-19 pandemic leading them to spending reaction which are not replicated by high income consumer groups. As such, the level of panic that drives reactionary spending appears to be lower in higher income consumers, who tend to normalize their spending after day 12 according to the standard reaction of the entire market.

5. Conclusion

The current study offers insight into the spending behaviors of a number of Hellenic-consumer spending clusters during the early periods of the COVID-19 pandemic. The analyses conducted (based on the application using the RATS software) revealed that after a certain period following the reports of the numbers of infections, deaths, and

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ICU admissions due to COVID-19, spending normalizes, leading to stable convergence after 13 days. We observed that on average, the number of reported deaths affect spending sensitivity more than the number of infections and the numberCOVID-19 patients in ICUs (except in the case of cluster 4). Also, we found that the number of reported deaths of cluster 3 shows a high variability and in cluster 4 the intensive care unit admitted patients appears to affect spending, more dramatically than other Covid related variables. Although it was not part of the purpose of this study, we are interested to discover why spending patterns of the clusters vary. The submitted literature revealed several psychological factors that affect consumer spending in such circumstances (i.e. fear) however we have no evidence about their effect on the specific population. Clearly as shown in this study lower spending clusters react more intensively to COVID-19 outcomes. This finding is consisted with other studies presented in the literature however our work was not designed to reveal the reasons for this occurrence.

The outputs of the study bare implications for both business practice and research. The reasons that cause the variability in the spending patterns of the clusters could be explored to provide answers to retailers' questions on how to best manage supply of goods during crises. Methodologically speaking we recognize the need to conduct non-linear and possibly chaotic causality tests on daily data per: sector, county, country, continent, income class, urban versus rural populations, online versus physical shopping of the populations under study. Such results can be useful for entire grocery retail supply chains and individual grocery stores as well. Also, we signal the need to examine threshold info in relation to specific *types of products* on spending distributions. This means we could examine the exact threshold of change in consumers' spending patterns on specific product categories, as influenced by reports of COVID-19 related factors (i.e. deaths infections, ICU admissions). Finally future studies on this phenomenon conducted in Greece, could replicate the approach of Ng et al (2022), in exploring how psychological traits of Hellenic consumers affected their supermarket spending during the COVID-19 pandemic. Such work could aid grocery retailers better predict the composition of the product portfolia critically affected by reported crises outcomes, aiding them in better managing pricing and just in time delivery of such product classes. The study revealed time lags pertinent to specialty logistics management, including promotional and pricing policy decisions for supermarket and grocery retailers. Thus, the study identifies opportunities for inventory and warehouse management decisions of supermarket related items producers. Finally, we suggest that the study identifies time related opportunities for social media advertising campaign strategists, related to reactionary messages to reported numbers of covid related variables.

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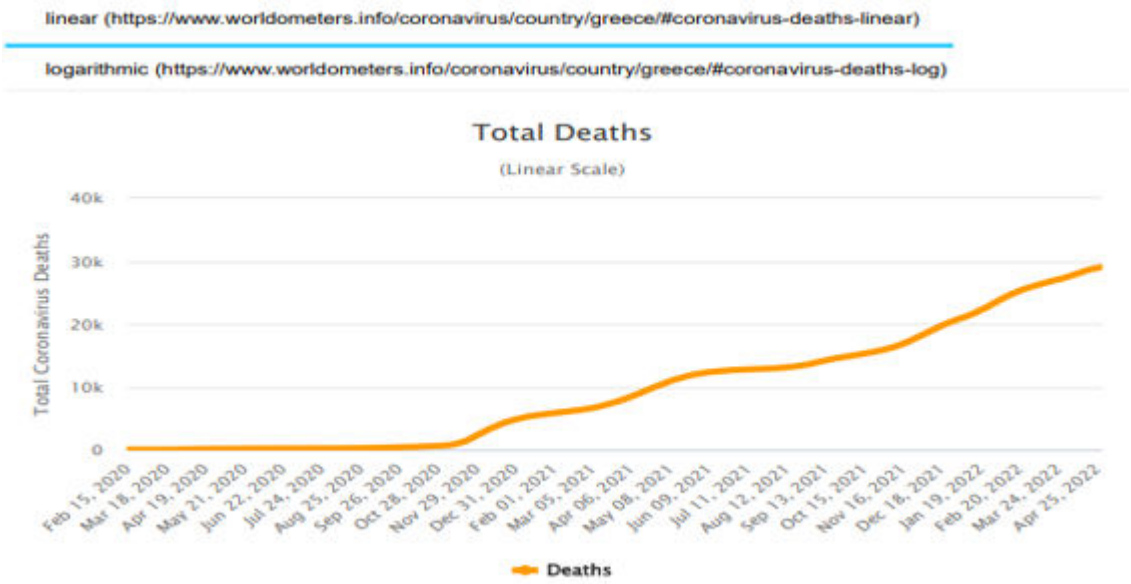
Appendix

Appendix A: Total number of Coronavirus deaths in Greece



Source: https://www.worldometers.info/coronavirus/country/greece, accessed April 29, 2022.

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