INERTIA. MODELS AND APPLICATIONS TO ECONOMY

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Abstract

In the economy there is inertia in the performance of distribution companies. It can particularly be highlighted by the extent of sales variation in a certain period as compared to the previous one. Another interesting phenomenon is the behavior of economic agents in relation to different events such as social conflicts, uncertainties created by the crisis, major changes in the activity of companies given by fiscal relaxation, privatization or nationalization, etc.

Concretely, Romanian business environment was severely affected by the economic crisis in the years 2009-2010, a time when the real estate blockage led to new construction cessation as well as to the freeze on those being in different stages of construction. Starting with 2010, the price of building materials dropped at times steadily but relatively sharply other times, in this way affecting the activity of manufacturers, importers and distributors in the field. The effect is directly revealed by sales revenues from current sales as opposed to those registered in previous periods. After the crisis, the major cause is the price of promoting and selling the products.

In this paper I aim to analyze the extent to which product distribution (quantified in sales revenues) is sensitive to past price changes, past distribution returns, as well as to major reforms in VAT in 2016, in terms of inertia.

The analysis refers to the trading companies specialized in the field of metallic materials for construction and light, medium and heavy metal fabrications active in Romania between 2011 and 2016. The products belonging to this commercial area with direct implications on the construction and real estate market in general are wire and wire mesh for reinforcement, longitudinally welded or laminated, rectangular or round pipes, profile type angles, tees, strip, strips and sheets in different shapes and sizes, black or thermally galvanized against corrosion.

As regards the price of metallurgical products in the construction sector, the analyzed period is characterized by instability: a steady price decrease trend was followed by an interval of instability with slight fluctuations, followed by a linear growth period.

In the period 2015-2016, government measures directly influenced the construction materials market. The law proposed for adoption, which was

approved and implemented as of January 1, 2016, was to lower VAT on all products from 24% to 20% and in the case of new dwelling purchase, houses and apartments below the threshold of 100,000.00 euros, VAT was reduced from 24% to 5%.

Under these conditions, the market has experienced a major change in the real estate and building materials sectors. If final beneficiary's advantage at the time when VAT reduction was implemented was 18%, due to previous instability on the market, when successive price oscillations averaging 2% had occurred, by 2016 it had gradually reduced to about 13%. Progressively, starting from the recovery of wasted iron, following the normal course, factory – distributor (importer) – trader, the price of building materials increased by 4.67% as compared to the similar period of the previous year.

The government reform implemented on January 1, 2016 had a definite impact on the following period, generating advantages for manufacturers, distributors, builders and end-users.

In the work that follows a separate analysis was made on the impact of the above mentioned measure and the role it played in an inertial maintainance of the sales trend for another quarter against a price increase background.

Keywords: inertia, price, sales, variables, coefficients, regression, statistical tests

JEL Classification: C01, L11, L61

Introduction

Formulated in 1640 by Galileo Galilei, the principle of inertia, was rephrased by Newton as a law of motion. Inertia was defined as the property of a body that tends to stay at rest or maintain its motion unless acted on by a net external force. Therefore, the first law of dynamics or inertia law can be summed up as follows: *A body moving on a level surface will continue in the same direction at a constant speed unless disturbed* (Newton I. - 1967)

In the same way, in economy a company engaged in an economic activity, regardless of the NACE area it deals in, tends to maintain the course of its development in the market as long as other entities or events do not act upon it and change its state (as is the case of physics). Examples of such entities could be other competing trading companies that manage to capture its customers; as for the events, these can be measures taken by the legislator that lead him to change the current state of the commercial society in order to continue its economic activity in another form or another level.

In the physical law of inertia, the key element is the body, which is moving or at rest, but the physical measure describing its inertia is its mass; the greater a body's mass is, the higher its inertia.

In economy, the body is the company (the commercial society) that should respond directly in proportion to the meaning in physics, namely, the greater it is, the higher its inertia should be when acted upon by disturbing factors. On this point particularly we are going to focus our attention and analyse its validity.

As follows, an analysis will be conducted in the case of four companies in the trade of construction materials and metallic light, medium and heavy fabrications, active in Romania during the period 2011-2016. The analyzed societies are characterized by the fact that two of them are considered large companies (*great mass objects*) with annual turnovers exceeding 100,000,000.00 lei, while the other two companies with turnovers below the mentioned thresholod are considered as belonging to the small and medium-sized category.

Literature review

Anghelache, C. and Anghel, M.G. (2016) presented statistical methods and models used in the analysis of economic phenomena. Anghelache, C. and Anghel, M.G. (2014) studied the main statistical and econometric models, presenting a series of fundamental aspects regarding micro and macroeconomic research. Anghelache, C. (2008) is a reference work in the field of economic statistics and analyzed the statistical indicators applicable in the study of entity evolution and the correlations between variables. Gheorghiu, A. (2007) classifies different economic models and uses a range of physical models to analyze economic phenomena. Gheorghiu, A., Spanulescu, I. (2007) have studied aspects relating to the application of physics and mathematics in economic theories. Gligor, M., Ignat, M. (2003) analyzed the applications of theoretical physics in macroeconomic modelling. Bulinski, M. (2007) addresses the field of economics. Pecican E.S. (2005) addresses the regression models (multifactorial or linear one-factor), the significance and insignificance of dependence between variables. Isaic-Maniu A., Mitruț C., Voineagu V. (2004) analyze indexes and calculates them as a ratio of two averages, indexes of value, physical volume and prices. With regard to applications of the principle of inertia to the study of economic phenomena, several studies can be mentioned. Rizki, Turner, Hall (2011) applied the inertia concept in interpreting data related to inflation in Indonesia, while Vuslat and Ozkan (2005) addressed the topic of inflationary inertia in the case of recent Turkish economy.

Research methodology, data, results and discussions

In order to quantify dependence relations in the economy, several theories and methods have been elaborated, among which we mention the calculation of relative quantities, elasticity, multiplier theory, connection theory (direct, inverse), as well as statistical regression.

In order to quantify the effect income obtained at momentum *t* as compared to the ones obteined in *t-1*, due to causes related to price changes, the regression will be used, a model often used in Econometrics. The results of the regression analysis are statistically verified (F-test, t test, etc.) to assess the significance of the influence the effect changing has as response to modification of the cause.

The linear regression model – multifactorial case will be used for accuracy related purposes in analysing sales revenues inertia to modifying factors in the case of the four companies in focus.

The linear regression model - the multifactorial case

$$y_t = a_0 + a_1 * x_t + ... a_k * x_{kt} + u_t \quad [1]$$

where y_t, x_t,...., x_{kt} = factors

a_0, a_1,..., a_k = regression parameters

u_t = residual value

We will consider revenues in *t-1* noted in tables as *YT1*; revenues in t-2 noted *YT2*; and revenues in *t-3* noted *YT3*. The average selling price will be marked with P.

Firstly the effect of inertia due to past earnings will be considered.

Multifactorial linear regression model in this case will be as follows:

$$Y_t = C_1 + C_2 * P + C_2 * Y_{t-1} + C_3 * Y_{t-2} + C_3 * Y_{t-3} \quad [2]$$

For all companies analyzed were considered quarterly revenues during 2012 - 2016, in this way having data for a total of 20 quarters for periods *t*, *t-1*, *t-2* and *t-3*.

The first company under consideration is part of the medium and small companies category, with an annual turnover under 100,000,000.00 lei. The data obtained are quantified in Table 1.

Table 1

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	12583126	6248290.	2.013851	0.0623
P	-3355.835	3593.549	-0.933850	0.3652
YT1	0.702875	0.248316	2.830565	0.0127
YT2	0.088190	0.306972	0.287289	0.7778
YT3	-0.291950	0.245612	-1.188664	0.2531

R-squared	0.564296	Mean dependent var	21073766
Adjusted R-squared	0.448109	S.D. dependent var	1935452.
S.E. of regression	1437835.	Akaike info criterion	31.40749
Sum squared resid	3.10E+13	Schwarz criterion	31.65643
Log likelihood	-309.0749	F-statistic	4.856767
Durbin-Watson stat	2.083979	Prob(F-statistic)	0.010295

Data source: http://www.mfinante.ro/infocodfiscal.html

According to the obtained results, for the analyzed company, F-statistical is 4.85 and is higher than Ft = 3.06, which validates the used model.

As far as t-statistic for Y_{t-1} is concerned, it is 2.83, which is also higher than $t_{tabelat}$ = 2.131, indicating a sales inertia in relation to the high price change for this company. Also, the error probability for Y_{t-1} is 1.27%, which confirms the inertial behaviour of sales.

The second company in focus is the smallest among the analyzed ones and the results are summarized in Table 2.

Table 2

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	2889162.	923263.8	3.129292	0.0069
P	-2328.000	795.0100	-2.928265	0.0104
YT1	0.354997	0.270797	1.310936	0.2096
YT2	-0.412666	0.300254	-1.374390	0.1895
YT3	0.050010	0.209310	0.238927	0.8144

R-squared	0.911201	Mean dependent var	1472280.
Adjusted R-squared	0.887522	S.D. dependent var	255101.4
S.E. of regression	85555.32	Akaike info criterion	25.76403
Sum squared resid	1.10E+11	Schwarz criterion	26.01297
Log likelihood	-252.6403	F-statistic	38.48041
Durbin-Watson stat	2.204312	Prob(F-statistic)	0.000000

Data source: http://www.mfinante.ro/infocodfiscal.html

In the case of the analyzed company, F-statistical is 38.48, well above the table value, which validates the used model.

Unlike the previously analysed company, t-statistic has a value of 1.31, indicating lower inertia, while having a large error margin of 20.96%. Therefore, as regards the company with the smallest turnover in the analysed group, we consider that other factors that have not been taken into account influence sales and shield or distort inertia for the quarterly data. In other words, sales inertia maintains for a period less than a quarter, the small firm responding more quickly to the factors involved than larger firms.

The R-squared coefficient corresponds to a value of 0.91 close to the unit.

The third company the analysis focuses on belongs to the category of large trading companies, with an annual turnover above the mentioned threshold, the data being recorded in Table 3.

Table 3

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	5549816.	8150702.	0.680900	0.5063
P	2860.715	3795.802	0.753652	0.4627
YT1	1.068860	0.222135	4.811757	0.0002
YT2	-0.012629	0.347421	-0.036351	0.9715
YT3	-0.210378	0.254354	-0.827106	0.4211

R-squared	0.878032	Mean dependent var	46609020
Adjusted R-squared	0.845507	S.D. dependent var	2798141.
S.E. of regression	1099826.	Akaike info criterion	30.87152
Sum squared resid	1.81E+13	Schwarz criterion	31.12045
Log likelihood	-303.7152	F-statistic	26.99575
Durbin-Watson stat	2.191505	Prob(F-statistic)	0.000001

Data source: http://www.mfinante.ro/infocodfiscal.html

The result indicates a value for F-statistic of 26.99 far above the table value, which validates the used model.

As regards the t-statistical evolution for the *t-1* period, we observe the value of 4.81, which is higher than the one tabulated, and an error margin below 0.01%, which confirms the inertial maintenance of sales over the next quarter. Sales inertia is lost in the second quarter, a fact confirmed by t-statistical in *t-2*, which records the value of -0,036.

The R-squared coefficient corresponds a 0.87 close to the unit.

The last company analysed is also a large company, and the data are listed in Table 4.

Table 4

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-21473115	17892568	-1.200114	0.2487
P	20387.39	13405.79	1.520791	0.1491
YT1	0.946126	0.261080	3.623897	0.0025
YT2	0.234892	0.356818	0.658296	0.5203
YT3	0.031395	0.409219	0.076720	0.9399

R-squared	0.930037	Mean dependent var	44106825
Adjusted R-squared	0.911380	S.D. dependent var	4229609.
S.E. of regression	1259120.	Akaike info criterion	31.14204
Sum squared resid	2.38E+13	Schwarz criterion	31.39098
Log likelihood	-306.4204	F-statistic	49.84938
Durbin-Watson stat	1.962165	Prob(F-statistic)	0.000000

Data source: http://www.mfinante.ro/infocodfiscal.html

In the case of this society, F-statistical is 49.84 thus validating the used model.

As in the case of the previous company, the behavior of this one is similar, with the t-statistical values for *t-1* being 3.62 higher than the tabulated limit with a very low error margin of less than 0.01%. Sales inertia to the occurred changes is lost in the second quarter from the time the cause initiated.

Correspondingly, the R-squared coefficient is close to the unit value of 0.93.

After analyzing inertia sales revenue compared with the previous quarter achievements, a relevant concluding remark can be drawn. Companies with high turnover have higher inertia of income which maintains throughout the following quarter, while very small firms have a lower inertia, this being maintained for a period shorter than a quarter.

This aspect is directly proportional to the phenomenon of physics where a body with a large mass has a higher inertia than a body with a smaller mass. Thus, sales inertia to price changes as opposed to prvious periods are confirmed, and in economy act in a way similar to classical physics models.

As follows, we propose to analyze the extent to which a major decision (VAT reduction from 24% to 20% for all products and from 24% to 5% for the purchase of new houses falling below the value of 100.000,00 euros) will influence the inertial phenomenon in the activity of the distribution companies.

The modifications regarding VAT generated a qualitative change (being preceded by a relative stability of the value of VAT) followed by another situation different from the former.

With the purpose of quantifying the outcome of the intervention, the solution is to introduce the alternative variable that we mark with D, with zero values until the fourth quarter of 2015 and the value of one for the other four quarters of 2016.

As a result, the regression model that will also include the alternative variable will become:

$$Y_t = C_1 + C_2*P + C_2*Y_{t-1} + C_3*Y_{t-2} + C_3*Y_{t-3} + C_5*D_t + C_6*D_{t-1} \qquad [3]$$

The results are conclusive particularly regarding the inertial aspect in small firms. In this way, if we choose to exemplify one of these companies, we get solutions like those in the following table:

Table 5

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	2280051.	926546.8	2.460805	0.0286
P	-1832.505	760.2617	-2.410361	0.0315
YT1	0.220056	0.236617	0.930010	0.3693
YT2	-0.344550	0.278760	-1.236009	0.2383
YT3	0.356553	0.211263	1.687721	0.1153
D1	173588.0	91710.39	1.892784	0.0809
D2	-301497.7	105897.1	-2.847082	0.0137

R-squared	0.945343	Mean dependent var	1472280.
Adjusted R-squared	0.920116	S.D. dependent var	255101.4
S.E. of regression	72101.22	Akaike info criterion	25.47875
Sum squared resid	6.76E+10	Schwarz criterion	25.82725
Log likelihood	-247.7875	F-statistic	37.47417
Durbin-Watson stat	2.115117	Prob(F-statistic)	0.000000

Data source: http://www.mfinante.ro/infocodfiscal.html

Both the coefficients and the F test confirm the validity of the model. The t test strongly confirms the influence on sales after the intervention of the alternative variable.

As for the t test applied to large firms the results are not conclusive, and this is understandable once the direct influence over the real estate market of the VAT reduction to 5% particularly for housing, is taken into account. Implicitly the price of distributed products and services in the respective line of business rose. The increase in distribution prices generated by this financial loop occurred amid falling housing prices, due to lowering VAT, leading to descreases in sales of building materials. However, inertial behaviour of large companies is revealed by the trend analysis of the analysed quarterly data, mainting in the quarter that followed government measure.

Conclusions

Trading companies operating in Romania in the field of building materials which have been the subject of the analysis in this article have responded positively from an inertial point of view regarding the reaction of the distribution during the analysed period to that of the previous period and the price change. Practically, with one exception, sales inertia maintains in all cases for another quarter. The exception is a small firm for which, according to the data from the previous analysis, the inertia is preserved, but for a period shorter than a quarter.

Large firms present a better inertia than trading firms with lower turnovers, which confirms a strong and direct link with the phenomenon

described in Physics that larger bodies (with a larger mass) have a higher inertia than bodies with a smaller mass.

The second part of the analysis is concerned with studying trading companies inertia to the government's two-fold VAT cut: one for all the products and the other directly affecting the activity of the analysed companies. The results support the overall level of the impact. Thus, the model validates sales inertia after the implementation of the measure, especially in the case of small businesses. Additionally, the trend was maintained in the case of all the analysed trading companies for another quarter. Following the trend proved to be necessary as the real estate VAT reduction to 5% led to price increases and implicitly to lower sales. However, the decline in sales did not occur immediately, but the upward trend continued for an additional quarter, indicating a sales inertia in the context of this major event that affected the activity of economic agents.

References

1. Anghelache, C., Anghel, M.G. (2016). Bazele statisticii economice. Concepte teoretice şi studii de caz, Editura Economică, Bucureşti
2. Anghelache, C., Anghel, M.G.(2014). Modelare economică. Concepte, teorie şi studii de caz, Editura Economică, Bucureşti
3. Anghelache, C. (2008). Tratat de statistică teoretică şi economică, Editura Economică, Bucureşti
4. Brenneke R., Schuster G. (1973). Fizica, Editura Didactică şi Pedagogică, Bucureşti
5. Bulinski, M. (2007). Econofizica si complexitate, Editura Univ. Bucureşti
6. Gheorghiu, A. (2007). Econofizica Investiționala, Editura Victor
7. Gheorghiu, A., Spanulescu, I. (2007). Noi abordari si modele econofizice, Editura Economica
8. Gligor, M.,Ignat,M. (2003). Econofizica, Editura Economica, Bucureşti
9. Isaic-Maniu A., Mitrut C., Voineagu V. (2004). Statistica, Ed. Universala Bucureşti
10. Pecican E.S. (2005). Econometria pentru...economisti: econometrie si aplicatii, Editura Economica
11. Reif, F. (1983). Fizica statistica (Berkeley vol. V), Editura Didactică şi Pedagogică, Bucureşti
12. Rizki E. Wimanda, Paul M. Turner, Maximilian J. B. Hall (2011). ,,Expectations and the inertia of inflation: The case of Indonesia", *Journal of Policy Modeling,* 33 (3), 426 – 428
13. Vuslat U., Ozcan K. M. (2005). ,,Optimal univariate expectations under high and persistent inflation: new evidence from Turkey", *Physica A: Statistical Methods and its Applications*, 346 (3 – 4), 499 – 517
14. www.mfinante.ro (http://www.mfinante.ro/infocodfiscal.html)