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INVESTIGATING PROFIT PERSISTENCE AMONG HUNGARIAN PLASTIC MANUFACTURING COMPANIES

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ABSTRACT

This study examines the competitive nature of the Hungarian plastics industry sector based on 2010-2019 data from the Crefoport database.. The aim of the study is to examine that how close the market of plastic industry companies is to perfect competition. Market efficiency was investigated using a Markov chain and profit persistence estimation (Arellano & Bond, 1991). Corporate profitability was measured using the ROA indicator. Variables reflecting industry and market effects are also included in the analysis as controls. Based on the Markov transition probability matrix, market competition is harmed. Based on the panel model estimation, the profit persistence value shows a low value (0.129) compared to the existing literature. The profitability of plastic companies can be statistically proven to be affected by company size (p=-0.046), short (p=0.016) and long risk (p=-0.093), and the volatility of profitability (p=0.633). Among the exogenous variables, industry income (p=0.081) and market concentration (p=0.974) have a significant effect on the profitability of companies. Limited market competition reduces overall social benefit and efficiency in several ways: it reduces price competition, quality orientation, and the pursuit of innovations. Therefore, from the point of view of economic policy , it is definitely justified that the sector receives subsidies in an appropriate amount that improves the efficiency and productivity of small and medium-sized enterprises, as well as encourage technological development and innovation.
Keywords: market competition, profitability, dynamic panel, Markov chains

INTRODUCTION

One of the foundations of economics is that, in the case of perfect competition, no company can realize a profit above the market average in the long run. If, however, we find that a significant proportion of companies are able to achieve (abnormal) profits higher than the market average in the long term, then market competition is harmed, thereby reducing the consumer surplus (and, with it, the overall social benefit). In a short time, even in the case of perfect competition, it is possible to achieve an abnormal profit, but in the long term, thanks to competition, prices adjust to the market norm. The "perfection" of market competition, i.e. its efficiency, can be measured by profit persistence, which shows how quickly profit realizing

abnormal profits converge (return) to the equilibrium level, i.e. how fast the correction is. Since the 1970s, scholars working in the fields of economics and strategic management have conducted extensive research on profit persistence (*Mueller,* 1977*; Roquebert et al.* 1996*; McGahan & Porter,* 2003*; Gschwandtner,* 2005, 2012; *Gschwandtner & Hirsch,* 2017*; Sanderson et al.* 2018*; Hirsch et al.* 2020), which form the backbone of the theoretical background of our research.

Due to its nature, market efficiency and profit persistence can be analysed at the meso level for a specific industry. In this case, our choice fell on the plastics industry, which is also significant from an economic and sustainability point of view. The world's plastic production has grown continuously over the past seventy years. The amount of plastic produced in the 1950s increased from 1.5 million tons to 367 million tons by 2020 (*Plastics Europe,* 2021).

This global growth is, of course, not evenly distributed worldwide. Therefore, the availability of plastic-containing products has increased, the commercial drivers being durability, cost-effectiveness, versatility, flexibility and long lifetime (*Brahney et al.* 2020*; MacArthur,* 2017). Plastics are used in many fields, including construction, transportation, packaging, electronics, automotive or agriculture (*Plastics Europe,* 2021*; Wang et al.* 2019). While the social benefits of using plastics are extensive and inexhaustibly applicable (*Andrady & Neal,* 2009), plastics as commodities are the subject of increasing environ-mental concerns (*Cole et al.* 2011). Thanks to this, the sector has undergone significant changes recently. Companies invest significant capital, development and expertise to sustainably achieve their 2050 net zero emissions and circular economy goals. With their investments, they intend to develop their technological base, which provides innovative solutions to answer questions such as the problem of plastic waste and climate change (*Lehoczki,* 2020).

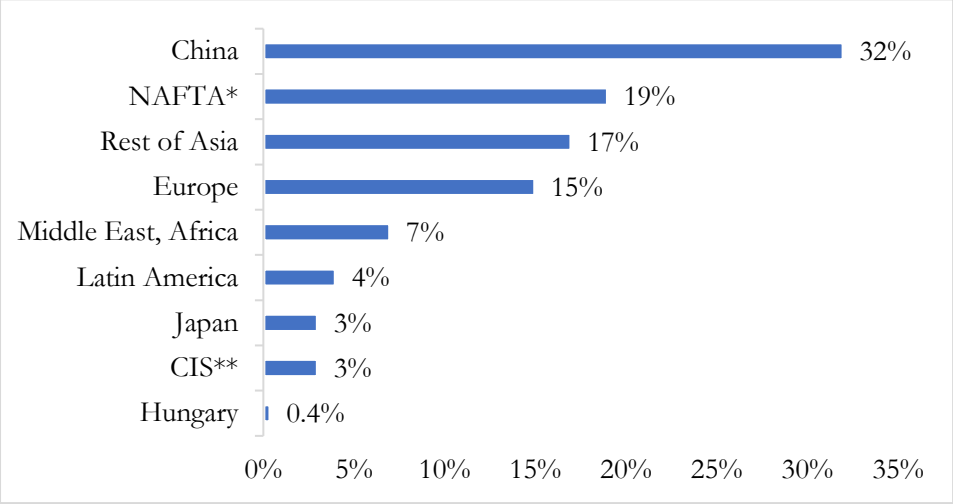
Figure 1 clearly illustrates that Asia is the world's major power of plastics production. It accounts for 50% of the total volume. Among the economic entities, China is at the forefront, covering 32% of the entire portfolio internationally. With its production of 55.5 million tons, Europe ranks fourth in the ranking. The figure also shows Hungary, which is in the focus of our study, where the production volume of the plastics industry was 1.6 million tons, which covers 3% of European production.

It is essential to highlight that European plastic production differs slightly from global trends (*Figure 2*). In the four years before the coronavirus, European production decreased. Germany is at the top of European plastic production, and Romania is at the bottom of the ranking. According to 2020 data, the six largest European countries (Germany, Italy, France, Poland, Spain, and England) cover 70% of market demand. Regarding the industrial use of plastics, the packaging and construction industry represents the largest end-user markets, with the two sectors representing 60% of the total European volume (*Plastics Europe,* 2021).

From Hungary's internal economic performance point of view, the plastics industry is also of considerable importance. Hungary's manufacturing industry contributes around 20-21% to the GDP. This value is higher than the European Union average. The production of rubber, plastic and non-metallic mineral products is one of the defining branches of the domestic manufacturing industry, contributing

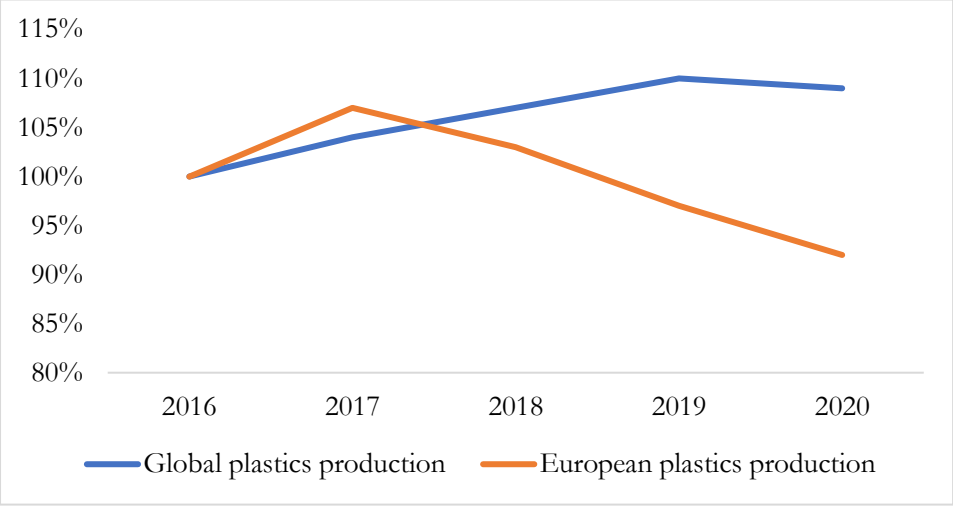
an average of 9% to the production value of the manufacturing industry in the last ten years, which also exceeds the EU average (*KSH*, 2021b). The Hungarian volume index increased between 2016 and 2019, but the pandemic broke this growth and even caused a downturn in the sector's output (*Figure 3*).

Figure 1: Territorial distribution of global plastics production by production volume (2016-2020)



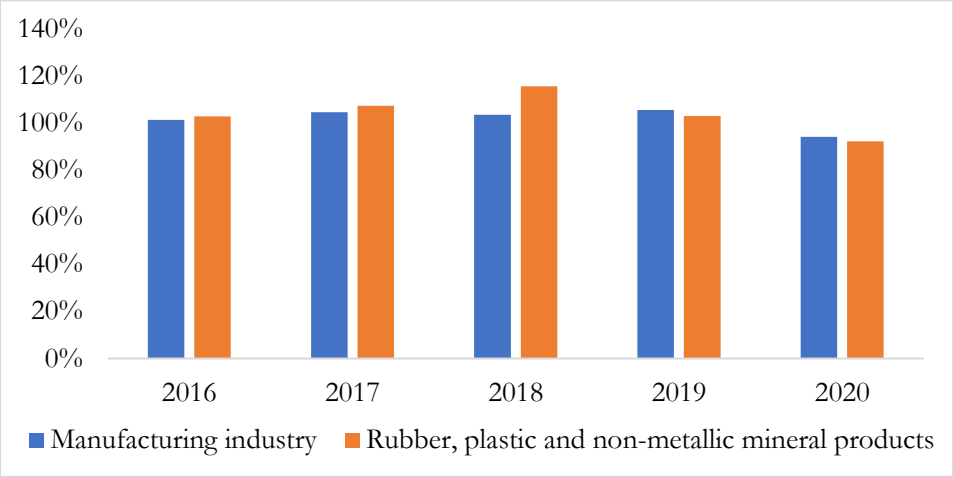
Source: Based on *Plastics Europe* (2021)
(* North American Free Trade Agreement, ** Commonwealth of Independent States)

Figure 2: Development of global and European plastics production [not including the production of recycled plastics] (2016-2020)



Source: Based on *Plastics Europe* (2021).

Figure 3: Volume indices of the sales of the manufacturing industry and the production of rubber, plastic and non-metallic mineral products [the previous year = 100.0%] (2016-2020)



Source: *KSH*, 2022

Nothing shows the importance of the sector better than the fact that at domestic level, the fourth largest activity of the manufacturing industry is the plastic production. At the same time, among the EU27 countries, in terms of the industry's share of the country's gross added value, Hungary ranks fourth, therefore taking all this into account, it is worth conducting in-depth research on the sector itself (*KSH*, 2021a). As a Hungarian case study, our research can be the first to contribute to a better understanding of the competition within the EU plastics industry and explore the nature of sectoral efficiency and profitability. Our research can convey additional information to our knowledge about profit persistence while also leading to valuable recommendations from a sectoral development point of view.

Theoretical background

During the analysis of profit persistence, we determine how long companies are able to maintain profits above the equilibrium level (abnormal profit), i.e. how quickly they return to the equilibrium level, which we call correction. The higher the value of profit persistence, the farther the market is from perfect competition, and thus the correction process is slower. The methodological basis of profit persistence studies is the estimation of the auto-regressive (AR) process, through which we measure the extent to which the profit rate in period t depends on the profit of the previous period(s). The tests can be carried out at the plant or industry level, and accordingly, the results are prepared using time series models or panel models. Abnormal profit was first studied in an article by *Dennis C. Mueller* (1977), and later he first used an autoregressive model to study profit persistence (*Mueller,* 1986). Recently, studies with panel models have been in the foreground, with more modern estimation procedures available (*Hirsch,* 2017; *Iskenderoglu & Haykir*, 2018).

The results of *Mueller's* (1977) study are consistent with *Shepherd's* (1975) findings that corporate profit rates are related to market shares. The author argued that high market shares are relatively stable over time. *McGahan & Porter* (1999) used data from a sample of US firms to examine the persistence of incremental industry, firm-parent, and store-specific effects on profitability. The authors conclude that the incremental effects on industry profitability last longer than the growth effects of the corporate parent and the specific line of business. Changes in industry structure affect profitability more permanently than changes in company structure. In their 2003 research, the authors also found that the industry and company-parent company effects of well-performing companies are more sustainable than their business-specific advantages. *Schumacher & Boland* (2005) conducted an in-depth study of companies' profitability in different food industry sectors. Their findings show that profits are more persistent within an industry than within any specific company. *Chen & Lin* (2010) investigated the profit persistence of the IT industry in Taiwan, concluding that the effect of companies on profitability lasts longer than the effect of the industry. A major shortcoming of the profit persistence literature is that it only considers surviving firms. In his study, *Gschwandtner* (2005) uses a unique database to examine the persistence of profits to examine surviving and bankrupt companies. The results for survivors are consistent with the existing literature: profits converge on average to the market norm, but profit stickiness is also significant. The results show that the competition between exiters is higher (lower profit persistence) than the survivors. However, there are also companies among them that do not fully converge to the market norm. Recent developments in econometrics are discussed by *Goddard et al.* (2005) and used to examine the determinants of profitability for manufacturing and service sector firms in Belgium, France, Italy and the United Kingdom. The study synthesizes the empirical models researchers use in industrial economics, strategic management, accounting, and finance. Despite the formation of the single goods and services market of the European Union, the above-average profit continues to be significantly maintained year after year. Overall, the structural time series analysis (STS) detected a more frequent occurrence of profit persistence: nearly 70% of the companies did not converge to zero, compared to barely half of the AR1 estimate. STS outperformed AR1 in predictive performance comparisons regarding prediction error rates at conventional significance levels. In his research, *Resende* (2006) examined the profit persistence of Brazilian industrial companies over a relatively short period. The obtained results show that the existence of the unit root is mostly preferred for the two different profitability measures. Therefore, extremely durable profits can still be observed despite the apparently more competitive environment of the Brazilian economy. *Guan et al.* (2015) analyse and compare industry and company effects on profitability using a sample of Chinese machinery manufacturing companies listed on the Shanghai and Shenzhen stock markets. The results show that company effects persist longer than industry effects, thus supporting the hypotheses of the resource-based approach. Studies in this area have used different research subjects, backgrounds, study periods, and profit-sharing criteria, contributing to differences in research findings. *Tsoulfidis et al.* (2015), in their study, test the classical hypothesis

of whether the profit rate between industries tends to approach the average profit rate of the economy. Their research applied individual and panel unit root tests to a sample of 52 Japanese manufacturing industries from 1974–2008. In the study, two different estimation methods of profitability were used, a standard based on the average capital associated with AROP (Average rate of profit) and a new standard based on regulatory capital associated with IROP (Incremental rate of profit) - in a certain sense marginal capital. The authors concluded that the two profitability measures are uncorrelated and move in an intertwined manner. The main difference is that IROP exhibits a much larger oscillatory behaviour, crossing the zero line multiple times. *Zeren & Öztürk* (2015) analysed whether the profits of these companies are sustainable or not by using the return on assets (ROA) and return on equity (ROE) indicators of the manufacturing companies listed on the Istanbul Stock Exchange, for which the Hadri-Kurozumi panel unit root test was applied. As a result of their research, they determined that profit is x permanent in sectors operating in manufacturing areas such as paper, packaging, and printing, as well as stone, soil, and cement. However, they experienced the opposite effect in chemistry, petroleum, plastic, metal industry machinery, major metal, and the clothing sector. *Puziak* (2017) examined the persistence of Polish manufacturing companies' abnormal profit (the part above average profit). He investigated profit persistence using a dynamic panel model with generalized moment estimates (GMM). He applied the method to a panel database of 5 303 Polish manufacturing companies between 2006 and 2014. Puziak was able to draw three main conclusions: within the same industry, there are significant differences between profit rates at the division level, the estimated persistence of ab-normal profit coefficients is at a moderate level, and there are significant differences between the estimated persistence of profit coefficients of businesses operating in the same industry. In their research, *Isik & Tasgin* (2017) empirically analysed the factors determining the profitability of 120 manufacturing companies listed on the Borsa Istanbul Stock Exchange from 2005-2012. The estimates from the dynamic panel model, which considers the endogeneity of variables, show that lagged profitability, company size, financial risk, R&D costs, net working capital and economic growth are the most important variables affecting the company's profitability. Specifically, profit persistence (past, company size, net working capital, and economic growth positively and significantly affect profitability. On the other hand, R&D costs and financial risks reduce profitability. In their exploratory study, *Gschwandtner & Hirsch* (2017) used GMM estimation to analyse the factors affecting the profitability of the American and European manufacturing industries. The results show that, in the examined period, the food industry produced lower profit persistence than the other processing industry sectors. Company-specific drivers of profitability are company size and financial risk. Regarding industry characteristics, industry concentration and growth rate significantly affect profitability. In addition, the results provide insight into the management of food processing companies in the United States and Europe, which aims to increase their competitiveness. *Sanderson et al.* (2018) investigated the profit persistence of the Zimbabwean banking industry. The study revealed that profitability is not permanent. That is, banks realize abnormal profits over the years.

The results also show that market power, cost efficiency, credit and liquidity risk and the size of banks significantly affect profitability. Furthermore, the results conclude thatthe ' profitability of banks is determined by the strategies used by the bank management.

Considering the number of foreign publications dealing with profit persistence, the profitability of the domestic plastics industry has not been researched before, so in our study, we would like to fill this gap by examining the Hungarian economy. Based on the above, our research aims to examine the competitiveness and profitability of the Hungarian plastics industry through profit persistence.

MATERIALS AND METHODS

The research examines market efficiency through the profitability of Hungarian plastic manufacturing companies. In the definition of the plastics industry sector, we considered companies that, based on TEÁOR, belong to the plastic product manufacturing (222) classification. A unique feature of the study is that no profit persistence study has yet been prepared for domestic plastic companies.

When examining profit persistence, the generally accepted profitability measure is the return on assets (ROA). To measure profit persistence, we use the *Blundell & Bond* (1998) dynamic panel model, during which the company's profit (ROA) is explained by the profit of the previous period, taking into account the company. These macroeconomic and regional factors are considered a novelty in this topic.

The Crefoport Scholar[1] database provides the data required for the analysis. The MATE Kaposvár Campus has a subscription to the database.

Profit persistence studies are often based on some econometric estimation, and profit is measured by a continuous variable (usually ROA). However, the Markov chain (following *Stephan & Tsapin,* 2008) used in this research approaches the measurement from another point of view, with the help of which it is possible to examine how likely a company is to be transferred to a more profitable or less profitable group. The Markov chain is an appropriate starting point, and based on the obtained results, expectations regarding the competition dynamics can also be derived. Profit (ROA) was divided into groups of five or ten equal elements based on the size of the examined sample and sorted according to profitability. The groups were defined from 1 to (5) 10, where 1 is the least profitable and (5) 10 is the group of companies with the highest profitability. The purpose of the breakdown into 10 profitability groups is to check the robustness of our results. In terms of profit persistence, the values in the diagonal are relevant. The closer these values are to 1, the higher the profit persistence, from which we can conclude that the profits of companies are "sticky". That is, they cannot move from their current profitability group.

The dynamic panel model will give a more accurate picture than the Markov chain analysis (*Hirsch,* 2017) thanks to the time invariance and controllability of the different effects. In our case, we used relevant variables (*Gschwandtner and Hirsch*, 2017*; Puziak*, 2017; *Isik & Tasgin*, 2017) such as sales revenue, short (current assets

[1] www.crefoport.hu

divided by short-term liabilities) and long-term risk (proportion of long-term liabilities within re-sources), export activity (value 1 if the company has export revenue in the given year, otherwise 0), market share based on sales revenue, industry revenue, market share of top 10 companies, and the 3-year rolling ROA standard deviation, which we assume have an impact on profitability.

Table 1 contains the descriptive statistics of the variables. based on which the average ROA was 0.116 in the examined period. In case of the sales revenue, the median value was 18.693. Furthermore, the short risk shows even higher average value than long risk. The median long risk is about 0, i.e. slightly more than half of the companies have long-term liabilities. Regarding export dummy variable, the median value is 0, based on the average, 19.2% of companies also produce for export. In terms of industry revenue, there was no significant increase during the period under examination. Market share resulted the lowest mean value, and at the same time the share of the top 10 companies became significantly higher. Finally, the ROA_sd3 variable resulted 0.117 average value.

Table 1: Descriptive statistics of the variables

Variable	N	Mean	p50	SD	Min	Max
ROA	8469	0.116	0.060	0.231	-0.383	1.360
ln_sales_revenue	8472	18.776	18.693	2.182	7.601	25.859
short_risk	8462	0.778	0.537	1.017	0.002	7.395
long_risk	8469	0.092	0.004	0.163	0	0.874
export_dummy	8472	0.192	0	0.394	0	1
ln_industry_revenue	8472	27.469	27.486	0.279	27.006	27.926
market_share	8472	0.001	0	0.006	0	0.141
top10_share	8472	0.349	0.343	0.020	0.326	0.393
ROA_sd3	7765	0.117	0.058	0.188	0.001	1.279

RESULTS AND DISCUSSION

Table 2 contains the transition probability matrices estimated for the five profitability categories.

Table 2: Transition probability matrix (five profitability categories)

ROA	(1)	(2)	(3)	(4)	(5)	Pi
(1)	**48,48**	19,84	12,49	7,65	11,54	100
(2)	19,15	**40,89**	19,58	11,24	9,14	100
(3)	12,52	19,78	**34,23**	20,42	13,04	100
(4)	6,46	9,53	20,30	**41,45**	22,26	100
(5)	6,87	7,31	12,81	22,94	**50,07**	100
Pj	19,45	19,95	19,93	20,35	20,31	100

Source: Based on *STATA* results

The higher the probabilities in the crossover, the greater the profit persistence. In the case of the database divided into five income groups, the diagonal values are between 34 and 50%. In the case of perfect competition, these values would be around 20%, so in our case, a strong profit persistence can be observed among Hungarian plastic manufacturing companies, which indicates that previous years' performance has spillover effects for the current year. It can be observed that the probabilities are the highest for groups (1) and (5). In the case of poorly performing companies, there is a high probability that they will not be able to enter a more profitable group. In contrast, well-performing companies have a good chance of remaining in the more profitable group. Profit stickiness appears among the examined companies, i.e. the current year's profit is also determined by the previous year's profit. The profit rates are not independent of each other. Markov chain results suggest that the market is not perfect, and it results provide indirect evidence of distortion of market competition.

Table 3 shows the estimation results of the dynamic panel models of the Hungarian plastics industry sector. Based on the panel model estimation, the profit persistence value is low (0.129) compared to the values measured in similar international research (*Isik & Tasgin,* 2017; *Pervan et al.* 2019; *Isık et al.*, 2017). Contrary to our expectations, in-creasing sales revenue reduces profitability. An increase in short risk (which is essentially a liquidity indicator) increases that company's profit rate. Here, it is worth mentioning the study by *Borszéki* (2008), according to whom the increase in trade payables does not mean an improvement in the market financing position but rather the presence of debt chains, which is a sign of a sector problem. On the other hand, in the analysed industry, the opposite appears to be the case: an increase in the liquidity position increases profitability. The long-term risk reduces profitability, based on which the cost of attracting foreign capital exceeds the benefits of the development. As a result, the sector's prospects deteriorate significantly in the medium to long term. This can lead to the postponement or non-implementation of significant investments. The coefficients of the export dummy and the market share variables did not become significant. That is, the export activity of the companies, as well as the position within the industry, basically do not affect the profit relative to assets. The 3-year rolling ROA standard deviation is significant, which means if companies take on more risk, it positively affects profitability. This confirms the basic assumption of classic economics about the direction of the relationship between returns and risks. The industry sales revenue and the market share of the top 10 companies should be analysed together. Based on the results, the industry sales revenue increases the profitability of the companies, which at first contradicts what was learned from microeconomics since, in a growing market, the competition also increases, and it is more difficult to achieve an outstanding profit. This effect is complemented by the effect of the share of the top 10 companies, based on which profitability decreases as market con-centration increases. Growing industry revenues increase profitability if the companies' market share does not change significantly, i.e. everyone can grow - approximately - equally.

Table 3: Results of the dynamic panel estimation

Variables	ROA	
L.ROA	0.129***	(0.036)
ln_sales_revenue	-0.046***	(0.010)
short_risk	0.016**	(0.007)
long_risk	-0.093**	(0.041)
export_dummy	0.017	(0.021)
market_share	0.974	(1.484)
ROA_sd3	0.633***	(0.057)
ln_industry_revenue	0.081***	(0.014)
top10_share	-0.693***	(0.164)
Constant	-1.106***	(0.357)
Observations	7.752	
Number of IDs	706	
AR(2) p-value	0.059	

Note: Standard errors are in parentheses; *** p<0.01; **p<0.05; *p<0.1

CONCLUSION

The plastics industry underwent significant changes during the examined period. Based on the investigation, it can be said that profit persistence is significant in the plastics industry. This phenomenon can undermine but limits the efficiency-enhancing effect of market competition. Based on the Markov chain analysis we found emipirical evidencies that the least profitable companies find developing challenging, while companies with high profits can easily maintain their position. In such a market environment, it is easier for larger companies to maintain their market position, and it is more difficult for new competitors to enter the market.

Based on the dynamic panel model, it can be said that the profitability of plastic manufacturing companies can be statistically proven to be influenced by company size (sales), short and long risk, and the volatility of profitability. Among the exogenous variables, industry income and market concentration significantly affect companies' profitability. It also gives companies with smaller sizes or profitability less chance to improve their position with adequate market performance.

From the point of view of the sector, the decrease in income caused by long-term indebtedness is a significant limitation. In such an environment, the investments will not pay off. The lack of investments will put these companies at a competitive disadvantage in the international market, increasing their exit from the sector and limiting their entry. These processes worsen market competition and result in competitive takeovers and incapacitation, which cause damage to the level of society as a whole.

To sum up, our results confirm limited competition in the investigated market. .According to the basic principles of economics, limited market competition reduces overall social benefit and efficiency in several ways: it reduces price competition, quality orientation, and the pursuit of innovations.

Taking an economic perspective, it may be beneficial to implement public interventions that improve the market efficiency of the plastics industry without disrupting competition. These interventions can comprise subsidies for investments in productivity and efficiency for small and medium-sized enterprises, as well as financial support programs that promote technological advancements and innovation in the industry.

A further policy implementation of our results could be public intervention to reduce market concentration. It is advisable to support new entrants or existing small-scale firms with high growth potential, through tax incentives or targeted investment credits to increase production capacity. The latter should be complemented by green financing schemes, given the high environmental impact of the industry.

The investment credit schemes proposed here should be complemented by an appropriate security rating system, as long-term indebtedness is already a competitiveness problem in the group of companies under study. The development of such a complex rating and credit system could be the subject of a future research project.

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