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Modelling Economic Policy Issues

Financial performance and capital structure – an econometric approach for Romanian e-commerce companies during the COVID-19 pandemic

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ABSTRACT

The study investigates the inverse relationship between financial performance and capital structure for the Romanian B2C e-commerce companies, based on a representative sample of 437 companies active in the period 2005–2020. Statistical analyzes show the evolution of financial performance and the impact of the COVID-19 pandemic on it, depending on the company category. All company categories had better financial performance in 2020 compared to 2019, based on sample results. The study reveals valid reference values for the financial ratios of Romanian electronic commerce, being a model to be applied in any industry. The analysis of the causality of the financial variables and their correlations, on the sub-periods 2005–2008 and 2009–2020, both at the company category level and at the sample level, are the basis of the GMM approach. The econometric models Difference GMM and System GMM explain the relationship between financial performance and capital structure leading to interesting conclusions. As e-commerce has a sustainable development, the findings and conclusions of the study provide guidance for economic policies at the sectoral level. Financial performance in relation to strategic debt management depends on the company category. Stimulating the development of those categories of companies that ensure the efficient performance framework can be the key to a sustainable development of the national economy. The study is useful for managers, investors, financial analysts, decision makers, in financial education as well as for the banking system.

1. Introduction

The COVID-19 pandemic has significantly affected businesses around the world (Zhigang and Yao, 2023; Shen et al., 2020; Rizvi et al., 2020; Nurhayati et al., 2021; Shahimi et al., 2021; Kawaguchi et al., 2021). The e-commerce sector was more privileged during the pandemic, as online activity replaced offline activity when restrictions imposed. In 2020, 22 % of businesses in the European Union had e-commerce sales, which represented 20 % of their total turnover in 2020. (Eurostat, 2021). In 2020, the EU enterprises obtained 7 % of their total turnover from sales via a website or apps: 4 % of total turnover

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from web sales to other businesses and government (B2BG), and 3 % of total turnover from business to consumer web sales (B2C).

Our study considers the B2C Romanian e-commerce companies in activity code NACE 4791 - Retail trade by mail order or internet. Based on a representative sample of 437 autonomous companies in the B2C e-commerce sector that were active from 2005 to 2020, we assessed and bi-directionally modeled financial performance and financial leverage at the sample level and by company category. We evaluated changes in companies' financial indicators in 2020 compared to 2019 to understand the impact of the pandemic on e-commerce. Our study highlights the extent to which the pandemic has influenced the categories of e-commerce companies in Romania. We emphasized the positive impact of the pandemic and the sustainable development of e-commerce through its positive contribution to economic growth.

Statistical and econometric analyses approach financial indicators over time both at the sample level and at the company category level. The inference of the sample results at the sector level allows the characterization of its state at the end of 2020. The evolution of financial performance can describe the development of this economic sector by considering the expansion of the sample results.

Based on the financial indicators registered in euros, for the period 2005−2020 (www.firme.ro), we calculated the financial indicators: ROA, ROE, net profit margin and leverage ratio and based on them we consider a financial profile of the sample and by category of companies. *Return on Assets* (ROA) provides an overview of companies' ability to generate profit based on existing assets. The ROA is the ratio of net income to total assets. *Return on Equity* (ROE) expresses financial performance and informs shareholders about the company's ability to use invested capital (equity) to generate profit; is the ratio of net income to equity. *The net profit margin* indicates the profitability of a company, expressing the relationship with the markets; is the ratio of net income to sales turnover. These indicators characterize financial performance (Haţegan et al., 2021; Tudose et al., 2020) and indicate the economic and financial health of companies and their development trends.

Financial performance is influenced by capital structure; but also the capital structure influences the financial results of the companies. For the capital structure, we used the leverage ratio, also called the debt ratio or indebtedness degree, calculated as total debt divided by total assets at the end of the year. Our study evaluates the dynamics of the structure of Romanian e-commerce companies by category and their financial performance. Romanian legislation, in accordance with the European Commission Recommendation 2003/361/CE, and updated in 2020, establishes the criteria for determining the categories of companies: number of employees, volume of turnover and total assets (European Commission, 2020). According to the number of employees, the company categories are: less than or equal to 9 employees - microenterprises, between 10 and 49 employees - small enterprises, between 50 and 249 - medium enterprises, and over 250 employees - large enterprises. In addition, small and medium-sized enterprises (SMEs) with between 10 and 249 employees must meet at least one of two conditions: annual turnover must be less than 50 million EUR or total annual assets less than 43 million EUR. The category structure of total business economy in Romania, in 2019, was: small enterprises with 98.2 %, medium enterprises with 1.5 % and large enterprises with 0.3 %. This structure by size classes of enterprises was consistent with that of the most developed economies of the European Union, placing after Germany, Luxembourg, Denmark and Austria (Eurostat, 2021).

The objective of our study is to identify the financial performance and its relationship with the capital structure of the e-commerce companies in the sample and to extend the results to all Romanian companies with economic activity code NACE 4791. Panel data econometric models explain the relationship between financial performance and capital structure. We formulated the following seven working hypotheses grouped by main purposes.

- General hypotheses about the influence of the economic environment on the development of e-commerce:

H1: *In Romania, e-commerce companies follow a trend of sustainable development.*
H2: *The COVID-19 pandemic has been beneficial for the development of e-commerce in Romania.*

- Specific hypotheses regarding the determinants of the financial performance of Romanian e-commerce enterprises:

H3: *Financial performance (ROA) depends on the company category. The bigger the company, the higher the financial performance.*
H4: *Leverage ratio (LEV) negatively and significantly influences financial performance (ROA) to the same specific extent for each company category, every year – in the current year as in the previous year.*
H5: *Financial performance (ROA) is significantly and differently influenced by the market relationship depending on the company category. The larger the company, the greater the influence of the market relationship on financial performance.*

- Specific hypotheses about the determinants of capital structure of Romanian e-commerce enterprises:

H6: *Capital structure (LEV) is significantly and differently influenced by financial performance depending on company category. The larger the company, the greater the influence of financial performance (ROA) on the leverage ratio to reduce it.*
H7: *The capital structure of the previous year* (LEV_{t-1}) *influences the current capital structure (LEV), to the same extent, regardless of the company category.*

The hypotheses are supported by the results of the statistical analyzes and the econometric panel data models of financial indicators. We tested the working hypotheses during the presentation of the results on the study phases. This study contributes to the specialized literature in several ways, through the original approach of an economic sector, such as electronic commerce, by establishing the specific coordinates of financial performance. Another contribution to the financial

literature was the identification of the importance of company category in analyzing the relationship between financial performance and capital structure. Modeling the evolution of this relationship for the e-commerce sector has identified the impact of various shocks such as the 2008 economic crisis and the COVID-19 pandemic on it. Our study also finds a place in the specialized literature of the influence of the COVID-19 pandemic on economic development and especially on the financial performance indicators of the e-commerce sector. The econometric models that describe the double causality of the financial performance and the capital structure in its interaction with the company category, represent a novelty in financial econometrics. It can serve students as applications of estimation theory in learning economic statistics and also econometrics. Our study is important because of the new research directions it opens up.

The remainder of this paper is organized as follows. Section 2 contains the theoretical background based on relevant previous research on *E-commerce and financial performance - capital structure, in literature review*. Section 3 of *Materials and methods* contains the presentation of the data, objectives, and research methodology. Section 4 is devoted to *Results and discussions* of statistical analyzes and econometric approaches. Section 5 contains *Discussion* of the main findings and Section 6 of *Conclusions* contains the general results of our study, its limitations, future research directions and relevant policy recommendations.

2. E-commerce and financial performance - capital structure, in literature review

2.1. Electronic commerce – evolution and aspects of development

The pandemic has given e-commerce companies opportunities to thrive in times of economic isolation in European countries and at the EU level. E-commerce entrepreneurs have low costs by selling directly to customers, having smaller sales force and therefore lower salary expenses, selling to customers in different parts of the world, continuous service even during pandemic times, with minimal initial investment in fixed assets, plus both start-up and maintenance costs much lower than in a traditional business (Law no. 365/2002).

The pandemic has led offline retailers to rethink their business strategies, moving to online activities, either through their own websites or applications (web shops, web forms, booking service applications) or through websites or applications of e-commerce market, which are used by several businesses. In Romania, the penetration of electronic buyers on the B2C e-commerce market was only 45%, much lower than in the European Union, where it reached 86%, in 2020 (E-commerce Europe, 2021). The accelerated use of digital platforms has changed the business model in a short period of time due to their ability to perform an impressive number of tasks. The paradigm shift was to a 'data-driven world rather than a process-driven one' (Galhotra and Dewan, 2020). Data structure and protection then became essential in the new paradigm, accumulating in an exponential number of online transactions, each tracing back to a buyer and possibly shaping their profile. Quite quickly, and even before the "rush" of online shopping due to the successive lockdowns of the pandemic, a new data processing policy had to be implemented under the umbrella of the General Data Protection Regulation (GDPR). Data privacy rights derive from the 1950 Convention on Human Rights, which states that "everyone has the right to respect for his private and family life, home and correspondence" (European Court of Human Rights, n.d.).

The COVID-19 pandemic has forced almost all companies and organizations to move towards digitized transaction processes and invest in this direction (Sami Ur Rehman et al., 2021). The situation generated by COVID-19 has shown that e-commerce has become an important sector for the national economy (WTO iLibrary, n.d.). E-commerce supports small businesses by encouraging competitiveness, thus being an engine for domestic growth and international trade (Shen et al., 2020). During the COVID-19 pandemic, consumer behavior has changed towards online shopping to avoid crowding and exposure to disease risks (Galhotra and Dewan, 2020). As a result, there has been a growing inclination of the population towards e-commerce, regardless of age. Online shopping offers convenience and safety and has moved from fashion and electronics to food products - a category that barely existed in previous years in Romanian e-commerce. Payment behavior has also changed from cash on delivery to contactless payment by card or online via payment platforms or mobile solutions. Online payment platforms (Google Wallet, PayPal, Amazon Payments, Authorize.net, Apple Pay, etc.) and the emergence of other online payment systems have allowed the development of e-commerce companies in Romania. New online store solutions and mobile optimization of e-commerce through digital marketing have started to work. Private initiatives by delivery service providers have implemented a sustainable e-commerce infrastructure: fast and green transport to delivery, nearby warehouses, recycling and waste management. Government policies have encouraged the digitization of public administration by providing subsidies for green business purposes. The government has encouraged online consumer behavior. The existence of fast Internet and a large coverage of the country's territory determined the development of online trade services. Thus, the population needed to develop digital skills, as the rising standard of living is still desirable. E-commerce companies should develop digital technology to continue to exist in this sector. Companies entering the online market need to differentiate their product and service offerings to embark on a sustainable growth path. The restrictions imposed in the context of the pandemic led to the closure of some stores and boosted online commerce in Romania. The development of online business volume determined an increase in the financial performance of the e-commerce sector.

Part of the scientific research effort is devoted to the relationship between e-commerce and business performance (Alderete, 2018; Azeem et al., 2015; Baršauskas et al., 2008; Igwe et al., 2014; Jahanshahi et al., 2012; Quirós Romero and Rodríguez, 2010; Saeed et al., 2005; Šaković Jovanović et al., 2020; Sedighi and Sirang, 2018). These studies have shown that e-commerce implementation positively influences business performance. According to Sedighi and Sirang (2018), the use of

e-commerce is significantly effective on the performance of SMEs, especially on elements such as financial performance, internal process, customers, growth and learning.

The aspects of the development of e-commerce in Romania show the framework of the new competition faced by the companies analyzed in our study sample (Eurostat, 2022). The companies in the sample exist from 2005 to 2020 and are already at the maturity of their life cycle during the COVID-19 pandemic. New business opportunities in a regulated, effervescent and competitive environment, in full development in Romania, also stimulate financial performance.

2.2. Consequences of economic shocks on financial performance

The effects of the 2008 financial crisis on the performance of economic entities had also been the subject of debate in various studies (Tudose et al., 2019; Dolenc et al., 2012; Gonenc and Aybar, 2006; Kontogeorgos et al., 2017; Muchtar et al., 2019; Notta and Vlachvei, 2014; Setiawan, 2018; Thalassinos and Thalassinos, 2018; Konings and Yergabulova, 2021). Economic and financial crises cause imbalances over the economy and affect the business environment (Duguleană, 2019; Duguleană et al. 2021; Duguleană et al. 2022; Madaleno and Bărbuță-Mișu, 2019; Bătrâncea, 2022; Bătrâncea et al., 2022; Lim et al., 2020). Madaleno and Bărbuță-Mișu (2019) concluded that the crisis exerts a significant positive effect over financial performance as well as liquidity, assets turnover, and labor productivity, meaning that firms tend to put in greater efforts to maintain financial performance in the face of a crisis. Online consumer behavior influences the financial performance of businesses in the e-commerce market as measured by ROA, ROE and net profit margin (Hațegan et al., 2021).

The pandemic emphasized the importance of online in commerce. Since 2020, an impressive series of papers have discussed the impact of COVID−19 on firm performance (Aifuwa et al., 2020; Al-Bimani and Matriano, 2021; Hu and Zhang, 2021; Lam et al., 2021; Shahimi et al., 2021; Nurhayati et al., 2021; Sami Ur Rehman et al., 2022; Shen et al., 2020; Cho and Saki, 2021). A relatively large number of studies, published in 2020 and 2021, have focused on the impact of the COVID−19 pandemic on the business environment. Most of these studies have identified negative effects of the COVID−19 pandemic on the performance of companies, such as: decrease of investments and the total revenues (Donthu and Gustafsson, 2020; Shen et al., 2020; Baba et al., 2021), increase in leverage and decrease in liquidity and profitability (Devi et al., 2020), decreases in turnover (Apedo-Amah et al., 2020), and abnormal stock returns (Liu et al., 2021). Some works addressed the pandemic impact on retailer performance (Cho and Saki, 2021; Endri et al., 2020; Khaled et al., 2020), corporate governance and firm performance (Farwis et al., 2021; Golubeva, 2021; Khatib and Nour, 2021). Other studies discussed the changes in firm value (Adi and Daryanto, 2021; Bose et al., 2021; Febriantika et al., 2021), corporate solvency (Mirza et al., 2023), firms' organizational designs (Foss, 2020), and assets management (Rizvi et al., 2020). Studies on the impact of the pandemic on business and financial performance (Donthu and Gustafsson, 2020; Konings and Yergabulova, 2021; Song et al., 2021; Galhotra and Dewan, 2020; Liu et al., 2021) and small business (Bartik et al., 2020; Belitski et al., 2021; Dörr et al., 2021; Fairlie, 2020; Gregurec et al., 2021; Kawaguchi et al., 2021) added to the financial literature.

2.3. Financial performance and capital structure

Managerial decisions regarding the amount of debt or equity financing define the capital structure to ensure the continuity of an efficient economic and financial activity. Businesses use different combinations of equity and debt as sources of financing for their assets. The capital structure is subject of the theories of two currents of thought. The first traditional current holds that the combination of debt and equity increases the value of the firm, by reducing the weighted average cost of capital up to a permissible limit of financial leverage. The second school of thought is the capital structure irrelevance theory of Modigliani and Miller (1958). Their theory is based on the assumption of a perfect market where the composition of the financing mix does not influence the cost of capital. The composition of the capital structure becomes irrelevant in the valuation of a firm in an ideal market. So a firm's capital structure is irrelevant to its market valuation. Managers have more information about their firms than investors. Informational asymmetry becomes the subject of trade-offs of preference orders for funding sources and underlies Donaldson's (1961) pecking order theory of capital structure. The preferential selection of internal sources of financing has shifted towards required external funds, according to Myers (1984), who argues that firms prefer debt over equity because of the lower information costs associated with debt issues. Other opinions (Baxter, 1967 and Altman, 1984) stated that the optimal capital structure is a cost-benefit structure issue related to the net tax advantage of debt financing to balance the costs of leverage, as bankruptcy, holding firm's assets and constant investment decisions.

Theories of capital structure based on agency costs, asymmetric information, market interactions, and aspects of firm control have been developed through the contributions of many economists. Rathnasingha and Heiyanthuduwa (2019) investigated the informational asymmetry role based on the pecking order theory in the context of 70 Sri Lankan listed companies financing choices within multiple industrial sectors from 2011 to 2017 and identified the inverse relationship between profitability and debts ratios. They considered company size in analyzing financing behavior and found that smaller firms have more information asymmetry and they do not behave the same compared to larger firms.

The company category is significant in the research of Sánchez-Vidal and Martín-Ugedo (2005), who determined that financing preferences of Spanish firms in according with the pecking order theory is different for small to medium-size companies. They found higher coefficients of retained earnings than those of debt, and these ones in turn higher than equity issue coefficients of financing. These results are in accordance with the original pecking order theory which establishes

the hierarchy of financing as internal funds, debt and finally equity. Rathnasingha and Heiyanthuduwa (2019) showed that Sri Lankan smaller companies adhere to pecking order hypothesis rather than larger companies. Some authors (Chen, 2004; Chen et al., 2013; Delcoure, 2007) revised the pecking order hypothesis, for companies' financing preferences: retained earnings, equity and debt as the last choice. Companies in Central and East European countries prefer equity over debt (Delcoure, 2007) following a modified pecking order. Capital structure theories are relevant to developing countries. Even though there are differences by country factors such as GDP growth rates, inflation rates, unemployment rates, capital market development, and differences between emerging and developed economies, the variables affecting debt ratios and theories apply the same (Booth et al., 2001).

The link between financial leverage and the financial and market performance of firms has led to an important debate in the literature. Rajan and Zingale (1995) established profitability and firm size as determinants of capital structure. The inverse relationship of the profitability and the debt ratios determine the companies with the higher profits to finance by profits as retained earnings (Booth et al., 2001). The negative relationship between profitability and the leverage ratio was confirmed by Frank and Goyal (2003), Colombage (2005), Akani and Ifechi (2017), Booth et al. (2001) following the pecking order hypothesis, which works best in the large companies. Rajan and Zingales (1995) have found strong negative relationships between debt ratios and past profitability. The inter-influence between the financial performance and the capital structure was proved and explained by Abdullah and Tursoy (2021) for German listed non-financial firms in the period 1993–2016. They considered total debt to total assets to measure capital structure and ROA as a measure of financial performance, as we also considered in our study. Our econometric approach uses the same variables to analyze the relationship between financial performance and capital structure.

3. Materials and methods

3.1. Data

We use the financial data of a sample of companies with economic activity in B2C e-commerce and established before 2005 to analyze trends in the period 2005−2020. The sample contains 437 unlisted companies, with continuous activity in the field of online B2C commerce, NACE code 4791, in the period 2005−2020. The total number of companies registered in the Romanian Trade Register, with NACE code 4791 for online trade services, in 2020 was 21,746. Of this number, 13,638 companies completed the balance sheet in 2020, representing 62.7% of their total. The sample consists of 437 randomly selected companies out of the 13,638 companies operating under NACE code 4791, which had a balance sheet at the end of 2020. For the companies included in the sample, we took into account the financial data for the entire period 2005−2020. These companies have changed their managerial behavior over time depending on economic conditions, but not their legal status.

In order to extend the results of the sample at the population level, for all Romanian companies with NACE code 4791, we calculated the error limit, Δ_w. The error limit Δw for an unrepeated selection is based on eqn. (1), with the probability coefficient $z = 1.96$ for the 95% guarantee of the confidence intervals of the analyzed variables at the population level. The number N of all enterprises active in the field of electronic commerce in Romania in 2020 is $N = 13{,}638$. The correction coefficient in the finite population is $(1 - n/N)$, where n/N is the sampling ratio of 3.2%; the proportion p (in the worst case) is 0.5.

$$\Delta_w = z\sqrt{\frac{p(1-p)}{n-1}\left(1-\frac{n}{N}\right)} \cdot 100 = 4.62\% \tag{1}$$

The error limit is less than 5%, and we can consider that this sample is representative for all Romanian enterprises operating in the field of electronic commerce in 2020. We can use the results of the sample to extend them for all Romanian enterprises of NACE code 4971.

3.2. Research methodology

The research methodology consists of two parts: first part includes statistical analysis methods to characterize the financial profile of the Romanian e-commerce based on the sample, and the second part approaches the econometric models of the dual relationship between capital structure and financial performance, at sample level and per company category. Both parties intend to respond to the working assumptions set out in Section 1.

3.2.1. Analysis of the financial performance of the e-commerce sector in Romania

The analysis of the financial performance of the e-commerce sector in Romania will answer to the general hypotheses about the influence of the economic environment on the development of e-commerce, as well as the specific hypotheses regarding the financial performance and its relationship with the capital structure.

Given the onset of the economic crisis in Romania at the end of 2008, the analysis addresses three sub-periods of the period 2005−2020. The pre−crisis sub-period 2005−2008 includes two years of Romania's pre−accession to the European Union and the year of accession, 2007. In Romania, the economic crisis began at the end of 2008, thus the first sub-period 2005−2008 may be considered without the crisis obstacle. The second sub-period 2009−2020 includes the period of economic crisis and post-crisis, which involves recovery and upward evolution until 2019, and separately, we consider the state

of the financial profile of the year 2020, the year of the COVID-19 pandemic. In order to achieve the research objectives and to respond to the working hypotheses, the research plan aims to achieve the following results:

- The dynamics of the sample structure by company category in the period 2005–2020;
- The evolution of the financial indicators of the sample in the period 2005–2020;
- Analysis of financial ratios ROA, ROE, net profit margin and capital structure of the sample and by company category, over time;
- The impact of the COVID-19 pandemic on the financial variables of the companies in the sample and by category of companies in 2020 compared to 2019;
- Extending the results for all Romanian companies in the e-commerce sector in 2020;

Confidence intervals for financial indicators characterize the economic and financial development of the entire e-commerce sector of the national economy.

3.2.2. Econometric modeling of the dual relationship between financial performance and the capital structure during 2009–2020

Econometric modeling of the relationship between financial performance and capital structure proves the working hypotheses, both general and specific. The econometric approach considers both directions of causality between financial performance and capital structure expressed as the leverage ratio.

We use ROA as an indicator of financial performance, which can be explained by the degree of indebtedness as an indicator of the leverage effect (LEV) and other explanatory variables (X) that can control the characteristics of enterprises. The control variables X, are the size, based on the logarithm of total assets, and the net profit margin as explanatory variable of the companies' ability in relation to the market. The econometric models of ROA are based on the variables: ROA=f (LEV, X), where ROA, LEV and X are stationary panel variables. We test whether ROA can be influenced by previous year's financial performance, previous and current year's leverage ratio, and X variables. Lagged leverage ratio can show the existence of a prior influence on ROA.

The econometric models of LEV are based on relation between: LEV=f (ROA, X). We test whether the capital structure, highlighted here by the variable LEV, can be influenced by its previous level and the financial performance of the previous and current year, as well as X variables.

After analyzing the Granger causalities and the correlations of variables we decide to build models for the sample and for the company categories. We test the panel cointegration to ensure the efficacy of our econometric models. The Nickell bias (Nickell, 1981) appears when using Fixed Effects models (FE) for short panel ($T < N$). The solution for our panel is to use the Difference GMM method or System GMM (Baum, 2013; Fukase, 2010).

The Arellano–Bond estimation uses the Difference GMM method (Hansen, 1982, Arellano-Bond, 1991). The Generalized Method of Moments (GMM) on the variables' differences addresses the endogeneity problem by ensuring that the residuals are uncorrelated with the explanatory variables. The Arellano-Bond test verifies the serial correlation of residuals. We are interested in testing the significance of the AR(2) for the second-order correlation that may occur when the lagged dependent variable is introduced as a regressor. The Hansen J-statistic helps to establish the validity of instrumental variables. The Difference GMM model performs well with respect to the validity of instrumental variables, when the Prob(J-statistic) is greater than 0.25 and the p-value of the AR(2) leads to acceptance of the null hypothesis of no serial correlation of order 2 in residuals. We select *white period*, for using *GMM weights* which assume innovations have time series correlation structure that varies by cross-section. The first differences of variables in eqn. (3) remove the constant term and the fixed effects of eqn. (2):

$$y_{it} = \beta_1 + \rho y_{it-1} + \beta_2 X'_{it} + u_i + \varepsilon_{it} \tag{2}$$

$$\Delta y_{it} = \rho \Delta y_{it-1} + \beta_2 \Delta X'_{it} + \Delta \varepsilon_{it} \tag{3}$$

The GMM system was proposed by Arellano and Bover (1995) and Blundell and Bond (1998). When T is short, the difference GMM estimator may yield a biased and inefficient estimate (Blundell and Bond, 1998) of the coefficient of lagged dependent variable, in eqn. (3). The independent variables are not strictly exogenous, they are correlated with past or current error term. The endogeneity problem is not solved by Difference GMM, but by System GMM (Windmeijer, 1998, 2005; Youssef et. al, 2014). The GMM system, when T is small and N is large, allows the dynamic variable as the dependent variable, depending on its own past values, to be persistent, and the other regressors not strictly exogenous, with unobserved heterogeneity and heteroscedasticity, and the autocorrelation of the residuals of along the cross sections, but not over them. The System GMM estimator combines the two equations with the corresponding associated instruments. The equation in levels with instruments as lagged differenced levels of the variables and the second equation of differences with instruments as lagged levels of the variables.

The Difference GSM model (D-GMM) is preferred when the coefficient of the lagged dependent variable in eqn. (3) is in the range of the lower bound of this coefficient obtained with the Fixed Effects model (FE) and the upper bound of the Pool OLS coefficient. If the coefficient of the lagged dependent variable is less than or equal to the FE coefficient, then the GMM system should be applied. When the D-GMM coefficient of the lagged dependent variable is less than the FE coefficient, it has a downward bias (Blundell and Bond, 1998). The S-GMM estimator of the lagged dependent variable will be most reasonable being smaller than the OLS and larger than the FE coefficient. The coefficients of the lagged dependent variable

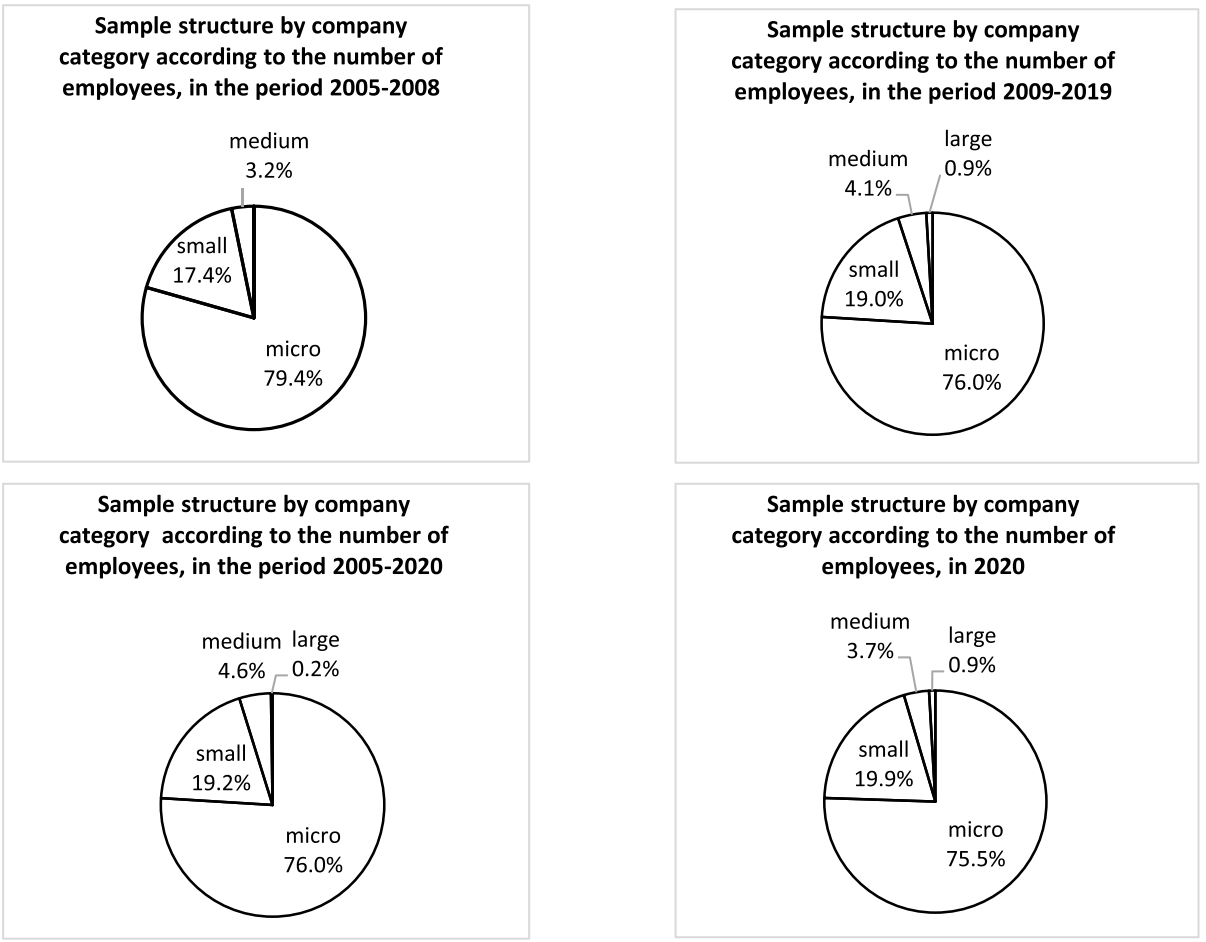

Fig. 1. Evolution of category structure of the sample over time and in the pandemic year.

in all models should be less than one and significant because they represent the speed of adjustment. A negative value of the coefficient of the lagged dependent variable indicates that the variable is not dynamic and a static model should be chosen.

4. Results and discussions

The following subsections mentioned in the research methodology (Section 3.2.) demonstrate the general and specific hypotheses about the influence of the economic environment on the development of e-commerce, and respectively about the characteristics of the dual relationship between financial performance and capital structure.

4.1. Dynamics of sample structure by company category in e-commerce

The sample is representative of Romanian e-commerce companies and we can assume that the structure of the sample by company category is approximately the same as for the entire e-commerce sector. Changes over time in the structure of the sample by company category were shifts to other categories with more employees, as seen in Fig. 1.

In the sample, the proportion of microenterprises fell in favor of SMEs starting with the sub-period 2009–2019. The development of enterprises with a larger number of employees continued in the pandemic year. The proportion of large enterprises remained the same at sample level, in 2020 as in previous sub-period, as seen in Fig. 1. As a characteristic feature of sustainable development in the analyzed period, we appreciate that the proportion of microenterprises in the first sub-period 2005−2008 decreased in favor of all other larger categories of companies.

The size structure of Romanian e-commerce companies is consistent with that of the most developed economies of the European Union, i.e. the proportions of small companies are higher than those of medium-sized companies. Aligning the size structure of e-commerce companies with that of the most developed economies in the European Union gives a sustainable aspect to the development of this sector in Romania. This conclusion proves the *hypothesis H1 that Romanian e-commerce companies follow a trend of sustainable development.*

4.2. Financial profile of the sample of e-commerce companies in the period 2005–2020

The way in which international economic events were reflected in the evolution of macroeconomic aggregate indicators led us to consider certain sub-periods of the 2005–2020 period. The evolution of e-commerce performance indicators in these sub-periods can provide a picture of how this sector responded to the two global shocks: the 2008 economic crisis and the 2020 COVID-19 pandemic. Fig. 2 shows the evolution of the median of the main financial indicators over the entire

Fig. 2. The evolution of the median values of the financial indicators of the sample in the period 2005–2020 (left) and 2009–2020 (right).

analyzed period and separately for the 2009–2020 sub-period. After the recovery from the financial crisis of 2008, the upward trend of ROA, ROE and net profit margin started with the year 2013. The median debt ratio (leverage ratio) has declined over time, as seen in Fig. 2.

In Fig. 2, the downward trend of the indebtedness ratio (the debt ratio) opposes the upward evolution of the financial ratios, proving the existence of an inverse correlation between them.

4.3. Analysis of financial indicators at sample level and by company category in the period 2005–2020

Median values of financial indicators, as robust values of central tendency, are sector benchmarks of financial indicators. Table 1 shows the changes in the median financial ratios of the company categories and of the sample, in each sub-period. The indicators of the last two years of the analyzed period, underline the impact of the pandemic on financial ratios.

The categories of micro and small enterprises recorded better values of median financial ratios in the sub-period 2005–2008 than in the following sub-period 2009–2019. Their values were lower after the 2008 financial crisis than at the beginning of the development of e-commerce. Financial indicators in the SME category are strongly influenced by the small business subcategory, which represents almost 84% of the SME category in the sample. The small business category achieved the best financial results in the analyzed period 2005–2020, including the pandemic year. The median values of ROA, ROE and net profit margin of the sample and by company category, in the last two years 2019 and 2020, show the upward trend of their evolution, in Table 1. For almost all categories of companies, financial ratios were higher in 2020 compared to 2019, supporting *hypothesis H2 that the pandemic was beneficial for the development of e-commerce.*

We see higher ROAs for both SME and large enterprises, in 2020, meaning better managerial performance in making income. Medium-sized and large enterprises achieved median ROA of about 14%. Large companies recorded the largest increase in ROE in 2020 compared to 2019, which means that investors were more confident in their development than for all other categories of companies. Large companies have best withstood the economic shock of the pandemic, turning it into an opportunity for financial development. We prove *hypothesis H3 that financial performance is ensured by larger enterprises.*

The median net profit margin in 2020 was around 7% for microenterprises and for the small businesses in the SME category. The e-commerce beneficiaries of the pandemic are all categories of companies and especially small businesses. This conclusion supports both *hypotheses H1 and H2 about the beneficial impact of the pandemic in the sustainable development of Romanian e-commerce.*

We have identified reference values valid for the e-commerce sector in Romania: ROA of approximately 10%, ROE of 25%, net profit margin of 7%, and leverage ratio of approximately 48%, less than 50%. We can say that most company categories preferred to finance 50% of their capital through debt and the other half through equity. Leverage values in 2019 and 2020 are similar, of about 50% and higher for large companies at around 60%. Micro-enterprises and SMEs less debt-oriented in

Table 1
Evolution of median values of financial indicators of the sample and by company category during the period 2005–2020.

Company category	Median values of financial ratios	Period				
		2005–2008	2009–2019	2005–2020	2019	2020
Microenterprises (less 10 employees)	ROA (%)	5.3	3.1	4.0	7.3	8.5
	ROE (%)	47.7	16.2	22.2	22.3	23.8
	Net profit margin (%)	3.1	2.3	2.7	5.9	7.3
	Leverage (%)	82.0	72.3	74.3	56.8	49.8
Small enterprises (>= 10 and <50)	ROA (%)	9.8	7.2	7.8	10.4	10.9
	ROE (%)	37.8	17.3	21.6	25.2	23.2
	Net profit margin (%)	4.1	3.3	3.7	6.3	6.9
	Leverage (%)	74.2	56.7	60.4	50.3	46.1
Medium enterprises (>= 50 and <250)	ROA (%)	5	4.8	5.1	8.8	14.5
	ROE (%)	18.9	19.1	19.3	22.8	22.6
	Net profit margin (%)	2.2	2.9	2.9	4.6	4.5
	Leverage (%)	77.4	67.1	67.6	47.7	50.3
SMEs (>= 10 and <250)	ROA (%)	8.4	6.9	7.5	10.2	10.9
	ROE (%)	34.5	17.5	21.3	25.1	23.2
	Net profit margin (%)	3.9	3.2	3.6	6.0	6.5
	Leverage (%)	74.2	58.6	62.8	49.5	46.1
Large enterprises (>= 250 employees)	ROA (%)	–	6.6	6.6	10.6	14.1
	ROE (%)	–	21.6	24	21.6	35.5
	Net profit margin (%)	–	1.8	1.8	2.7	4.1
	Leverage (%)	–	72.1	72.1	59.3	60.5
Sample	ROA (%)	6.3	4.4	5.1	8.8	10.0
	ROE (%)	44.1	16.9	21.9	23.0	23.7
	Net profit margin (%)	3.4	2.7	3.0	5.9	6.8
	Leverage (%)	80.0	67.6	70.2	55.1	48.3

Table 2
Dynamic indices of turnover, net profit and number of employees of the sample and by company category in 2020/2019.

Company category	$I_{2020/2019}$ of turnover (%)	$I_{2020/2019}$ of net profit (%)	Employees	
			$I_{2020/2019}$ (%)	% of change $_{2020/2019}$
Micro	101.0	130.3	95.5	−4.5
Small	104.6	114.0	98.5	−1.5
Medium	119.2	140.0	103.1	3.1
Large	80.6	60.4	85.9	−14.1
Sample	100.9	113.0	95.1	−4.9

their sources of financing than large companies. We can say that smaller companies are more equity oriented in terms of source of financing than large companies. These conclusions about leverage and ROA partially support *hypothesis H4*.

The median values of the financial indicators confirm the general hypotheses H1 and H2: in Romania, e-commerce follows a trend of sustainable development, and the COVID-19 pandemic has been beneficial for the development of e-commerce.

4.4. The impact of the COVID−19 pandemic on the financial indicators

Changes in financial ratios ROA, ROE and net profit margin in 2020 compared to 2019 highlight the effects of the pandemic on their evolution, in Table 1.

To determine the impact of the COVID-19 pandemic on the financial performance of the sample and by category of companies, we analyzed dynamic indicators of turnover, net profit (at constant prices, EUR 2015) (Eurostat, 2020) and the number of employees in 2020 compared to 2019, in Table 2.

At the sample level, turnover recorded a slight increase of 0.9 % in 2020 compared to 2019; net profit increased by 13 % and the number of employees decreased by about 5 %. Except for the large enterprise category, which saw a deep decline of around 20 %, all other categories increased their turnover. As a result, the net profit of large enterprises decreased by about 40 %, and the number of their employees fell the most by about 14 %. Medium-sized companies had the largest positive change in turnover of around 19 %. Net profit rose strongly for medium-sized enterprises by 40 %, supported by an increase of about 3.1 % in the number of employees in the pandemic year. For all the other categories of companies, the number of employees decreased. Next in the ranking is the category of microenterprises with an increase in net profit by 30 %, and small enterprises by 14 %. We see that *at the end of 2020, medium-sized enterprises benefited the most from the pandemic shock*.

The development trend of e-commerce is sustainable for larger companies, as it has been proven in the most developed economies of the European Union. Germany, Luxembourg, Denmark and Austria had lower proportions of small than medium-sized enterprises in the SME category in 2020. (Eurostat, 2021). The results in Table 2 are in accordance with the European coordinates of the sustainable development of e-commerce, supporting the general *hypotheses H1 and H2*.

Fig. 3 shows the evolution of financial variables and also the rates of change of GDP with a fixed base in 2005 and the GDP dynamic rates compared to the previous year, in the period 2005–2020. In Fig. 3, as well as in Table 2, the number of employees decreased in 2020 by approximately 5 %. Through econometric models, we demonstrate the nature of the interactions of variables during the COVID-19 pandemic and the economic crisis that in Romania began in 2009, on two levels: in the e-commerce sector and at the level of the national economy.

In order to find out the influence of the COVID-19 pandemic at the sectoral level, we built econometric models of *the turnover*, respectively of *the net profit margin*, as dependent variables and as independent variables we used *the total assets*, *the number of employees* and *the turnover*, for the sub-period 2009–2020. The variables are integrated of order 1 and they are cointegrated. To capture the impact of the COVID-19 pandemic, we used a dummy variable with a value of 1 in the year 2020 and 0 for the other years. The residuals of cross-sections are independent when using the option GLS cross-section weights. The FE cross-section models of the influencing factors on *turnover* and *net profit margin* provide the following results. Between brackets (…) is p-value for each coefficient.

$log(turnover) = 1.0134 \cdot log\_total\_assets + 0.0020 \cdot employees - 0.1063 \cdot d20 - 0.1824$				
Prob.	(0.0000)	(0.0000)	(0.0000)	(0.0339)
R^2=95.2 %				

All coefficients are significant at p-value less than 1 %, except the constant term which is significant at less than 5 %. R-squared is 95.2 % and adjusted R-squared is 95.0 %. We interpret the positive influence of 1 % increase in assets volume which determines about 1.0134 % increase in turnover from sales, when keep constant the other factors. When the number of employees increases with 1 person than the turnover will increase in average with 0.002 %, ceteris paribus. The impact of COVID-19 pandemic counted an average decrease in e-commerce turnover of 0.1063 %.

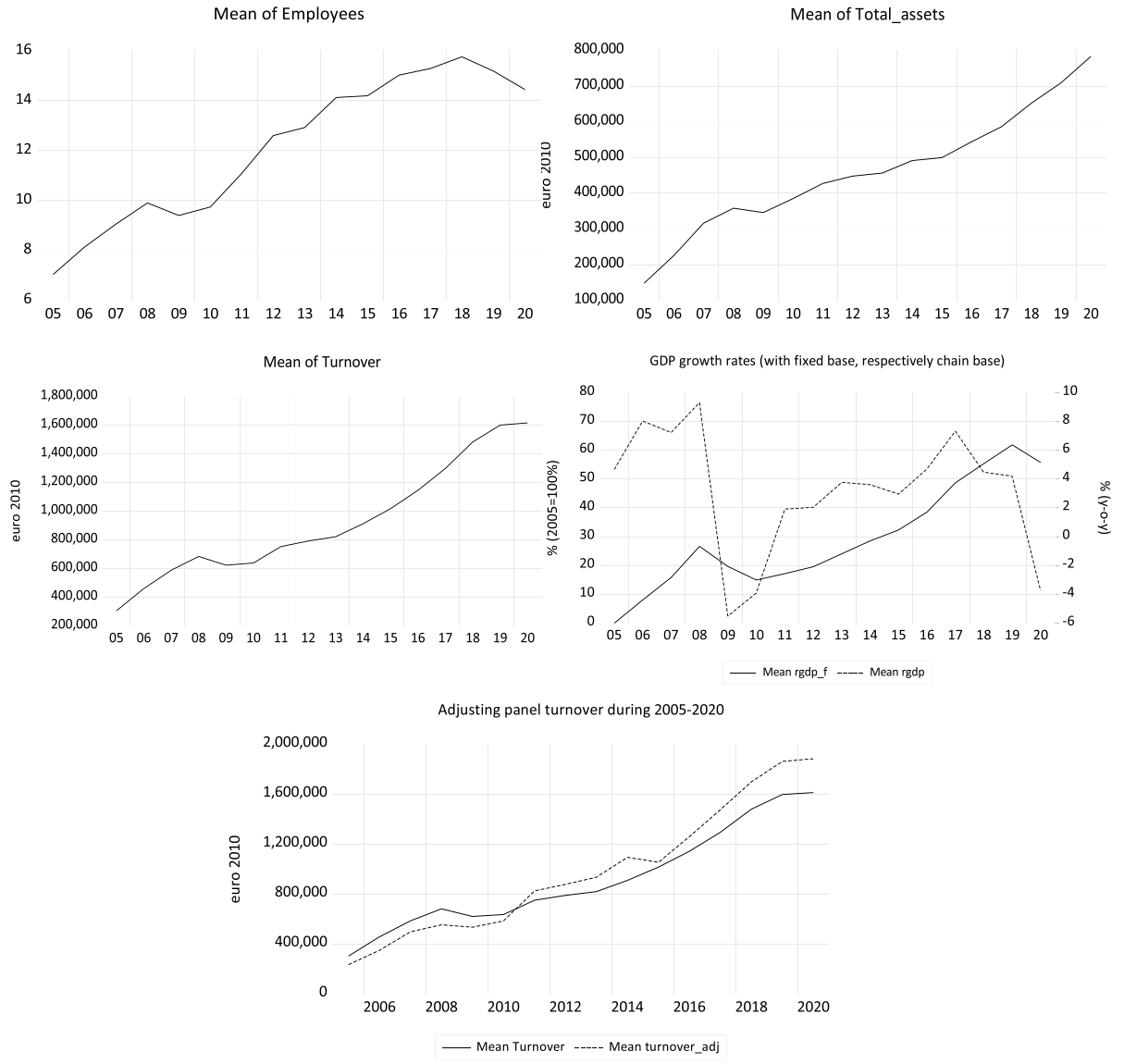

Fig. 3. Growth rates of GDP and the evolution of panel variables.

When studying the variation of the net profit margin in the following models, we observe alongside the positive influence of the dynamics of total assets or turnover and the positive influence of the pandemic year, which caused an increase of more than 2 % in the net profit margin.

$net\_profit\_margin = 0.0296 \cdot log\_total\_assets$ -	0.0003 · *employees* +	0.0264 · *d20* -	0.5086	
Prob.	(0.0000)	(0.0000)	(0.0000)	(0.0000)
R^2=36.3 %				
$net\_profit\_margin = 0.0504 \cdot log(turnover)$ -	0.0006 · *employees* +	0.0231 · *d20* -	0.7398	
Prob.	(0.0000)	(0.0000)	(0.0000)	(0.0000)
R^2=40.3%				

These conclusions support *hypothesis H2, of the positive impact of the pandemic on the development of e-commerce.*

The influence of e-commerce development on economic growth can be perceived when using GDP change rates (2005=100 %) (*rgdp_f*) as dependent variable and as regressors: logarithm of e-commerce *turnover* or *total asset*s, number of *employees* and the dummy variables: *D09* to capture the influence of the economic crisis of 2008 (started in 2009), and *D20*, for the influence of the pandemic year 2020. For the period 2005–2020, the results of the different FE cross-section models are as follows:

Table 3
Statistics for ROA, ROE, net profit margin, and leverage in 2020 for the sample and for all Romanian *e*−commerce companies.

At sample level	ROA (%)	ROE (%)	Net profit margin (%)	Leverage (%)
Mean	10.8	36.9	3.4	120.0
Std. Dev.	82.4	443.9	61.5	314.0
Limit error 95 %, CI	7.6	41.0	5.7	29.0
Lower limit 95 %, CI	3.1	−4.1	−2.2	91.0
Upper limit 95 %, CI	18.4	77.9	9.1	148.9

Table 4
Extending the ROAs, ROEs, and net profit margins in 2020, by company categories.

Category	Firms No. n_i	ROA (%)	Δ_{ROA} (%)	CI limits 95 %, ROA (%)		ROE (%)	Δ_{ROE} (%)	CI limits 95 %, ROE (%)		Net profit mg. (%)	Δ_{pr} (%)	CI limits 95 %, Net profit mg. (%)	
				Lower	Upper			Lower	Upper			Lower	Upper
Micro	330	9.5	9.1	0.4	18.7	37.8	49.2	−11.5	87.0	2.1	6.8	−4.7	9.0
Small	87	*15.6*	8.3	7.3	23.9	35.1	43.1	−8.0	78.3	*8.5*	6.0	2.5	14.5
Medium	16	8.9	11.8	−2.9	20.7	27.8	42.3	−14.5	70.2	2.6	8.3	−5.7	10.9
Large	4	13.3	19.2	−5.8	32.5	36.7	62.8	−26.1	99.5	3.7	7.8	−4.1	11.5
Sample	437	10.8	7.6	3.1	18.4	36.9	41.0	−4.1	77.9	3.4	5.7	−2.2	9.1

$rgdp\_f = 0.0202 \cdot log(turnover)$ - $0.0771 \cdot D09 + 0.2615 \cdot D20$ + 0.0517
Prob. (0.0000) (0.0000) (0.0000) (0.0000)
R^2=22.2 %
$rgdp\_f = 0.0195 \cdot log(turnover) + 0.0008 \cdot employees$ - $0.0734 \cdot D09 + 0.2573 \cdot D20$ + 0.0497
Prob. (0.0000) (0.0000) (0.0000) (0.0000) (0.0000)
R^2=23.8 %
$rgdp\_f = 0.0618 \cdot log\_total\_assets + 0.0005 \cdot employees$ - $0.0635 \cdot D09 + 0.2197 \cdot D20$ - 0.4238
Prob. (0.0000) (0.0000) (0.0000) (0.0000) (0.0000)
R^2=34.6 %

The models of fixed base GDP growth rates show the positive influence of the dynamics of the variables *turnover* or *total assets* and the *number of employees*. The negative impact of the 2008 economic crisis on the fixed rate of GDP growth in 2009 is almost the same in the three models, about −7 %. The impact of the COVID-19 pandemic is perceived as beneficial due to the positive coefficient of the dummy variable D20, which shows almost the same increase in *rgdp_f*, according to the three models used, of more than 20 % compared to 2005. These results support the general hypothesis *H1 regarding the sustainable contribution of e-commerce to economic growth in the analyzed period*.

4.5. Extending the sample results to all Romanian e-commerce companies in 2020

In order to extend the sample results to the population level of all Romanian enterprises in the field of online commerce, we summarize the average of the financial performance indicators in the year 2020, their limit errors, and the confidence intervals with a 95 % probability, in Table 3.

Table 3 contains the error limit, Δ for each financial indicator, *ind*, based on eqn. (4), with σ^2 – the variance of indicator at sample level, and $z = 1.96$, the value of probability coefficient for the 95 % probability of guaranteeing the confidence intervals at the population level. The number N of all enterprises in the field of electronic commerce in Romania in 2020 is $N = 13{,}638$, and the sample volume $n = 437$.

$$\Delta = z\sqrt{\frac{\sigma^2}{n-1}\left(1-\frac{n}{N}\right)}; \tag{4}$$

Table 4 presents the average annual values of performance indicators ROA, ROE, and net profit margin for each category of companies and for the sample. It also contains the confidence intervals, with a probability of 95 %, of the financial ratios for each category of companies, *i*, valid for the entire Romanian e-commerce. The limit error for each company category *i* and each indicator *ind*, denoted Δ_i^{ind}, in eqn. (5) takes into account the representativeness errors at the sample level and at the company category level, where n_i is the number of enterprises in each category, in Table 4.

$$\Delta_i^{ind} = z\sqrt{\frac{\sigma^{2\ ind}}{n-1}\left(1-\frac{n}{N}\right)+\frac{\bar{\sigma}_i^{2\ ind}}{n_i-1}\left(1-\frac{n_i}{N}\right)} \tag{5}$$

All categories of companies have benefited from the pandemic, but especially small businesses, with the highest values of average ROA and average net profit margin. When considering the average values of financial ratios, the category of small

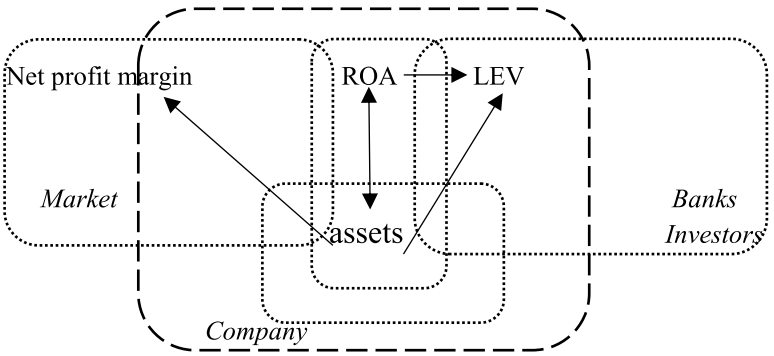

Fig. 4. Granger causality of financial ratios at sample level during 2009–2020.

Table 5
Granger causalities by company category and sample, in the period 2009–2020.

Variable does Granger cause	→ variable:	Micro (0 >=empl <10)	Micro (6>=empl <10)	Small (10>=empl <50)	Medium (50>=empl <250)	SMEs (10>=empl <250)	Large (empl> =250)	Sample
No. obs. (% in sample)		3916 (74.7%)	615 (11.7%)	1086 (20.7%)	207 (3.9%)	1293 (24.7%)	35 (0.7%)	5244 (100%)
ROA	LEV	x	x	–	–	–	–	x
LEV	ROA	–	–	x	–	x	–	–
Net profit mg	ROA	–	x	x	–	x	–	–
ROA	Net profit mg	–	x	x	x	x	–	–
ROA	Log(assets)	x	x	x	x	x	x	x
log_assets	ROA	x	–	x	x	x	–	x
LEV	Log(assets)	–	x	x	–	x	–	–
log_assets	LEV	x	x	–	–	–	x	x
log_assets	Net profit mg	x	–	x	–	x	–	x
Net profit mg	log_assets	–	x	x	–	x	x	–
Net profit mg	LEV	–	x	x	x	x	–	–
LEV	Net profit mg	–	x	x	–	x	x	–

companies with between 10 and 49 employees benefited the most from the business opportunities of the 2020 pandemic year.

4.6. Econometric modeling of financial performance and capital structure in Romanian e-commerce in the period 2009–2020

4.6.1. Testing the causal relationships of variables

From the beginning, we are interested in the causalities between the variables analyzed both for the entire period 2005–2020 and for the sub-period 2009–2020, at sample level and by company category. The Granger causality relationships between financial ratios at the sample level, for the period 2009–2020, are illustrated in Fig. 4.

The only difference for the period 2005–2020 at the sample level is that LEV is a Granger cause for total assets, demonstrating that this causality operates when a longer period is considered. In Fig. 4, in the period 2009–2020, the leverage ratio, measured by the degree of indebtedness, is influenced by the managerial ability to make a profit (ROA). ROA, as a market-driven financial performance, influenced leverage, LEV. By default, the volume of assets, which differentiates the categories of companies, is significant for both ROA, LEV and net profit margin.

The Dumitrescu and Hurlin (DH) panel causality test provides information on the direction of causality and allows for cross-sectional heterogeneity; here, the cross-sections are the enterprises in the panel. The DH panel causality test shows the two-way causalities between the leverage ratio and the financial performance as expressed by ROA, ROE and net profit margin. The DH test is concerned with short-term dynamics between variables by testing their first lagged series. The DH null hypothesis of homogeneous non-causality means that there is no causality in any cross-section. The null hypothesis is rejected for all combinations of variables, that is, there is partial causality in cross-sections. The alternative hypothesis of heterogeneous non-causality means that not for all but for some cross-sections the causality may be present. The results of DH test are similar for the sub-period 2009–2020, checking also for lags 1 and 2.

The variables ROA, LEV, net profit margin and the logarithm of assets are tested with Granger tests for non-causality, for the period 2009–2020. The results of rejecting the null hypothesis of non-causality with Prob. $< 1\%$ are presented in Table 5. The firms in the sample are not listed and ROE has less importance for the conclusions of this study. As we can see, ROE is not in any combination as Granger cause for any variable in Table 5. Granger causality analysis by company category is

Table 6
The simple correlation coefficients on sub-periods, during 2005–2020, at panel level.

	ROA			ROA(−1)			LEV		
	2005–2020	2005–2008	2009–2020	2005–2020	2005–2008	2009–2020	2005–2020	2005–2008	2009–2020
ROA	1	1	1						
ROA(−1)	0.121	0.490	0.011	1	1	1			
LEV	−0.298	**−0.939**	−0.218	−0.199	−0.564	−0.155	1	1	1
LEV(−1)	−0.041	−0.316	−0.005	−0.298	**−0.945**	−0.220	**0.801**	0.374	**0.829**
Net pr. mg.	0.104	0.018	0.132	0.019	0.051	0.008	−0.006	−0.010	−0.006

important for the choice of regressors in their econometric models. We observe that the financial behavior of the firms in the sample is different depending on the category they belong to.

We want to assess the significance of the dual relationship between financial performance (ROA) and the leverage ratio. Financial performance (ROA) of microenterprises is influenced by past profitability through total assets. Financial leverage, LEV is influenced by ROA and by its previous value through the influence of the size of assets on it. The microenterprise category has a large proportion (75%) in the sample, and its characteristics are reflected in the sample. At the sample level for the period 2009–2020, we find the same Granger causalities of the financial variables as for the category of microenterprises. The sample-level causalities from Table 5 are also seen in Fig. 4.

The small business category has a large number of Granger causalities, all of which are recognized by the SMEs' category where small businesses account for 84%. We observe that financial performance (ROA) in the small business category is directly and indirectly influenced by leverage, market relationship and asset size. Leverage is indirectly influenced by ROA, which directly influences market relationship and asset size, which in turn influences LEV. The larger the companies, the more complex the inter-influences between ROA and LEV, indirectly through other variables such as asset size and market relationship.

4.6.2. Analysis of correlations between variables

Based on correlation analysis, the specific working assumptions of both financial performance and capital structure can be referred. When our findings demonstrate specific hypotheses at the sample level, we report partial support, following as company category approach to complement them.

The correlations between ROA and LEV, presented in Table 6 over the period 2005–2020 and the sub-periods 2005–2008 and 2009–2020, show that all their simple correlation coefficients are negative. There is an inverse relationship between the two variables, both for the current year and for the previous year. The intensities of the correlations of the two variables are different over time. In the first sub-period 2005–2008, there is a strong simultaneous correlation of approximately −0.94 between ROA and LEV, and the same strong negative correlation of their values from the previous year. This conclusion based on correlation analysis partially proves *hypothesis H4*.

In the 2005–2008 sub-period of early e-commerce development, the simultaneous correlations between LEV and ROA for both the current year and the previous year were equally strong. After the 2008 crisis, starting with the recovery and in the 2009–2020 period, the intensity of the correlation between financial performance and capital structure suddenly reduced to almost non-existent; the negative nature of the correlation has a weak intensity. When financial performance increased after the 2008 crisis (Fig. 2), the correlation with the leverage ratio decreased in intensity, demonstrating that their relationship depends on the sectoral economic development cycle. This conclusion is related to *hypothesis H1*.

In the 2009–2020 sub-period, the previous year's LEV has a strong influence on the current leverage ratio, marking this relationship as strong and for the entire period around 0.80, partially supporting *hypothesis H7*.

Except for the relationship between ROA and LEV and the autocorrelation of LEV, all other correlation coefficients between financial variables at the sample level either show no links or weak relationships. There are no correlations between ROA, respectively LEV, and the other variables: net profit margin and logarithm of total assets. All simple correlation coefficients between LEV and the logarithm of total assets are negative and around 0.2 marking the lack of correlation in the analyzed period. The simple correlation coefficients between net profit margin and LEV are negative and close to 0. There is no sample-level correlation between ROA and net profit margin, in Table 6.

The correlation coefficients of the sample-level variables for the whole period 2005–2020 are almost the same as those of the larger sub-period 2009–2020. This fact gives weight to the conclusions based on the research results of the sub-period 2009–2020 to demonstrate the working hypotheses. At the panel data level, the simple correlation coefficients are those specific to micro-enterprises, as they represent the largest proportion of the sample, 75%.

Analyzing in depth the correlations between the financial variables for the two sub-periods 2005–2008 and 2009–2020, by company category, in Table 7, we find that they depend not only on the sub-period, but also on the company category; there are stronger correlations the larger the company.

In the sub-period 2009–2020, we see in Table 7 that the ROA of the previous year influences the current ROA, not for micro-enterprises, but moderately to strongly, to a greater extent for the category of larger companies. So, more than *hypothesis H3 supports, financial performance does not only depend on company category, but it is also auto-correlated to a greater extent for larger companies.*

Table 7
Comparing correlations by company category in the periods 2005–2020 and 2009–2020.

	ROA		ROA(−1)		LEV		LEV(−1)	
	2005–2008	2009–2020	2005–2008	2009–2020	2005–2008	2009–2020	2005–2008	2009–2020
ROA(−1)	**0.490**	**0.011**	**1**	**1**				
- micro	0.489	0.010	1	1				
- small	0.195	0.507	1	1				
- medium	0.731	0.796	1	1				
- large	–	0.637	–	1				
LEV	**−0.939**	**−0.218**	**−0.564**	**−0.155**	**1**	**1**		
- micro	−0.939	−0.218	−0.563	−0.155	1	1		
- small	−0.575	−0.541	−0.244	−0.445	1	1		
- medium	−0.676	−0.570	−0.687	−0.541	1	1		
- large	–	−0.728	–	−0.756	–	1		
LEV(−1)	**−0.316**	**−0.005**	**−0.945**	**−0.220**	**0.374**	***0.829***	**1**	**1**
- micro	−0.315	−0.004	−0.945	−0.220	0.373	*0.828*	1	1
- small	−0.187	−0.381	−0.454	−0.496	0.718	*0.890*	1	1
- medium	−0.452	−0.489	−0.576	−0.547	0.923	*0.960*	1	1
- large	–	−0.522	–	−0.727	–	*0.891*	–	1
Net pr. mg.	**0.018**	**0.132**	**0.051**	**0.008**	**−0.010**	**−0.006**	**−0.060**	**−0.007**
- micro	0.016	0.132	0.050	0.007	−0.008	−0.004	−0.059	−0.005
- small	0.833	0.681	0.040	0.350	−0.506	−0.447	−0.092	−0.348
- medium	0.947	0.825	0.701	0.658	−0.671	−0.496	−0.454	−0.417
- large	–	0.924	–	0.643	–	−0.671	–	−0.522

In the first sub-period, the negative correlations between LEV and ROA were strong for micro-enterprises and decreasing in intensity for larger companies. The situation reversed in the second sub-period 2009–2020, when current LEV negatively influences ROA even more for larger companies from weak to medium intensity, supporting *hypothesis H4*.

The correlation between previous LEV and ROA is almost the same as that of current correlation of LEV and ROA, specific to each company category, increasing as the company is larger. It has a medium intensity of correlation for the category of large companies in both sub-periods. The two series of correlations are colored gray in Table 7. These findings of the same correlations between current-year and prior-year ROA and LEV by company category and specifically within each sub-period support *hypothesis H4*.

In both sub-periods, the correlations between the previous year's LEV and the current ROA are almost absent for micro-enterprises, and slightly increasing for the categories of larger companies. The same is true for the correlations between the previous year's ROA and the current LEV, but they are higher than those between the previous year's LEV and the current ROA, supporting *hypothesis H6*.

In the second sub-period, the previous year's LEV strongly influences the current LEV for all company categories to the same extent (highlighted in italics in Table 7), proving *hypothesis H7*.

The close relationship between ROA and LEV in the first sub-period changed in the second sub-period to emphasize the strong influence of the previous year's LEV on the current LEV, regardless of company category. This change corresponds to the conditions of the economic boom and the maturity of the banking system in the sub-period 2009–2020.

The correlation between current ROA and net profit margin is more important for larger companies, in both sub-periods; there is no correlation for microenterprises. Their correlation coefficients slightly decreased in the second sub-period compared to the first sub-period, to a medium intensity for small companies, but still a strong intensity for medium and large companies. The influence of the previous year's ROA continues to act on the current net profit margin by decreasing, but with greater intensity for larger businesses. *The relationship with the market significantly influences the financial performance by category of companies, supporting hypothesis H5. The larger the companies, the higher the correlation between net profit margin and ROA.* The correlations of current net profit margin with ROA and LEV decrease over time, being more significant the larger the companies.

We find that the relationship between financial performance and leverage ratio is different depending on the company category, but also on the conditions of economic growth. Based on correlation analysis, econometric approaches will provide results for causal investigation. We use the selected variables in building econometric models of the panel data of the sample and by category of companies.

4.6.3. General considerations on econometric approaches for the period 2009–2020

Our econometric approaches consider both directions of causality between financial performance and the leverage ratio. Our models use ROA as indicator of financial performance and indebtedness degree (LEV) as indicator of capital structure. We also include other variables to control for firm characteristics, such as asset size, expressed as the logarithm of total assets, and market relation, via net profit margin.

For all selected variables: ROA, LEV and net profit margin - the unit root tests reject the null hypothesis of non-stationarity. The variables are stationary. The cointegration concept envisages non-stationary variables related to the long-

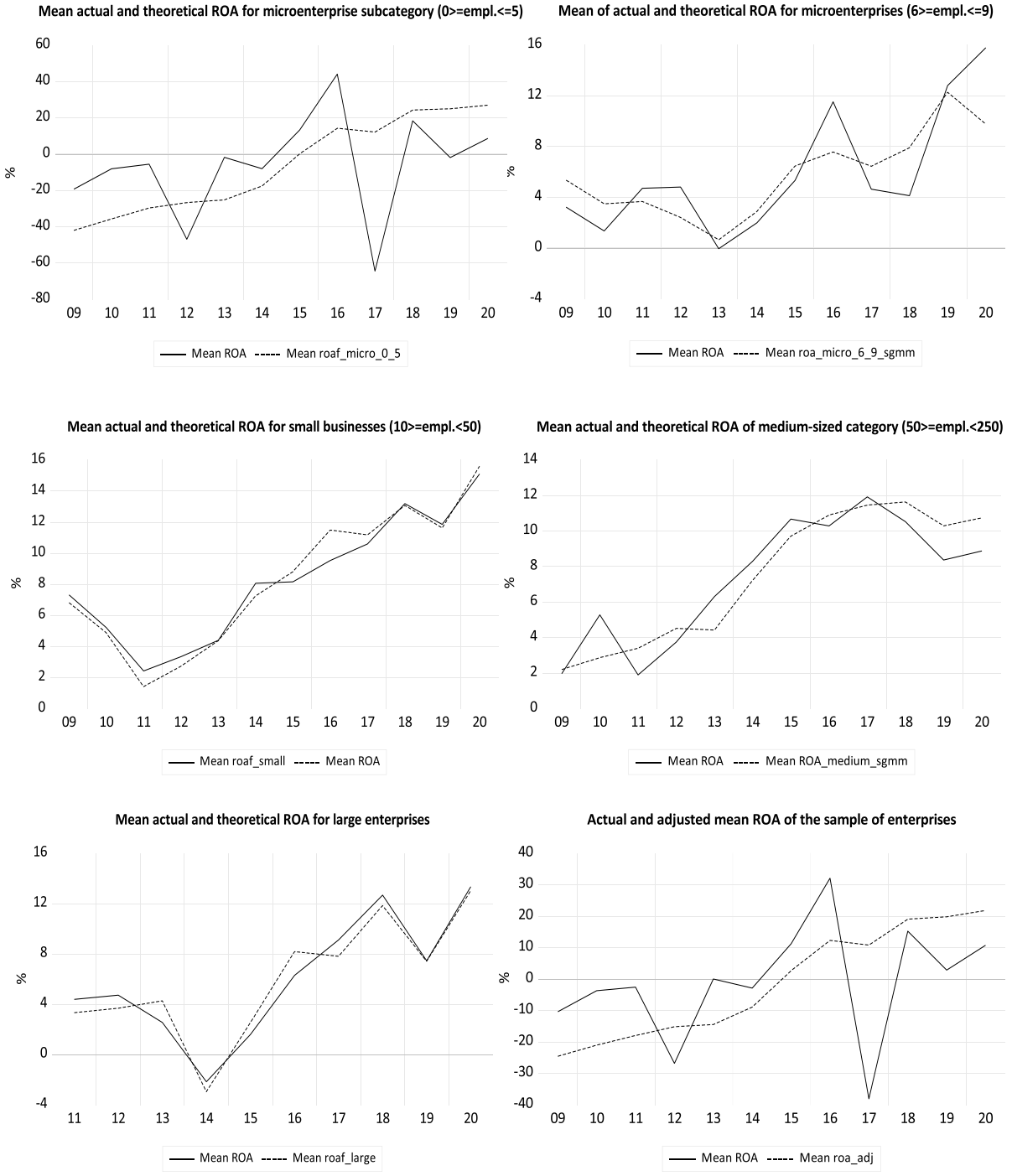

Fig. 5. Actual and theoretical mean values of ROA, with different models.

term equilibrium relationship. The variables have neither an individual unit root nor a common unit root for the cross sections. Even if our variables are stationary, they respect the condition for cointegration to be integrated of same order, I(0). The Pedroni test of cointegration shows eight out of eleven test statistics which reject the null hypothesis of no cointegration and we accept panel cointegration for the period 2005–2020 (Annex 1). Also the Johansen Fisher cointegration test and Kao test admit the panel cointegration. Cointegration is also confirmed for the 2009–2020 sub-period by six out of eleven test statistics of the Pedroni cointegration test.

The heterogeneity of the sample is due to the categories of companies. For this reason, we built a separate model for each company category. In the 2009–2020 sub-period, 16.4% of the total sample has 0 employees, representing 21.9% of

the micro-enterprise category. The financial performance (ROA) of this part is almost negative throughout 2009–2020. The next subcategory with between 1 and 5 employees, which represents 62.4% of the microenterprise category and 46.6% of the panel data, recorded poor financial performance in the period 2009–2020. The top subcategory of microenterprises with between 6 and 9 employees representing 15.7% of the microenterprise category and 11.7% of the panel was the only subcategory to record a positive average ROA on an upward trend from 2009 to 2020, as seen in Fig. 5. We will consider separately the upper subcategory with between 6 and 9 employees of the microenterprise category in our models.

The econometric approach, undertaken for the period 2009–2020, is based on the GMM method because the panel of enterprises is short with a small T (12 years) and a large N (437 firms), respecting the context of a dynamic data panel. The regressors are correlated with the lagged dependent variable, either ROA or LEV, and their coefficients may also be biased. The GMM method allows for some endogeneity in the regressors.

4.6.4. Econometric models of financial performance (ROA) for the period 2009–2020

This section addresses the specific working hypotheses regarding the determinants of the financial performance (ROA) of Romanian e-commerce enterprises (H3, H4 and H5).

Table 8 contains the coefficients of the lagged dependent variable ROA in the Pool OLS, FE (fixed effects) and Difference GMM (Arellano and Bond, 1991) models for the choice between Difference GMM (D-GMM) and System GMM (S-GMM). Depending on the variables included as regressors, at the sample level and by company category, we use variations of eqn. (6) for the Pool OLS and FE models and eqn. (7) for the D-GMM models.

$$ROA_{it} = a_0 + a_1 ROA_{it-1} + a_2 LEV_{it} + a_3 net\_profit\_margin_{it} + \varepsilon_{it} \tag{6}$$

$$\Delta ROA_{it} = \propto_1 \Delta ROA_{it-1} + \propto_2 \Delta LEV_{it} + \propto_3 \Delta net\_profit\_margin_{it} + \Delta\varepsilon_{it} \tag{7}$$

The EViews GMM (S-GMM) specification for ROA corresponds to the variables listed as regressors. Table 8 contains the results of testing the appropriate model, either static or dynamic, and if dynamic, which model should be preferred between D-GMM and S-GMM. The large company category does not support a GMM approach due to the small number of observations; the number of instrumental variables must be less than the number of cross sections.

In Table 8, we see the GMM method can only be applied to the subcategory of micro-enterprises with between 6 and 9 employees and to the category of medium-sized enterprises, as the coefficients of the lagged variable ROA are significant and positive, even if they are close to 0 indicating a low persistence. The persistence coefficient estimates obtained with the D-GMM models are lower than those of the FE model estimates and an S-GMM is preferred to the D-GMM. For both the upper microenterprise subcategory and the medium enterprise category, we found valid S-GMM models in Table 9. The variables in the S-GMM models are in accordance with the Granger causalities highlighted by company category in Table 5. For the upper subcategory of microenterprises, the only part of it that can be modeled with the S-GMM system shows a sign change of the inverse relationship between LEV and ROA, showing an effective debt management change policy.

The α_1 coefficients of the lagged variable ROA in Table 8, obtained with D-GMM models with different regressors, for the category of medium enterprises, of 0.066, 0.194, and 0.023, respectively, are less than one and statistically significant at p-value less than 1%, as evidence of conditional convergence. The coefficient of the lagged variable ROA represents the speed of adjustment. The low values demonstrate a very competitive operating environment in the e-commerce sector among medium-sized companies, in the analyzed period 2009–2020. It means that history does not matter much for present developments. Efforts to return to previous normal conditions are minimal, especially for medium-sized firm category, when considering the influence of leverage, net profit margin, and asset volume on ROA. For the medium-sized firm category, we prefer the S-GMM in Table 9 because it provides unbiased ROA estimator compared to the D-GMM estimators. The negative coefficient of LEV in the S-GMM model for the medium-sized enterprise category is consistent with the negative correlation

Table 8
The corresponding model at sample level and at category level for the period 2009–2020.

2009–2020 ROA(−1) coefficient for	FE Lower limit a_1^{FE}	Pool OLS Upper limit a_1^{oLS}	D-GMM (differences) $\alpha_1^{D\text{-}GMM}$	Regressors	Model choice: Static or Dynamic (D-GMM /S-GMM)?	Final model
Sample	−0.097***	−0.024*	−0.094***	LEV	Static	FE
micro	−0.111***	−0.024	−0.104***	LEV	Static	FE
micro 6–9	0.283***	0.503***	0.137***	LEV	S-GMM	–
micro 6–9	0.187***	0.359***	0.133***	Net profit mg	S-GMM	–
micro 6–9	0.143***	0.308***	0.069***	LEV, Net profit mg	S-GMM	S-GMM
small	0.075***	0.263***	−0.085***	Net profit mg	Static	FE
medium	0.176***	0.473***	0.066***	Net profit mg	S-GMM	–
medium	0.312***	0.730***	0.194***	LEV	S-GMM	–
medium	0.083	0.432***	0.023***	LEV, Net profit mg, log(assets)	S-GMM	S-GMM
SMEs	0.094***	0.272***	−0.067***	Net profit mg	Static	FE

Table 9
GMM models for the upper sub-category of microenterprises and the medium-sized category during 2009–2020.

GMM models of ROA – dep.	Micro (>=6 empl.<10) S-GMM	Medium (>=50 empl.<250) S-GMM
Coefficients	c_i	c_i
C	−0.031	−1.013
ROA(−1)	0.237	0.191
LEV	0.063	−0.012
Net_profit_margin	0.988	1.192
Log_total_assets	–	0.070
J-statistic	0	0
R sq.	62.2 %	54.2 %
Adj. R sq.	62.0 %	53.3 %
No. observations	615	207

Table 10
FE cross-section econometric models of ROA for the period 2009–2020.

FE-LS models of ROA	Sample	Micro *ent.* (>=0 and <10 empl.)	Micro *ent.* (>=0 and <=5 empl.)	Small *ent.* (>=10 and <50 empl.)	SMEs (>=10 and <250 empl.)	Large *ent.* (>=250 empl.)
ROA – dep.	a_i***	a_i***	a_i***	a_i***	a_i***	a_i***
C	−3.819	−4.757	−7.977	0.056	0.066	0.110
LEV	−0.095	−0.094	–	−0.196	−0.165	−0.081
LEV(−1)	0.095	0.095	0.037	0.188	0.138	–
	0.204	0.177	0.170	0.805	0.867	1.792
Net_profit_margin						
Log(total assets)	0.334	0.442	0.746	–	–	–
R^2	24.3 %	25.3 %	15.6 %	83.31 %	82.7 %	94.8 %
Adj. R^2	17.3 %	17.3 %	5.4 %	80.30 %	80.0 %	91.0 %
No. observations	5244	3916	3301	1086	1293	35
Cross sections	437	375	355	163	172	6
Significant FE?	No	No	Yes	Yes	Yes	Yes

*** (- p-value significance level less than 1 %).

between ROA and LEV. The S-GMM estimator for lagged ROA is in the range bounded by the FE estimator as the lower bound and the Pool OLS estimator as the upper bound in Table 8. For the upper sub-category of micro-enterprises the speed of adjustment is higher than for the medium-sized firm category in Table 9. For micro-enterprises, the operating environment was less competitive than for medium-sized enterprises, during the analyzed period. This conclusion is consistent with the results in Tables 1 and 2, which show that medium-sized enterprises were the beneficiaries of the pandemic shock. The sustainable development of EU e-commerce in the most developed economies is based on medium-sized enterprises (Eurostat, 2021).

The FE panel data models of the categories of companies for which the dynamic nature of ROA was absent are presented in Table 10. The Pool OLS model of ROA cannot omit cross-sectional heterogeneity. The Lagrange multiplier tests accept the null hypothesis of no random effects. The redundant fixed effects tests show significant cross-section fixed effects over the analyzed period for almost all FE-LS models of the company categories (unbalanced panels), as presented in Table 10. Cross-sectional dependence tests for panel data of Breusch-Pagan Chi-square, Pearson LM Normal, Pearson CD Normal and Friedman Chi-square cannot reject the null hypothesis of cross-sectional residual independence for the FE models in Table 10. All the coefficients of the explanatory variables in the fixed-effects cross-sectional models of ROA are significant at a p-value of less than 1 %.

The cross-sectional fixed effects are not significant for the sample and for the microenterprise category as a whole, as we expected, having previously considered this category in subcategories. The category of microenterprises is the largest in the sample, and the heterogeneity appears between those with a small number of employees versus those with more employees, with between 6 and 9. For the upper subcategory of micro-enterprises and the category of medium-sized enterprises the GMM models are presented in Table 9.

The current leverage ratio (LEV) negatively and almost equally influences ROA for all categories of companies in Table 10 by about 0.1 – 0.2 pp on average for each 1 pp increase in LEV. The financial performance of smaller firms is less influenced by leverage compared to larger firms, but for both medium-sized firms (Table 9) and large firms (Table 10) the pressure of LEV on ROA becomes smaller. The previous year's LEV positively influences the current ROA and about the same extent that the current LEV influences it negatively. This finding is consistent with *hypothesis H4, according to which the ROA*

Table 11
The corresponding model for LEV in the period 2009–2020.

2009–2020 LEV(−1) coefficient	FE Cross-section, a_1 Lower limit	Pool OLS a_1 Upper limit	D-GMM (differences) α_1	Model choice: Static or Dynamic (D-GMM /S-GMM)?
Sample	0.676***	0.827***	0.317***	S-GMM
micro	0.677***	0.827***	0.334***	S-GMM
micro 6–9	0.745***	0.895***	0.459***	S-GMM
small	0.992***	0.974***	0.359***	S-GMM
medium	0.681***	0.962***	0.529***	S-GMM
SMEs	0.970***	0.970***	0.327***	S-GMM
large	0.703***	0.789***	–	–

for almost all categories of companies is influenced to the same extent by the leverage ratio specific to the category of companies, as in the previous year.

The positive influence of net profit margin on ROA is greater for larger companies, as seen in Table 10. In ascending order of company size category, ROA increased by 0.2 pp to 1.8 pp for every 1 pp increase in net profit margin. The influence of net profit margin on ROA increases as firm size increases, proving *hypothesis H3, that financial performance is higher for larger companies*. The conclusion about the influence of net profit margin on ROA, also supports *hypothesis H5*, *financial performance is closely related to the relationship with the market. The larger the company, the greater the influence of the market relationship on financial performance*.

The volume of assets is significant for the category of micro-enterprises with a smaller number of employees. The conclusions about the results of the FE models of the firm categories are supported by the high determination coefficient values of over 80 %, for small enterprises and total SMEs, and even over 90 % for the large firm category.

In Fig. 5, the theoretical ROA values calculated with the models presented in Tables 9 and 10, for each subcategory and enterprise category, are combined into a single sample-level adjusted ROA series. The SME graph is very similar to that of small businesses, with them representing 84 % of the SME category. The same is true for the ROA graph at the sample level (Fig. 5) being similar to that of the subcategory of microenterprises with between 0 and 5 employees, which represents 63 % of the panel data.

Financial performance was more volatile for micro-enterprises in the period 2009–2020, in different ranges of evolution by company category. All categories of companies recorded an increase in financial performance in the pandemic year 2020.

4.6.5. Econometric models of leverage ratio (LEV) for the period 2009–2020

This section addresses the specific hypotheses about the determinants of financial leverage of Romanian e-commerce enterprises (H6 and H7). The leverage ratio (LEV) econometric models are based on the causalities shown in Fig. 4 and Table 5 and the correlation analysis in Tables 6 and 7. For the period 2009–2020, the GMM method is used because the panel of enterprises has a small T (12 years) and a large N, being unbalanced according to the number of employees in each year. The LEV regressors are ROA and net profit margin, depending on the company category, and their coefficients may be biased when using Difference GMM models. The System GMM method solves the problem of endogeneity of regressors. Table 11 contains the coefficients of the lagged dependent variable LEV in the Pool OLS, FE models and Difference GMM models for the choice between Difference GMM (D-GMM) and System GMM (S-GMM). In Table 11, we use eqn. (8) for the Pool OLS and FE models and eqn. (9) for the D-GMM models which underlie the construction of the corresponding S-GMM.

$$LEV_{it} = a_0 + a_1 LEV_{it-1} + a_2 ROA_{it} + \varepsilon_{it} \tag{8}$$

$$\Delta LEV_{it} = \propto_1 \Delta LEV_{it-1} + \propto_2 \Delta ROA_{it} + \Delta\varepsilon_{it} \tag{9}$$

The coefficient of the lagged dependent variable must be positive, less than one, and significant. In Table 11, for all enterprise categories the D-GMM coefficient α_1 of the lagged dependent variable LEV is positive, but below the lower limit of the range delimited by the corresponding FE coefficient and the upper limit by the Pool OLS coefficient.

We choose the System GMM (S-GMM) dynamic data models shown in Table 12. The explanatory variables of LEV are different in the S-GMM models of the company categories. For the large company category, the D-GMM cannot be determined, but the corresponding S-GMM is shown in Table 12. All S-GMM models have positive and significant coefficients of the lagged variable LEV at less than 1 % p-value, except in the large company category model, which is significant at 10 % p-value. The Wald test shows the joint non-zero significance of the coefficients, c_i in all S-GMM models.

The leverage ratio (LEV) is positively influenced by its previous level LEV_{t-1}, as the remaining debt adds pressure to the current debt. For all categories of companies, the value close to 1 of the coefficients of the lagged dependent variable indicates a high persistence of the leverage ratio, and history plays an important role in its current evolution. The debt mechanism has a lot of inertia and changes are slow. Values very close to 1 of the adjustment speed of LEV are similar for all firm categories, almost the same regardless of firm category, proving *hypothesis H7*, and consistent with the strong correlations of previous year and current year LEV in Table 7. For the upper subcategory of micro-enterprises and for the category

Table 12
S-GMM models of LEV for the period 2009–2020.

S-GMM models of LEV	Sample S-GMM	Micro *ent.* (>=0 and <10 empl.) S-GMM	Micro *ent.* (>=0 and <=5 empl.) S-GMM	Micro *ent.* (>=6 and <10 empl.) S-GMM	Small *ent.* S-GMM	Medium *ent.* S-GMM	SMEs S-GMM	Large *ent.* S-GMM
	c_i	c_i	c_i	c_i	c_i	c_i	c_i	c_i
C	0.000	0.008	−0.022	0.595***	0.095	0.024	0.073	0.617**
LEV(−1)	0.995***	0.995***	0.995***	0.313***	0.891***	0.987***	0.914***	0.430*
ROA	–	–	–	−0.421	−0.335	−0.213	−0.233	–
ROA(−1)	0.255	0.262	−0.134	–	–	–	–	−1.752
J-statistic	0	0	0	0	0	0	0	0
No. obs.	5244	3916	3301	615	1086	207	1293	35
R sq.	66.2 %	66.2 %	65.5 %	55.0 %	81.4 %	93.1 %	82.2 %	75.2 %
Adj. R sq.	66.2 %	66.2 %	65.5 %	54.9 %	81.4 %	93.0 %	82.1 %	73.6 %

(***/ **/ * - p-value significance level less than 1 %, 5 %, respectively 10 %).

of large companies, the adjustment speed had lower values, around 0.3 and 0.4, respectively, showing that they acted in a more competitive economic environment compared to the others, proving a better debt management. The previous year's debt utilization efficiency is included in ROA. In Table 12, the S-GMM model of the microenterprise category shows a positive influence on current LEV of about 0.2 pp for each 1 pp increase in previous year's ROA. Since micro-enterprises are the most numerous in the sample, this characteristic is reflected at the sample level. The negative correlation between ROA and LEV explains the positive influence of past profitability on current LEV as an increased pressure due to ineffective debt management in the previous year. The current LEV for the subcategory of microenterprises with 0 to 5 employees is negatively influenced by the previous year's ROA. The LEV of large enterprises has mostly declined under the large negative ROA influence of the previous year. The ROA of the current year is a significant determinant of the decrease in the LEV of the upper subcategory of micro-enterprises, but also of small and medium-sized enterprises. For every 1 pp increase in current ROA, the drop in LEV is about −0.4 to −0.2 pp. The LEV of microenterprises with 6 to 9 employees benefited from the negative influence of ROA by decreasing −0.4 pp for every 1 pp increase in the current ROA. These findings prove *hypothesis H6*: *financial performance influences the leverage ratio differently by company category; the larger the company, the greater the influence of ROA to reduce the leverage ratio.* Higher financial performance (ROA) leads to lower leverage (LEV) to a greater extent for larger companies, as seen in Table 1, proving hypothesis H6 and the validity of the results of the S-GMM approach in Table 12.

The inverse relationship between the leverage ratio and financial performance is influenced by the value of the previous year's leverage by increasing the current leverage, which will cause the ROA to decrease. Meanwhile, the previous year's leverage propagates into current leverage to a lesser extent for those categories that have had dynamic competitive behavior, i.e. the upper subcategory of microenterprises and the category of large companies.

Findings based on the LEV S-GMM approach describe the dual relationship between the leverage ratio and financial performance as an adaptive system. The conclusions are supported by the high values of the coefficients of determination of the S-GMM models in Table 12.

In Fig. 6, the actual and theoretical values of LEV, obtained with the different S-GMM models presented in Table 12, show the evolution intervals of LEV for the categories of companies. The graph of the mean actual and theoretical LEV for the lower subcategory of microenterprises with 0 to 5 employees is similar to that of the sample.

In Fig. 6 we see that the separate approach to financial leverage by company category better describes the behavior of corporate indebtedness over time.

4.6.6. Conclusions of testing relationship financial performance - leverage ratio

For all ROA models of company categories in Table 10, the LEV coefficients are significant at p-value less than 1 %. The negative effect of LEV on financial performance is almost constant for all company categories around −0.1 to −0.2 pp for a 1 pp increase in LEV. The previous year's LEV positively influences ROA to about the same extent as the negative influence of the current LEV for each company category (*hypothesis H4*). The positive influence of a 1 pp increase in net profit margin on financial performance varies on average around 0.2 pp for micro-enterprises and between 0.8 pp and 1.8 pp for larger companies. The positive effect of net profit margin on ROA argues that market influence on ROA increases for larger company categories. Financial performance is influenced more by the relationship with the market, and more for the larger companies (*hypotheses H5 and H3*).

For all LEV S-GMM models of company categories, the variable LEV is negatively influenced by financial performance to reduce it; for every 1 pp increase in current ROA, LEV falls on average in the range of −0.4 pp to −0.2 pp (*hypothesis H6*). The positive influence on the current LEV of a 1 pp increase in the previous year's LEV is almost constant around 1 pp for all company categories, except for the upper microenterprise subcategory and the large company category, for which it is on average of 0.3 – 0.4. pp, more lower for larger companies (*hypothesis H7*).

In absolute terms, the negative effect of ROA on LEV is larger than the negative effect of LEV on ROA, as observed in Table 12 and Table 10. We can conclude that *financial performance influences the leverage ratio more strongly than vice versa*. So dual causality is measured by analyzing the change in each variable under the influence of the other.

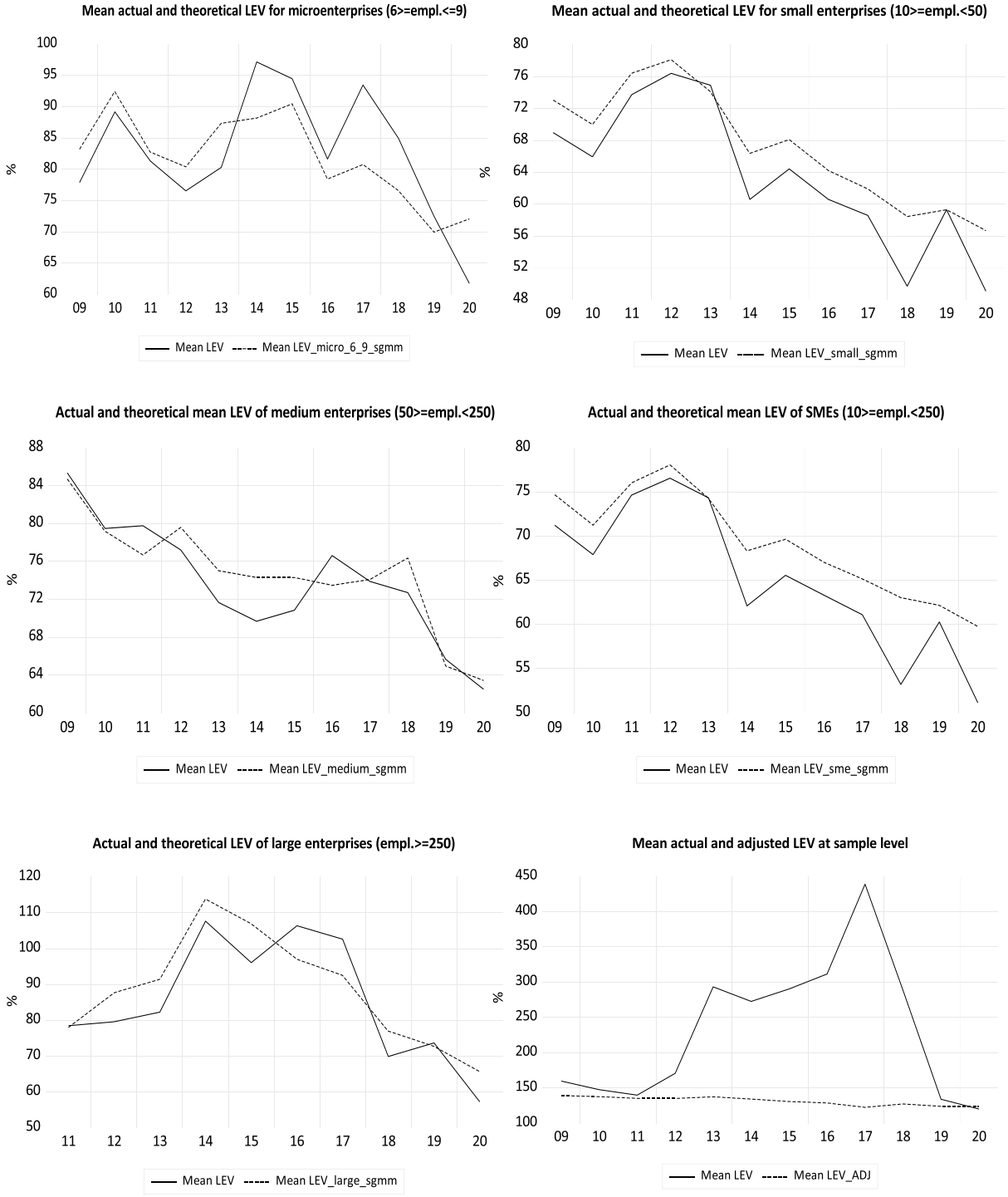

Fig. 6. Actual and theoretical mean values of LEV, with different S-GMM models.

5. Discussion

Many papers confirmed a significant relationship between capital structure and financial performance, but others found it insignificant (Mashavave and Tsaurai, 2015; Chadha and Sharma, 2016; Khalaf, 2013). Many researchers found a negative relationship between capital structure and financial performance, but others stated it as positive (Singh and Bagga, 2019; Nassar, 2016). Some authors have differentiated between the significant impact of long-term and short-term debt on

firm performance; long-term debt has a positive influence, while short-term debt has a negative impact (Abor, 2005; Khalaf, 2013; Vătavu, 2015). Yazdanfar and Öhman's (2015) found that both short-term debt and long-term debt had a negative relationship with profitability based on a sample of 15,897 Swedish SMEs operating in five industry sectors during 2009 –2012. Other significant determinants of SMEs' financial performance and capital structure are: ownership structure, managerial ability, autonomy and competence and other factors, as industry, companies' age (Bazhair and Alshareef, 2022; Nunkoo et. al., 2020; Degryse et al. 2012; Nenu et al., 2018).

Our work highlighted the existence of a bidirectional negative relationship between financial performance and capital structure, depending on the company category. The negative relationship between profitability and capital structure has been confirmed by several researchers (Rajan and Zingale, 1995; Frank and Goyal, 2003; Colombage, 2005; Akani and Ifechi, 2017; Booth et al., 2001). The bidirectional nature of the relationship between financial performance and capital structure has also been explained by other researchers (Abdullah and Tursoy, 2021; Rajan and Zingale, 1995). Rathnasingha and Heiyanthuduwa (2019) identified the inverse relationship between profitability and debt ratios as a function of firm size and found that smaller firms behave differently than larger firms. Several authors have found that company category is significant for financing preferences, which differ from microenterprises to small and medium-sized firms (Zhigang and Yao, 2023; Sánchez-Vidal and Martín-Ugedo, 2005).

Our econometric models for the period 2005–2020 emphasized the negative impact of the 2008 economic crisis and the positive impact of the 2020 pandemic, demonstrating *the sustainable development of e-commerce and its positive contribution to economic growth (hypotheses H1 and H2)* (Paraschiv et al., 2022).

We studied the relationship between financial performance and capital structure over the period 2005–2020 and in two separate sub-periods. We came to the conclusion that the *relationship considered is closely related to the economic cycle.* Halling et al. (2016) established 'that observed and target leverage evolve counter-cyclically over the business cycle'. We also confirm this conclusion by analyzing the evolution of LEV by company category in Fig. 6 compared to economic growth (2005 fixed base indices of GDP) and financial indicators in Fig. 3 and also in Fig. 2. E-commerce has contributed to economic growth and its financial performance (ROA) is pro-cyclical, which demonstrates its negative relationship with capital structure. We showed in detail how the negative relationship between financial performance and leverage has evolved between 2005 and 2020 and how its characteristics change over time, with the economic crisis in 2008, followed by economic recovery and development until 2020.

The analysis of the correlations between the financial indicators at the sample level and by categories of companies for the two sub-periods identified the differences in the way the relationship between financial performance and capital structure acts over time. In the 2005–2008 sub-period before the economic crisis, which was a sectoral decline in e-commerce, there is a strong correlation between financial performance (ROA) and leverage ratio (LEV), specific to each company category. In the 2009–2020 sub-period of economic expansion, the link between the previous year's leverage ratio and current leverage acts strongly regardless of company category *(hypothesis H7)*, while the link between financial performance and leverage is weaker by company category, lower for smaller businesses (Tables 6 and 7). For both sub-periods, the previous year's negative correlations between ROA and LEV are almost the same as their current correlations, with higher intensities for larger companies *(hypothesis H4)*, demonstrating that the dual relationship between LEV and ROA is almost the same in the current year as in the previous year, by category of companies.

Our econometric approach to the relationship between financial performance and the leverage ratio mainly referred to the sub-period 2009–2020. Granger causality analysis at the sample level and by company category contributed to the choice of explanatory variables for the econometric models of ROA and LEV.

We found that *financial performance (ROA) depends on company category, being higher for larger companies (hypothesis H3)* (Lassala et. al., 2017; Jónsson, 2007). Gaio and Henriques (2018) used a sample of 54,654 firms from 21 EU countries in 17 industries from 2004 to 2013, concluded that 'Eastern European SME are more profitable than their counterparts in Western Europe .... Regarding the sectoral analysis, large enterprises are more profitable than SME in all sectors except a sector of water supply, sanitation and waste management activities'.

The GMM econometric approach to ROA evolution revealed that only certain categories of companies acted competitively: micro-enterprises with between 6 and 9 employees and medium-sized enterprises; we conclude that the latter is more competitive, with the lowest speed of adjustment (Table 9). In Romania, medium-sized enterprises ensure a sustainable development of electronic commerce, being consistent with the sectoral coordinates of the most developed economies of the European Union (Eurostat, 2021). The negative effect of LEV on financial performance is almost constant for all company categories (*hypothesis H4*).

The positive influence of net profit margin on financial performance varies according to the category of companies, being greater for larger companies *(hypothesis H5)* (Jahanshahi et al., 2012).

In our research we identified a large persistence of capital structure (LEV), higher for smaller firms, which means that the influence of history matters a lot. In contrast, financial performance (ROA) has low inertia and the past does not influence the present. The leverage mechanism makes the capital structure change slowly, unlike the competitive operating environment of profitability.

Indebtedness is a self-adaptive system but also controlled by the feedback of financial performance, specific to the economic cycle of the 2009–2020 sub-period. The leverage ratio is significantly influenced by the financial performance (ROA) depending on the company category. The negative correlation between leverage and ROA is more evident for larger companies. ROA acts to reduce the leverage of larger companies to a greater extent than for smaller companies *(hypothesis H6)*.

The persistence coefficients of S-GMM models can be considered a proxy of information asymmetry. The micro-enterprises have the highest leverage persistence rates and we conclude that they have greater information asymmetry than larger companies. The leverage ratio has almost the same speed of adjustment for all categories of companies, except for the sub-category of micro-enterprises with 6 to 9 employees and the category of large enterprises, for which previous year's financial performance reduces leverage *(hypothesis H7)*. The interaction between the two variables is the basis of understanding the pecking order theory trade-off. The two categories of firms are more dynamic than others, having less inertia in the decision regarding the source of financing. We found that Romanian e-commerce microenterprises and SMEs agree with Delcoure's (2007) conclusion that, in Central and Eastern European countries, companies follow the revised pecking order theory of equity financing preferences over debt. The large Romanian e-commerce companies adhere to the original pecking order theory preferring equity as the last choice. Our results are in accordance with the conclusions of Rathnasingha and Heiyanthuduwa (2019), who establish that company size determines the financing behavior and they found that smaller firms do not behave the same compared to larger firms. Sánchez-Vidal and Martín-Ugedo (2005) found that pecking order theory is different from small to medium-sized companies.

We may say that the capital structure pecking order theory in Romanian e-commerce sector depends on the economic cycle. We see in Table 1 that in the sub-period 2005–2008 the median leverage ratio was around 70%, and in the sub-period 2009–2020 it drops to around 50%, proving the adaptive behavior of financing preferences from debt to equity, until a balance between the two options. We established a median financial profile of the sample and by company category that also contains the capital structure, in Table 1 and Fig. 2. When leverage is very high, companies are overleveraged and this has a negative impact on the sustainable development of firms (Xiaobing et. al., 2023). Looking at the median leverage ratio in Table 1, Fig. 2 and the median leverage in Fig. 6, we estimate that e-commerce has a sustainable development in 2020 for micro-enterprises with 6 to 9 employees and for all other larger enterprises.

The S-GMM models in Table 12 describe the evolution of leverage by company category and at the sample level. The average financial leverage behavior can only be perceived at the company category level, in Fig. 6. The speed of leverage adjustment in the S-GMM models demonstrates the high inertia of the debt-oriented financing mode.

Following the two-way analysis of the relationship between financial performance and leverage, we determined that financial performance has a greater influence on the leverage ratio than vice versa. Since we have shown that prior-year leverage has almost the same influence on current leverage for all company categories, it remains that financial performance can significantly change leverage. Our conclusion is that the pecking order theory is dynamic in nature and financial performance (ROA) can shift the balance between debt or equity financing preferences. Since the leverage ratio in turn has an almost constant influence on the financial performance for all categories of companies, it remains that only the positive influence of the net profit margin can increase it. The pecking order capital structure theory cannot be explained without considering the inter-influence of financial performance and leverage ratio.

The results of our study verify all working hypotheses based on statistical methods and econometric models. We found that company category is significant in analyzing and interpreting the relationship between profitability and financial leverage.

6. Conclusions

Romania's accession to the European Union in 2007 overlaps with the beginning of the 2008 economic crisis. The development of *e*−commerce coincided with the recovery period after the economic crisis of 2008. The research results show that the pandemic has provided opportunities for *e*−commerce companies to thrive even during periods of economic isolation. The development of information and communication technologies and the expansion of online products and service offerings have led this industry to the pinnacle of economic performance.

The study describes the evolution of the financial indicators in the period 2005−2020 and highlights the impact of the 2020 pandemic. We concluded that the *e*−commerce companies achieved better financial performances in 2020 compared to 2019 based on the sample, in Tables 1 and 2. We identified the categories of companies that benefited the most from the pandemic, describing the changes in the sample's financial indicators in 2020. The paper is a contribution to the literature in the field of *e*−commerce, being the first to analyze the financial performance of all Romanian companies in this sector, by company category, based on the extension of the sample results. The extended results, in Tables 3 and 4, allow us to formulate conclusions for all Romanian companies in electronic commerce.

ROA calculated for businesses is different by industry. A good ROA level, as considered by managers is greater than 5%. We calculated ROA by company category for the e-commerce sector, and all values are greater than 5%, as observed in Table 4. The average ROA of the sample is 10.8% (Table 4); we deduce that for the e-commerce sector a value of 10% is good to consider. When comparing the financial performance of Romanian e-commerce businesses, the median ROE of 24% is in accordance with the online retail ROE of 25.6% in Western Europe in 2020 (Statista, 2022). Investors consider a good ROE level of at least 15%. The conclusion is that for the e-commerce sector in Romania, a good ROE is around 25%. An average level of net profit margin is considered 10%, while 20% is high and 5% is low (Keenan, 2022). In 'Margins by Sector (US)' (Damodaran, 2022) the net profit margin of 7.26% for online retail with 60 companies included was close to that corresponding to the total market (which includes 5619 companies, excluding financials) of 8.19%.

According to the results in Table 1, at the sample level and at the level of company categories a median net profit margin is of about 7% and an average of 8.5% for small enterprises is shown in Table 4. The average value of the net profit margin

of the sample was 3.4%, in Table 4. For the e-commerce sector, we conclude with a 95% probability that the maximum net profit margin can be around 9%. The upper bounds of the confidence intervals allowed by the company categories vary between 9% and 15%. These conclusions are consistent with the analyzed evolution of the median values of financial rates in Fig. 2. The e-commerce of a developing economy has high values of financial ratios ROA and ROE, but still low values of net profit margin. Based on an analogy with the situation presented in the American study 'Margins by Sector (US)' (Damodaran, 2022), we can assume an estimate of the net profit margin for the total market in Romania of 3 to 4%.

The specific values of financial ratios in the e-commerce sector: ROA, ROE and net profit margin can be interesting for financial analysts and investors, but also for managers and economic decision makers. The econometric approach to the relationship between financial performance and capital structure reveals the specifics for the e-commerce sector. Cross-sectional FE models and GMM models describe the main determinants of financial performance and capital structure in their complex interconnection. How financial performance influences capital structure has been shown to be stronger than how capital structure influences financial performance. The capital structure influences the financial performance almost to the same extent regardless of the company's category. Financial performance influences the capital structure differently depending on the company category. The working hypotheses were proven by statistical analysis and econometric models.

Policymakers can find ways to base their tax system and incentivize larger companies rather than micro-enterprises, or rather small and medium-sized firms. Company managers are the first beneficiaries of this study, but also investors and financial analysts who can find financial performance indicators full of information for expected profit. The relationship between financial performance and capital structure by category of companies may be of interest to the banking system in assessing appropriate credit conditions for companies.

Some limitations of our study can become research directions for future research. The use of ROA alone as a proxy for financial performance can be extended by using ROE as well. Taking long-term debt and short-term debt into account, the nature of their impact on financial performance can differ at the sectoral level and by company category.

Considering the life cycle of the company within the company category can reveal some characteristics of the relationship between financial performance and capital structure at different stages. Our study does not consider any sales structure on the main product groups of online transactions. Considering other determinants of the relationship between financial performance and capital structure—such as firm age, board structure, ownership structure, industry, and environmental indicators—can improve its explanation. The sample included enterprises with activity code NACE 4791 - Retail trade by mail order or Internet, B2C electronic commerce. The study can be completed by considering companies with business-to-business and government e-commerce (B2BG) activity. The conclusions of our study can be tested for the entire e-commerce activity in Romania. Another limitation of our study is that, in the sample, we did not consider the status of listed or unlisted firms. The paper contains econometric models only for the 2009–2020 sub-period, being more recent and with an almost constant evolution of financial indicators, in accordance with the economic cycle. The first sub-period 2005–2008, at the very beginning of the development of e-commerce and before Romania's accession to the European Union, reflects the relationship between ROA and LEV differently from the following sub-period. Other econometric models adapted for the 2005–2008 sub-period can explain the ROA-LEV relationship. Since ROA is different by industry, we assume that our results only hold for the e-commerce sector. The relationship between financial performance and capital structure is complex and more complex for larger companies. The indebtedness mechanism depends on the maturity of the banking system, industry-specific legislation, tax systems and Internet-specific indicators: penetration rate, IT endowment of the population and companies, the population's standard of living, the level of education - the general economic conditions reflected in the business cycle, as we have shown.

Future research can address the complex relationships between financial indicators of e-commerce sector in a comparative perspective with other industries and test the validity of the hypotheses of this study. How capital structure theory is perceived by categories of companies in different industries may reveal different behaviors for sources of financing. Companies' financing preferences may be specific to a certain level of industry development or a certain stage of the companies' life cycle. Further research could study the level of economic performance of e-commerce companies in each EU member state in a comparative way. Further studies should consider a common, regulated online environment for the same working conditions and taxation in EU countries. The characteristics of working conditions, employment and new jobs generated by e-commerce should be included in an integrated way for countries with similar regulatory systems. The regulation of electronic markets following the explosion of e-commerce has online implications for almost all activities. The inclusion of digital marketing and augmented reality in the management strategies of companies can contribute to the development of e-commerce. The integration of augmented reality into online shopping platforms will change the buying behavior of consumers. Studying customer profiles can provide more insight into changing trends of online behavior in the medium and long term.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

CRediT authorship contribution statement

Constantin Duguleană: Data curation, Formal analysis, Funding acquisition, Investigation, Methodology, Project administration, Resources, Visualization. **Liliana Duguleană:** Conceptualization, Methodology, Validation, Formal analysis, Investigation, Resources, Software, Writing – original draft, Supervision, Writing – review & editing. **Klára-Dalma Deszke:** Data curation, Formal analysis, Investigation, Resources, Validation, Visualization, Writing – review & editing.

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