Profitability and optimal debt ratio of the automobiles and parts sector in the Euro area

Charalampos Basdekis
Department of Economics, School of Economics and Political Sciences, National and Kapodistrian University of Athens, Athens, Greece
Apostolos Christopoulos
Department of Business Administration, School of Business, University of the Aegean, Chios, Greece
Ioannis Katsampoxakis
Department of Economics, School of Economics and Political Sciences, National and Kapodistrian University of Athens, Athens, Greece, and
Alexandros Lyras
School of Applied Mathematical and Physical Sciences, National Technical University of Athens, Athens, Greece

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Abstract

Purpose – The goal of this paper is twofold: to assess the influence of specific corporate and market features on automobiles and parts sector's profitability in Euro area and to identify this particular sector's optimum debt level.

Design/methodology/approach – For the paper's purposes, the authors applied a panel data analysis on an annual basis for the period 2005–2017.

Findings – There is a strong statistical significance of debt ratio, growth domestic product per capita growth, E.C.'s economic sentiment index (ESI), the European Central Bank key interest rate and the Euro area crisis on sector's profitability, while weak statistical significance appears to emerge for the firm's size. Moreover, the authors find average 14.4% profitability for the entire sector of the Euro area, without significant fluctuations among firms and/or during the examined time period. Another interesting finding of this study is that results are consistent with the theory of Modigliani Miller that financial leverage at a "low" level is beneficial for the firm, but beyond a turning point, it becomes counterproductive. This turning point for the automobiles and parts sector in Euro area has been computed at 47.3%.

Originality/value – The paper focuses on issues of profitability, capital structure and optimal debt ratio of an important sector of the economy, the automotive sector. As regards the Euro area automotive sector, it is a dynamic sector with a significant multiplier effect for the European economy as it is strongly correlated with other industrial sectors as chemicals, steel, textiles, information technology and so forth, having an outstanding multiplier effect on the economy.

Keywords Profitability, Financial leverage, Size, GDP per Capita, Economic sentiment index, Optimal debt ratio, Economic crisis, Automobile and parts sector

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1. Introduction

Firms' profitability and the factors that affect it are of major importance for all actors of an economic system, while its study has become even more crucial during the recent economic crisis. To have a complete picture of firms' developments though, profitability has to be combined with the level of financial leverage.

More specifically, after the recent global financial crisis, the optimum debt level has become increasingly vital, in the sense that, among others, firms may face financing problems as a result of an unexpected increased country risk.

For our study purposes, ROE is applied as a measure of profitability, while the independent variables include firm's size, accruals, the Eurozone's Economic Sentiment Indicator, growth domestic product (GDP) growth rate per capita and the European Central Bank (ECB) key interest rate, a dummy variable for the crisis, as well as the debt ratio and its square.

As regards the Euro area automotive sector, it is a dynamic sector with a significant multiplier effect for the European economy as it is strongly correlated with other industrial sectors as chemicals, energy, steel, textiles, information technology and so forth, having an outstanding multiplier effect on the economy. In favor of this argument, the German chancellor intervened a few years ago to save OPEL, highlighting its importance for the economy and the need for a successful outcome in the rescue process. Moreover, it is an industry the products of which are being characterized by price elasticity, and so far it is estimated to be affected by a continuous economic crisis.

EU is one of the largest producers of motor vehicles all over the world, and automobile industry is considered as the largest private investor in the field of R&D and innovation technology. In order to strengthen the competitiveness of EU automobile industry and maintain its world-leading technology, European Commission (EC) supports global technology harmonization and provides R&D funding.

Furthermore, this sector faces significant challenges related to environmental issues, as it is clear that there is a shift toward more environment-friendly vehicles which need lower fuel consumption. The production of Electric cars is a characteristic example of this environment-friendly transition process. Most of the Western states subsidize the electric cars' market, expecting by 2050 to dominate the market. On top of that, in the era of artificial intelligence, the next major challenge for the industry is autonomous driving as well as their potential to be accessible to the general public. Finally, significant efforts are also needed to improve infrastructure, for example, the creation and expansion of a natural gas supply network and charging stations for electric vehicles.

It is apparent though that the above plans require large-scale investments, especially for funding research and development (R&D) and with no guaranteed payback. That is why there is a great mobility in the sector through mergers and acquisitions in order for firms to achieve economies of scale. In the era of globalization, prominent firms facing sustainability issues were acquired by startups to remain alive.

The EU is one of the largest producers of motor vehicles with the largest percentage of private investments in R&D, and the EC to increase also the funding for R&D in order to enhance the competitiveness of the EU automotive industry worldwide. In order to understand more clearly the potential of this sector and its role to Europe's prosperity, it has to be noted that the automobile industry is one of the key industries in the European Union, as documented by official figures. More specifically, there are more than 200 manufacturing and assembly plants that produced more than 18 million vehicles in 2015 (OICA 2016). The importance of the automobile industry can be also documented by its 7% share on the total GDP of EU, 5% share on EU employment as it provides jobs for 12 million people (2015), 13.3 million in 2019 (European Automobile Manufacturers Association) and by a significant

presence in exports (more than 6.5 million cars a year). The most characteristic case is Germany, who exports more than three-quarters of all cars produced (Kallstrom 2015; Vosta and Kocourek 2015, 2017).

The largest percentage of activity in the sector is concentrated in vehicles (about 80%), while components and tires account for about 20% (13% and 7%, respectively). On a country-level basis, Germany dominates (62%), followed by France, Italy and Finland (23%, 13% and 2%, respectively).

In 2015, a total of 21 million motor vehicles of all types were produced in Europe, which represents a 23% share in the global production of more than 90 million units. EU stands for production of 18 million new vehicles of all types, which means the EU's share on the global production shrank from 32% in 2000 to 20% in 2015 (STATISTA 2016; Vosta and Kocourek 2017).

All these have a particular interest, given the extraordinary macroeconomic conditions during the period under review where "specific" economic policies were implemented at fiscal, monetary and structural levels (fiscal adjustment, quantitative easing and reforms), which, in turn, had an impact on demand, inevitably affecting the car industry. Also, the ECB's monetary policy eventually reduced the systemic risk to the industry by supporting equity placements.

The paper is structured as follows. In the second section, there is a short reference to the macroeconomic environment of the period under investigation. In the third section, there is a brief presentation of the relevant literature, which is quite rich but with conflicting conclusions. In the fourth and fifth sections, the study's hypotheses, sample of the model and the implemented methodology are presented in detail. In the sixth section, the empirical results of the survey are being analyzed, while the paper ends with the highlighting of the most important conclusions.

2. The Euro area crisis and the European policy

There is a broad consensus that firms are strongly affected by the macroeconomic conditions, that is, in times of economic growth, firms are given further impetus, while in times of recession, they face several problems, mainly related with demand and funding, that may threaten their sustainability.

Thus, in this study where the factors that affect profitability and the optimal debt ratio are examined, a short reference to this period's macroeconomic developments cannot be omitted as the period under consideration includes a two-stage crisis, which has been tackled by a combination of fiscal and monetary policies and structural reforms.

The Economic Sentiment Indicator is a fundamental leading indicator to economic activity, as it integrates the expectations of the main sectors of the economy (trade, industry, construction, consumption, services). As expected, the international crisis (2008) and the European debt crisis (2012) influenced the index. Furthermore, there seems to be a significant co-movement between the index for the euro area and of the major member states. It was obvious that Europe, particularly the eurozone, was not ready to deal with such crisis, and in some cases (e.g. Greece), there were several failures in the design and implementation of supporting programs.

However, despite any concerns and objections, ECB has made several targeted steps to support the common currency (interest rate reduction, key declarations, quantitative and qualitative easing). These actions were needful, given the deflationary pressures during the last years. Specifically, ECB has been steadily reducing interest rates since the outbreak of the international crisis, adopting a quantitative easing program in 2015, with the key interest rate at zero point since mid-2012, before passing into negative territory. This resulted in around zero cost of borrowing in many member states.

3. Literature review

According to Gitman and Zutter (2012), profitability is the ratio to measure the performance of the company. It gives a clear picture of a company's financial reporting and shows a company's ability to generate earnings for a certain period, improving their sales and assets and increasing capital stock. Performance assessment can be expressed by ROE (return on equity) as proxy financial indicator for measuring profitability (Erina and Lace, 2013; Tailab, 2014; Katsampoxakis *et al.*, 2015, 2018; Fara and Supartica, 2016), mainly due to high importance of investors (shareholders) risk undertaken. Alternatively, ROE as profitability's representative indicator expresses the shareholders who support the long-term operation and development of their firms.

For examining the evolution and importance of the profitability process at micro level, there are more financial indicators used for research purposes such as current ratio, liquid ratio, receivables turnover ratio (Burja, 2011), working capital to total asset (Singh and Pandey, 2008), net operating profitability (NOP) (Raheman *et al.*, 2010; Dong and Su., 2010), return on total assets (ROTA) (Deloof, 2003; Padachi, 2006), return on invested capital (ROIC), return on assets (ROA) (Narware, 2010), economic value added (EVA), operating profit margin (OPM), earnings per share (EPS) (Rayan, 2008) and earnings before interests and taxes (EBIT) (Akintoye, 2008).

Factors that affect profitability are essential for the long-run strategies of the firms. However, the existing literature on factors affecting firms' profitability, such as firm's size, financial leverage and R&D expenditures, leads to ambiguous conclusions. Sougiannis (1994) argued on this, indicating that it may be due to the use of a small sample, the applied econometric techniques and the quality of the selected data for the research surveys. However, Storey *et al.* (1987) showed that the profitability of small firms is increasing at an increasing rate, while for large firms the profitability is decreasing at an increasing rate. Furthermore, they found that the age of small firms has a significant impact on their performance but has little impact on the performance of large firms.

In addition, Burgstahler and Dichev (1997) and Degeorge *et al.* (1999) found that a firm's profit management is likely to correspond to the size of the firm. Therefore, it is presumed that large firms are more likely to generate greater profits than smaller firms. Their findings appear to be consistent with Yangseon *et al.* (2003), as large firms can develop stronger internal control systems to defend their reputation, avoiding the manipulation of profits. In a similar way, Goddard *et al.* (2005) found that firms indicate a negative relationship between their size, leverage ratio and profitability (Srinivasan *et al.*, 2011), while the impact of market share and liquidity on profitability appears to be positive.

On the other hand, Li and Hwang (2011) found that firms with higher than average earnings show a positive relationship between profitability and R&D spending, as opposed to companies with lower earnings. Also, they concluded that non-financial firms with higher than average profits show a negative relationship between firms' size and ROE, and vice versa. Furthermore, Salman and Yazdanfar (2012) found that sales growth and overall factor productivity had a significant positive effect on firms' profitability, whereas firm size was found to have a significant negative effect on profitability. They also concluded that the profitability of small and medium-sized firms plays a key role in regional development. Christopoulos *et al.* (2013) found that liquidity is an important factor for firms' profitability and sustainability, while Giovanis and Ozdamar (2014) showed that firms' size and debt have a positive effect on profitability but only up to a certain point, beyond which the relationship turns negative. The asset-to-sales ratio, conversely, seems to be going in a different direction, namely, having a negative impact on profitability in the beginning, but beyond some turning point, the relationship becomes positive.

Farah and Supartica (2016) looked at factors that affect profitability, such as the size of the firm, its age, growth, one-year lag of profitability and productivity. They concluded that

firm's size, growth and one-year lag of profitability have a negative impact on profitability (Pervan and Visic 2012), while productivity has a positive impact on profitability. On the contrary, the age of the firm does not seem to affect the profitability of the firm in any way. On the other hand, according to Tailab's (2014), firm's size seems to have a positive impact on profitability.

In addition, Christopoulos et. al. (2019) investigated the predictability of financial distress for a sample of NYSE listed firms based on the assumption that liquidity and profitability constitute the key criteria for the status of a firm. They apply two independent models – the first on the pillar of liquidity and the second on the pillar of profitability – while a third model is established as a result of the combination of the two previous models.

Other studies focus on financial leverage, such as Abor (2005), who distinguishes between the effects of short- and long-term leverage on firm's profitability. In particular, he found a significantly positive relationship between short-term financial leverage and firm's profitability. However, this impact is negative when considering the impact of long-term financial leverage on corporate profitability, while the ratio of total debt to total assets shows a strong positive impact on equity (ROE). Wald (1999) found that the most advanced countries were characterized by large differences in the relationship between financial leverage, as approached by the relationship of long-term debt to total assets and risk, profitability, size and firm's growth. These discrepancies are due to differences in the application of tax policies and agency problems, including differences in bankruptcy costs, asymmetric information and conflicts between shareholders and creditors.

According to studies, firm's size was positively correlated with financial leverage such as those by Eriotis *et al.*, (2007), Daskalakis and Psilaki (2008), Mat Kila and Wan Mansor (2008) and Srinivasan *et al.* (2011), in contrast to the findings of Pervan and Visic (2012). Moreover, Mat Kila and Wan Mansor (2008) found that size, liquidity and interest rate coverage ratios were significantly negatively correlated with corporate debt ratio. The results also reveal that there is a significant difference in capital structure between high-yielding and low-yielding firms.

In accordance to the above, Li and Hwang (2011) concluded that in the case of low-profit firms, increasing financial leverage has a negative impact on profits. However, they found that there was a positive correlation between financial leverage and corporate profits for the most profitable firms. According to the results of Liargovas and Skandalis (2010), leverage, firms' size, export orientation, liquidity and managerial skills have a significant impact on the competitiveness of the firm as measured by three variables, such as return on assets, return on equity or return on sales.

The results of Tailab's (2014) study concluded that debt ratio, higher inventory levels and firm's growth are negatively related to profitability, while liquidity and size have a positive impact on profitability. Aras and Kutlu Furtuna (2017) highlight the pros and cons of corporate cash holding and examine the corporate cash holding across different firm sizes and industries in BRIC countries and Turkey.

Katsampoxakis *et al.* (2015) found that firm's size, earnings smoothness and ten-year government bond yield negatively affect profitability, while leveraging the firm appears to have a positive effect on firm's value. However, the impact of the independent variables on ROE does not remain constant over time as their coefficients are time-dependent, mainly due to the impact of the global financial crisis and the crisis in Greece. Moreover, Katsampoxakis *et al.* (2018) found an average yield of 6.97%, which varies considerably between firms and during 2005–2016. In determining the optimal debt ratio of Greek firms, they found that before the Greek debt crisis, the results were incompatible with the Modigliani–Miller theory, in contrast to the period of deep recession, where the optimal debt ratio was estimated at 40.9% compared to the 52.6% for the entire examined period.

Aras *et al.* (2010) explore the relationship between corporate social responsibility and financial performance in developing countries. They use 100 listed firms from the Istanbul Stock Exchange (ISE) to show some causality as a result of lagging between periods for financial performance and CSR and a possible relationship between firm size, profitability, risk level and CSR, but they did not find any significant relationship between corporate social responsibility and financial performance/profitability.

4. Hypotheses, data and variables

4.1 Hypotheses

The evaluation of factors influencing the prospects of corporate earnings contributes to obtain important information about the optimal capital structure that can lead to profit maximization. There are many important factors that affect firms' profitability, leading to different outputs and conclusions depending on the country and time period.

There have been studies that either agree or contradict economic theory or not confirming the expected impact on profits. However, in the present study, empirical findings on the relationship between the examined micro and macro variables and corporate profitability show that maximizing firms' profitability is closely linked with better financial management, which is not related exclusively on how variables affect profitability, but also with the capital structure and debt level. Therefore, we consider the following empirical issues:

(1) Whether the examined variables – fiscal, monetary or market – affect firms' profitability, as suggested by the relevant theory.

(2) Whether it is observed linearity between leverage and profitability, and if not, which is the estimated critical point of the debt ratio curve.

(3) Whether the global financial crisis affected firms' profitability.

4.2 Sample

For the purposes of this study, we use a sample of 169 observations with panel data from 13 automotive companies in Euro area over a period of 13 years, 2005–2017, in order to be compatible with the reporting currency used for the entities' financial statements and the application of International Financial Reporting Standards (IFRS). Firms include vehicles and spare parts manufacturers, as well as spare parts and other parts manufacturers, varying in size.

4.3 Variables

As a measure of profitability, we use ROE which is given as the ratio of net profit to total equity, and it is the dependent variable of the model. The independent variables are:

(1) *Debt ratio*: Is defined as the ratio of total liabilities to total assets, indicating the degree of financial leverage in relation to the total assets. The debt ratio squared is used to take into account nonlinearities and to test whether Modigliani–Miller theory is being applied to this model.

(2) *Natural logarithm of total assets*: Is used as a proxy variable to control firms' size.

(3) *GDP per capita*: The annual percentage change in real GDP per capita of each country is used, and each firm performs at constant prices. This variable is important for the model's specification as it captures each country's total economic activity.

(4) *ECB key interest rate*: This is the ECB's deposit facility interest rate, which stands at zero level since mid-2012, and has, since then, dropped to negative territory. It

obviously affects the yield on 10-year government bonds and also the cost of firms' credit. It is worth noting that it is a strong benchmark for determining the weighted average cost of capital (WACC). This variable is used with one-year lag, as it is considered a leading indicator.

(5) *Accruals*: Is defined as the difference between net income and net cash flow from operating activities. This variable is used as an indicator of earnings' quality and furthermore reflects earnings' outlook. This variable is used with one-year lag, as it is considered leading indicator.

(6) *Eurozone economic sentiment indicator*: An index which is published on a monthly basis by the EC and is an important precursor to the evolution of economic activity, as it reflects expectations for consumers, industries, services, construction and retail trade. For this reason, it is used with one-year lag.

(7) *Crisis*: Is a dummy variable used to control the crisis impact on firms' profitability in the industry. It takes price 0 for the period 2005–2011 and price 1 for the period 2012–2017. The year of this change related to the crisis evolution, is based on the statement of the former President of ECB, Mario Draghi, on July 23, 2012, that ECB is ready to take all necessary measures and use all available monetary tools to preserve the euro currency, with his famous expression "whatever it takes."

5. Methodology

The purpose of the present study is twofold. On the one hand, it examines the impact of debt ratio as well as specific fiscal, monetary and market variables on firms' profitability. On the other hand, it determines the optimal debt ratio taking into account the existence of non-linearity. In order to identify the factors affecting firms' profitability, this study builds on a previous study by Katsampoxakis *et al.* (2015, 2018). In addition, a quadratic equation based on Checherita and Rother study (2010) was introduced to estimate the evolution of the nonlinear relationship between debt ratio and profitability. The regression equation (1) is estimated as follows:

$$\begin{aligned} \mathrm{ROE}_{i,t} = {} & a_0 + a_1 * \mathrm{accruals}_{i,t-1,} + a_2 * \mathrm{In\_total\_assets}_{i,t} + a_3 * \mathrm{Crisis}_t + a_4 * \mathrm{debt\_ratio}_{i,t} \\ & + a_5 * \mathrm{debt\_ratio}^2 + a_6 * \mathrm{EA\_ESI}_{t-1} + a_7 * \mathrm{GDP\_}pc\mathrm{\_growth}_t \\ & + a_8 * \mathrm{ECB\_main\_rate}_{t-1} + \mu_i + u_{i,t} \end{aligned} \tag{1}$$

where,

$ROE_{i,t}$, is the return on equity of firm i at time t ($i = 1, \ldots,13$, $t = 2005, \ldots, 2017$).

$\mathrm{Accruals}_{i,t-1}$ is the difference between the net profit and cash flows from operational activities with one-time lag ($i = 1, \ldots,13$, $t = 2005, \ldots, 2017$).

$\mathrm{Ln\ Total\ Assets}_{i,t}$, is the firm's size, approached by the natural logarithm of total assets ($i = 1, \ldots,13$, $t = 2005, \ldots, 2017$).

Crisis is a dummy variable which accounts for prices 0 ($t = 2005, \ldots, 2011$) and 1 ($t = 2012, \ldots, 2017$).

$\mathrm{Debt\ Ratio}_{i,t}$ is the firm i debt ratio at time t ($i = 1, \ldots,13$, $t = 2005, \ldots, 2017$).

$\mathrm{Debt\ Ratio}^2_{i,t}$ is the firm's i squared debt ratio at time t ($i = 1, \ldots,13$, $t = 2005, \ldots, 2017$).

EA_ESI_{t-1} is a E.C. index reflecting the expectations of economic activity with one-year time lag ($i = 1, \ldots,13$, $t = 2005, \ldots, 2017$).

$\text{GDP}\_pc_{\text{Growth}\,i,t}$ is the annual percentage in real GDP per each country; each firm operates at constant prices ($i = 1, \ldots,13$, $t = 2005, \ldots, 2017$).

$ECB\_\text{main\_rate}_{t-1}$ is ECB's deposit facility interest rate with one-year time lag ($i = 1, \ldots,13$, $t = 2005, \ldots, 2017$).

μ_i is company's fixed effects ($i = 1, \ldots,13$).

$u_{i,t}$ is the stochastic term error ($i = 1, \ldots,13$, $t = 2005, \ldots, 2017$).

First, the above Eqn (1) is examined without including the debt ratio squared in order to test for the factors that affect profitability, and then the quadratic term is introduced, as depicted in Eqn (1), in order to compute the optimal debt ratio for the sector under review.

Accruals, ECB key interest rate and Eurozone Economic Sentiment Indicator are used in the above model with one-year lag, as they are expected to affect firms' profitability prospects. In addition, the debt ratio was included in the model both as simple and quadratic variable in order to take into account the nonlinear effect of debt on firms' value and earnings. In addition, the above adjustment is crucial in assessing the critical point beyond which further leverage has a negative impact on entities' profits according to Modigliani and Miller (1958, 1963) theory.

To be consistent with fundamental theory, we expect that the coefficients of accruals, total assets, GDP growth per capita, the dummy (crisis) and the European Sentiment Index have positive signs, while the coefficient of the ECB main rate has a negative sign.

Related to the debt ratio coefficients, it is expected that the coefficient corresponding to the debt level should be positive, while the one corresponding to the debt ratio squared should have negative sign in order to be verified that the debt ratio has a positive impact on firms' profitability until the point of optimum financial structure. Beyond the optimal debt ratio threshold, the impact on entities profits is expected to be negative. Excessive leverage is, therefore, counterproductive, just as it happens and in the case of excessive public debt. In order to calculate the optimal debt ratio, it is necessary to put the first partial derivative of Eqn (1) with respect to the debt ratio equal to zero and then solve for the debt ratio to find the critical point. Thus, the critical point is calculated by the ratio $\left(\frac{a_4}{-2 * a_5}\right)$. In addition, the second partial derivative of Eqn (1) with respect to the square of the debt ratio has to be negative, for the result to be consistent with MM's theory. If it turns out to be negative, then the profits as being approached by ROE will enjoy a local maximum at the critical point (optimal debt ratio). Since the relationship between debt and ROE is nonlinear, the normal 95% confidence interval calculated for each coefficient cannot be used to calculate the confidence interval for the critical point. To overcome the above problem, we used the delta method, using analytical derivatives, to estimate the standard error of the ratio $\left(\text{debt ratio}\,\frac{\text{factor}}{-2} * \text{debt ratio factor} = \frac{a_4}{-2 * a_5}\right)$.

This is an almost balanced panel, since the number of firms (13) is the same as the number of years (13). The econometric results of panel regression using ordinary least squares (OLS) method in the above equation are unbiased and consistent, but not efficient. We applied different estimation methods to obtain more robust standard errors, following all appropriate diagnostic tests to tackle heteroskedasticity and possible cross-correlation. The coefficients and standard errors of independent variables after appropriate adjustments are considered to be efficient and compatible with the feasible GLS panel method. Since feasible GLS ignores

the fact that the companies in our sample are of different sizes, we identified fixed effects in cross-sections to take into account companies' heterogeneity. However, we did not use fixed time effects, since we included in the model the variables of ECB key interest rate and Eurozone Economic Sentiment Indicator which are the same for all firms at any given time, during the period examined.

Regarding regression analysis, after excluding the use of pooled OLS, the Hausman test showed which process would be the appropriate between random effects and fixed effects. It was found that fixed effects were appropriate for this case. Also, GLS weights used cross-section weights due to the existence of the dummy variable for the crisis. Finally, the results are robust, as alternatives were used in the field of coefficient variance method and no substantial change occurred.

Also, in order to ensure that time series (for panel data are stationary), first differences have been used for the variables being given in percentage, while for the variables being computed at levels, a growth rate was used. Thus, all variables, except dummy, are being used in percentage form.

As regards the model hypotheses, it should be noted that the first hypothesis (i.e. influence of variables on profitability) will be confirmed by *t* and F coefficients tests for all independent variables. For the second hypothesis (i.e. the finding of the critical point of the debt ratio curve), we first test whether the coefficients are statistically significant, and whether the coefficient of debt ratio is positive and the coefficient of square debt ratio is negative, to confirm the theoretical approach. If the above conditions are met, then we calculate the turning point at 95% confidence interval.

6. Empirical results

6.1 Descriptive statistics

The basic descriptive statistics of the variables examined in this study are presented in Table 1.

According to the results, the average profitability rate is 14.4%, while the highest percentage was recorded by Faurecia (59.8% in 2010) and the lowest by Continental (−39% in 2009). The standard deviation stands at 23%, revealing the data's high volatility.

The average debt ratio stands at 70%, with Fiat showing the highest value in 2013 (90.5%) and Nokian Tyres the lowest in 2017 (21.8%). Here the standard error (13.1%) and range are significantly lower. Nevertheless, the industry is characterized by relatively high leverage due to the huge capital requirements.

Accruals average is negative, and the variable also shows very high standard error (i.e. high variance, which is common for this variable).

The average value of the natural logarithm of total assets is 10%. The maximum is 13% (VW at 2017) and the lowest is 6.7% (Nokian Tires at 2005). There is a moderate standard error, as there are companies of various sizes in the industry.

	PRETAX_ROE	DEBT_RATIO	Accruals	LN_TOTAL_ASSETS
Mean	0.144	0.698	−1123.789	10.106
Median	0.196	0.732	−672	10.197
Maximum	0.568	0.905	18,283.00	12.953
Minimum	−0.39	0.218	−14.98	6.681
Std. Dev	0.228	0.131	4.690	0.655
Skewness	−4	−2	0.708	−0.336
Kurtosis	32	6	7	2.031
Jarque-Bera	6.458	123	125	9.803
Probability	0.000000	0.000000	0.000000	0.007

Table 1.
Descriptive statistics for the main variables

Finally, given the probability of the value of Jarque-Bera statistic, variables do not seem to be normally distributed.

6.2 Regression models

As mentioned before, the econometric results are firstly estimated with a model without debt squared ratio variable in order to test which factors affect industry's profitability (see Table 2).

As shown in the above table, the model is overall statistically significant (with *F*-statistic value 16.4 and *p*-value 0), with an *R* squared coefficient of 61%. The adjusted *R* squared coefficient stands at 57.5%.

For each of the independent explanatory variables, as shown by the values of t-statistic and the corresponding *p*-value, accruals, debt ratio, GDP growth rate, ECB key interest rate and the dummy variable for the crisis appear to be statistically significant. In particular, the result is robust at each level of statistical significance. On the contrary, there does not appear statistically significant influence of firms' size and of eurozone economic sentiment index (ESI) on firms' profitability at any level of statistical significance.

Table 3 presents the results of the second econometric model, according to Eqn (1), as introduced at the beginning of the previous section. In comparison to the first model, it includes the debt square ratio to be able to calculate the optimal debt level, since the regression coefficients for the two related variables are statistically significant and the coefficient of debt ratio takes positive values and that of debt square ratio takes negative values.

Dependent variable: D_PRETAX_ROE
Method: Panel EGLS (cross-section weights)
Sample: 2005 2017
Periods included: 13
Cross-sections included: 13
Total panel (balanced) observations: 169
Linear estimation after one-step weighting matrix
White cross-section standard errors and covariance (d.f. corrected)

Variable	Coefficient	Std. Error	*t*-Statistic	Prob
C	0.686	0.242	2.831	0.0053
G_ACCRUALS_LAG	4.12E-06	1.27E-06	3.241	0.0015
D_LN_TOTAL_ASSETS	−0.031	0.041	−0.753	0.4527
CRISIS2	0.059	0.022	2.656	0.0088
D_DEBT_RATIO	−0.642	0.214	−2.996	0.0032
D_EA_ESI_LAG	0.001	0.000981	1.089	0.2778
D_GDP_PC_GROWTH	3.119	0.304	10.244	0.0000
D_ECB_MAIN_RATE	−1.106	0.800	2.764	0.0090

Effects specification

Cross-section fixed (dummy variables)

Weighted Statistics

R-squared	0.606	Mean dependent var	0.366
Adjusted *R*-squared	0.575	S.D. dependent var	0.429
S.E. of regression	0.187	Sum squared resid	5.185
F-statistic	16.374	Durbin–Watson stat	1.316
Prob (*F*-statistic)	0.000000		

Table 2.
Panel regression, 2005–2017, first model

Dependent variable: D_PRETAX_ROE
Method: Panel EGLS (cross-section weights)
Sample: 2005 2017
Periods included: 13
Cross-sections included: 13
Total panel (balanced) observations: 169
Linear estimation after one-step weighting matrix
White cross-section standard errors and covariance (d.f. corrected)

Variable	Coefficient	Std. Error	*t*-Statistic	Prob
C	−0.735	0.366	−2.012	0.0460
G_ACCRUALS_LAG	3.17E-06	1.09E-06	2.921	0.0040
D_LN_TOTAL_ASSETS	0.034	0.034	1.012	0.3133
CRISIS2	0.065	0.028	2.349	0.0201
D_DEBT_RATIO	1.896	0.3808	4.986	0.0000
D_DEBT_RATIO2	−2.006206	0.393	−5.110	0.0000
D_EA_ESI_LAG	0.0009	0.000	0.923	0.3586
D_GDP_PC_GROWTH	2.681	0.371	7.216	0.0000
D_ECB_MAIN_RATE	−2.093	0.892	−2.347	0.0202

Effects specification

Cross-section fixed (dummy variables)

Weighted statistics

R-squared	0.679737	Mean dependent var	0.385011
Adjusted *R*-squared	0.636458	S.D. dependent var	0.415724
S.E. of regression	0.184005	Sum squared resid	5.010960
F-statistic	15.70601	Durbin–Watson stat	1.345177
Prob (*F*-statistic)	0.000000		

Table 3.
Panel regression, 2005–2017, second model

Moreover, the model is statistically significant, with a *F*-statistic of 15.7 and *p*-value 0, *R* squared at 68% and the adjusted *R* squared at 64%.

Using the formula mentioned above (a4 / −2 * a5), we calculate the optimal debt ratio for the automobiles and parts industry under the reviewed period.

Thus, the optimal debt ratio stands at 47.3% and given that the second derivative of the ratio (1) with respect to the debt ratio is negative, the above ratio is a local maximum. In essence, the effect shown in the chart above is as follows: as leverage increases, firms' benefits from tax savings resulting from tax shield. However, beyond this turning point (47.3%), the weighted average cost of capital increases, raising doubts about firms' viability. In other words, further borrowing in this case becomes counterproductive.

7. Conclusions

The purpose of this study was twofold: to examine the factors affecting the profitability of the automotive sector in the euro area, 2005–2017, and to track the optimal debt ratio.

For the achievement of this purpose, two models are applied: the first one to indicate the factors affecting profitability and the second one contributes to the finding of the optimal debt level.

The results are consistent with MM's theory, according to which, leverage initially seems to have positive outputs for firms (given the existence of taxation and tax shields), but after some point it becomes counterproductive, creating substantial operational

problems. Alternatively, when firms plan new investments, both equity and loans financed, shareholders are entitled to tax interest deduction, which is fully tax deductible, in addition to investments net present value, if applicable. Correspondingly, creditors are entitled to interest and capital. If loans were not used, which is not a common case, there would be no tax savings due to interest, and generally it is on firms' interest to make use of leverage, especially through bond loans. However, the use of equity increases confidence for the investment and sends a positive signal, as it shows that shareholders believe in venture's success.

The optimal debt ratio was calculated at 47.3%, given that debt ratio and debt square ratio variables seem to be statistically significant. This means that any positive level of leverage up to the aforementioned critical point increases profitability of the firm through the mechanism described above. But beyond that point, firms' sustainability is doubtful, as interest rates start rising at an increasing rate, leading firms into a vicious circle, depicted in the downward curve of the above chart (Figure 1). This is also one of the reasons why highly indebted firms (as happens with countries and households) are extremely vulnerable to disruptions, and thus it is recommended to avoid extreme leverage. Therefore, when an entity is called upon to finance a new investment, this approach needs to be taken into serious account. Moreover, firms' average profitability is 14.4%, without high dispersion. As regards the other explanatory variables that seem to be statistically significant, apart from debt ratio square debt ratio, are accruals, GDP growth rate, dummy variable "Crisis" and ECB main rate. On the contrary, the firm size and the Economic Sentiment Indicator appear to be of weak statistical significance.

The close interaction (both theoretically and empirically observed) between firms and the economic outlook is clear. As expected, the crisis affected profitability, as well as the overall structure and operation of the automotive sector, as it also resulted in mergers and acquisitions, adjusting their business plans to some extent. In this context, GDP also appears to have a significant impact, obviously in a positive way, as it is the dominant economic indicator of any economy. As for firm's size, as the literature indicates, the weak statistical significance may also be related to the sample size, preventing us from drawing safe conclusions. Finally, the Economic Sentiment Indicator, as it describes the conditions and expectations of key players in an economy, is a leading indicator of economic activity and has been significantly affected by the several phases of the crisis in the euro area.

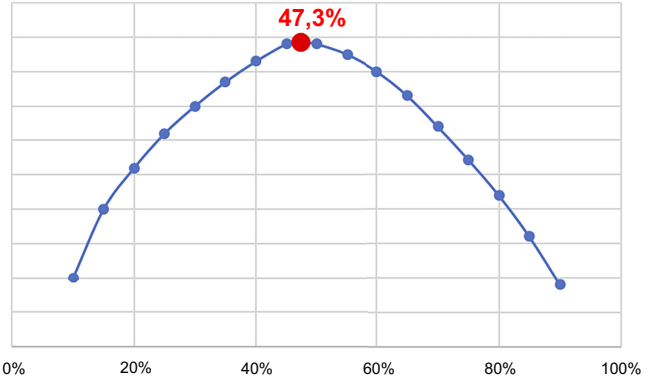

Figure 1.
Optimal debt ratio

References

Abor, J. (2005), "The effect of capital structure on profitability: an empirical analysis of listed firms in Ghana", *The Journal of Risk Finance*, Vol. 6 No. 5, pp. 438-445.

Akintoye, I.R. (2008), "Sensitivity of performance to capital structure", *European Journal of Social Sciences*, Vol. 7, p. 1.

Aras, G. and Kutlu Furtuna, O. (2017), "Insights from corporate cash holdings in emerging markets", *Global Review of Accounting and Finance*, Vol. 8 No. 1, pp. 95-103.

Aras, G., Aybars, A. and Kutlu, O. (2010), "Managing corporate performance: investigating the relationship between corporate social responsibility and financial performance in emerging markets", *International Journal of Productivity and Performance Management*, Vol. 59 No. 3, pp. 229-254.

Burgstahler, D. and Dichev, I. (1997), "Earnings management to avoid earnings decreases and losses", *Journal of Accounting and Economics*, Vol. 24 No. 1, pp. 99-126, doi: 10.1016/S0165-4101(97)00017-7.

Burja, C. (2011), "Factors influencing the companies' profitability", *Annales Universitatis Apulensis Series Oeconomica*, Vol. 13 No. 2, pp. 215-224.

Checherita, C. and Rother, P. (2010), "The impact of high and growing government debt on economic growth an empirical investigation for the euro area", ECB Working Paper Series No 1237.

Christopoulos, A., Dokas, I. and Matzaris, D. (2013), "The estimation of corporate liquidity management using artificial neural networks", *International Journal of Financial Engineering and Risk Management*, Vol. 1 No. 2, pp. 193-210.

Christopoulos, A., Dokas, I., Kalantonis, P. and Koukkou, T. (2019), "Investigation of financial distress with a dynamic logit based on the linkage between liquidity and profitability status of listed firms", *Journal of the Operational Research Society*, Vol. 70 No. 10, pp. 1817-1829.

Daskalakis, N. and Psillaki, M. (2008), "Do country or firm factors explain capital structure? Evidence from SMEs in France and Greece", *Applied Financial Economics*, Vol. 18 No. 2, pp. 87-97.

Degeorge, F., Patel, J. and Zeckhauser, R. (1999), "Earnings management to exceed thresholds", *The Journal of Business*, Vol. 72 No. 1, pp. 1-33, doi: 10.1086/209601.

Deloof, M. (2003), "Does working capital management affect profitability of Belgian firm?", *Journal of Business and Accounting*, Vol. 30, pp. 573-587.

Dong, H. and Su, T. (2010), "The relationship between working capital management and profitability: a Vietnam case", *International Research Journal of Finance and Economics*, Vol. 49, pp. 62-71.

Erina, J. and Lace, N. (2013), "Commercial banks profitability indicators: empirical evidence from Latvia", *IBIMA Business Review*, Vol. 2013, doi: 10.5171/2013.873515.

Eriotis, N., Vasiliou, D. and Ventoura - Neokosmidi, Z. (2007), "How firm characteristics affect capital structure: an empirical study", *Managerial Finance*, Vol. 33 No. 5, pp. 321-331.

Fara, M. and Supartika, N. (2016), "Factors affecting profitability of small medium enterprises (SMEs) firm listed in Indonesia stock exchange", *Journal of Economics, Business and Management*, Vol. 4 No. 2, pp. 132-137.

Giovanis, E. and Ozdamar, O. (2014), *"Determinants of Profitability: Evidence from US Firms", Facoltà di Economia, Università degli Studi di Verona*.

Gitman, L.J. and Zutter, C.J. (2012), *Principles of Managerial Finance*, 13th ed., Addison.

Goddard, J., Tavakoli, M. and Wilson, J.O.S. (2005), "Determinants of profitability in European manufacturing and services: evidence from a dynamic panel model", *Applied Financial Economics*, Vol. 15 No. 18, pp. 1269-1282, doi: 10.1080/09603100500387139.

Kallstrom, H. (2015), "Why growth shifted in the global automobile industry?", *Market Realist*, available at: http://marketrealist.com/2015/02/shift-growth-global-automobile–industry.

Katsampoxakis, I., Basdekis, H. and Anathreptakis, K. (2015), "How firm and market characteristics affect profitability: an empirical study", *International Journal of Corporate Finance and Accounting*, Vol. 2 No. 1, pp. 67-83.

Katsampoxakis, I., Basdekis, H. and Anathreptakis, K. (2018), "How the Greek crisis determined firm profitability and optimal debt ratio", in Zopounidis, C., Christopoulos, A. and Kalantonis, P. (Eds), *Perspectives, Trends, and Applications in Corporate Finance and Accounting*, IGI Global Publications, pp. 1-31.

Li, M.Y.L. and Hwang, N.C.R. (2011), "Effects of firm size, financial leverage and R&D expenditures on firm earnings: an analysis using quintile regression approach", *A Journal of Accounting, Finance and Business Studies*, Vol. 47 No. 2, pp. 182-204.

Liargovas, P. and Skandalis, K. (2010), "Factors affecting firm competitiveness: the case of Greek industry", *European Industrial Journal*, Vol. 2, pp. 184-197.

Mat Kila, S. and Wan Mansor, W.M. (2008), *Capital Structure and Firm Characteristics: Some Evidence from Malaysian Companies*, (MPRA papers), Munich Personal RePEc Archive.

Modigliani, F. and Miller, M.H. (1958), "The cost of capital, corporate finance and the theory of investment", *American Economic Review*, Vol. 48 No. 3, pp. 261-297.

Modigliani, F. and Miller, M.H. (1963), "Corporate income taxes and cost of capital: a correction", *American Economic Review*, Vol. 53 No. 3, pp. 433-443.

Narware, P.C. (2010), "Working capital management: the effect of market valuation and profitability in Malaysia", *International Journal of Business and Management*, Vol. 5, p. 11.

OICA (2016), "Production Statistics [online]. 2016. Organisation internationale des constructeurs d'automobiles", available at: http://www.oica.net/category/production -statistics/2015-statistics.

Padachi, K. (2006), "Trends in working capital management and its impact on firm's performance: an analysis of Mauritian small manufacturing firms", *International Review of Business Research Papers*, Vol. 2, pp. 45-58.

Pervan, M. and Visic, J. (2012), "Influence of firm size on its business success", *Croatian Operational Research Review*, Vol. 3, pp. 213-223.

Raheman, A., Afza, T., Qayyum, A. and Bodla, M.A. (2010), "Working capital management and corporate performance of manufacturing sector in Pakistan", *International Research Journal of Finance and Economics*, Vol. 47 No. 1, pp. 156-169.

Rayan, K. (2008), *Financial Leverage and Firm Value*, Gordon Institute of Business Science, University of Protoria.

Salman, A.K. and Yazdanfar, D. (2012), "Profitability in Swedish SME firms: a quantile regression approach", *International Business Research*, Vol. 5 No. 8, pp. 94-106.

Singh, J.P. and Pandey, S. (2008), "Impact of working capital management in the profitability of hindalco industries limited", *Icfai University Journal of Financial Economics*, Vol. 6 No. 4, pp. 62-69.

Sougianis, T. (1994), "The accounting based valuation of corporate R&D", *Accounting Review*, Vol. 69, pp. 44-68.

Srinivasan, R., Lilien, G.L. and Shridhar, S. (2011), "Should firms spend more on research and development and advertising during recessions?", *Journal of Marketing*, Vol. 75, pp. 49-65.

STATISTA (2016), *Worldwide Automobile Production from 2000 to 2015 (In Million Vehicles) [online]*, Statista, available at http://www.statista.com/statistics/262747/worldwide–automobile -production -since-2000.

Storey, D., Keasey, K., Wynarczyk, P. and Watson, R. (1987), "The performance of small firms: profits, jobs and failures", SSRN Papers.

Tailab, M.M. (2014), "Analyzing factors effecting profitability of non-financial U.S. Firms", *Research Journal of Finance and Accounting*, Vol. 5, pp. 17-26.

Vošta, M. and Kocourek, A. (2017), "Competitiveness of the European automobile industry in the global context", *Politics in Central Europe*, Vol. 13 No. 1. doi: 10.1515/pce-2016-0023.

Vošta, M. and Kocourek, A., (2015), "Automobile industry in the European union and its competitiveness in the world", *ACC Journal*, Vol. 11 No.2, pp. 40-51.

Wald, J.K. (1999), "How firm characteristics affect capital structure: an international comparison", *Journal of Financial Research*, Vol. 22 No. 2, pp. 161-187.

Yangseon, K., Liu, C. and Ghon Rhee, S. (2003), *The Effect of Firm Size on Earnings Management*, The University of Hawaii.

Further reading

European Automobile Manufacturers Association (2019), available at: https://www.acea.be/news/article/why-the-european-union-is-so-important-to-the-automobile-industry.

White, H. (1980), "A heteroskedasticity-consistent covariance matrix and a direct test for heteroskedasticity", *Econometrica*, Vol. 48, pp. 817-838.

Corresponding author

Ioannis Katsampoxakis can be contacted at: ikatsamp@econ.uoa.gr