

# DuPont analysis among European dentistry companies to measure the impact of the COVID-19 pandemic

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**Abstract:** Although health economics belongs to the highly respected economic disciplines within the research literature, there is a considerable gap related to the investigation of dentistry in particular, even after the global pandemic of COVID-19 disease. Fundamentally, the DuPont framework is a well-known complex analysis to evaluate companies from the point of view of financial performance. The investigation of the return on equity as a relation between the return on assets and the equity multiplier, simply called the leverage effect, is presented in this paper. Therefore, this study aims to estimate the effect of leverage and its changes due to the COVID-19 pandemic among dentistry companies in selected European countries with different healthcare insurance systems. This comparative investigation focused on the generalised method of moments with dynamic panel data from Orbis, the Bureau van Dijk financial database for 1,128 dentistry companies in nine European countries. Methodologically, concerning those post-estimation techniques to evaluate over- and underestimation of the models. It has been differentiating between companies with a high or low ownership concentration structure. The results have shown differences in the leverage effect during the pandemic, assuming that companies with a major owner increased their equity, while the debt leverage increased among those companies with dispersed ownership and vice versa. If economic theory states that debt financing is more effective for a company than using internal sources, it is apparently different in the case of dentistry during the pandemic. However, dispersed ownership is more often related to dentistry, according to mergers in this particular business industry.

**Keywords:** Financial performance, debt leverage, health economics, healthcare systems, concentration of ownership structure.

**JEL Classification:** G32, I11, M21.

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## Introduction

DuPont analysis is one of the oldest frameworks for fundamentally evaluating a company. However, no one has ever used that, even partially, to estimate the impact of the COVID-19 pandemic on company performance. Although Chang et al. (2014) used the DuPont framework

within the health economics already. The pandemic is generally considered the main cause of economic downturn among many industries in 2020 and 2021, and dentistry is not an exception (Patel, 2020). The question also is whether the healthcare system itself, either Beveridge or Bismarck model investigated throughout

the literature (Deppe & Oreskovic, 1996; Lameire et al., 1999; Marmor & Okma, 1997; Wendt, 2009; Widström & Eaton, 2004), could have somehow affected the situation among those dentistry companies during the pandemic. Based on the literature in the next section, three different research questions motivate this study: i) Since every human being living in a developed economy is somehow related to dentistry as a patient, did the COVID-19 changes caused by the pandemic vary across countries with a different health care system? (i.e., Beveridge vs. Bismarck); ii) Even though the DuPont framework is a crucial part of the fundamental analysis, could it be helpful to estimate the impact of the pandemic on dentistry?; and iii) Is the trend of mergers obvious among dentistry companies even during the affected period?

Focused on the Dupont analysis, this paper aims to estimate the leverage effect and its changes due to the COVID-19 pandemic among dentistry companies in selected European countries having either the Beveridge model (National Health Service System) or the Bismarck model (Compulsory Universal Health Insurance System). For the empirical part of this paper, DuPont analysis, essentially evaluating a breakdown of profitability and commonly even within health economics (Chang et al., 2014; Turner et al., 2015), has been deployed, according to Soliman (2008). Therefore, using this particular technique, individual influences that affect the final value of profitability ratios have been investigated (Doorasamy, 2016; Fairfield et al., 1996, 2009; Nissim & Penman, 2001). Furthermore, an investigation of dentistry companies with a high concentration of ownership has a major owner compared to those with a low concentration and dispersed ownership is carried out. The contribution of this study is also methodological, testing up-to-date post-estimation techniques while using the system-generalised method of moments with longitudinal data.

This paper is structured as follows. As mentioned above, Section 1 briefly reviews the literature related to health economics. The methodology and data are described in Section 2. A discussion of GMM estimates is made in Section 3 of this paper, right before its conclusion.

## 1. Theoretical background

It is important for the economies of individual countries that people can work and be active

in the labour market. To be able to be, they must be healthy. Therefore, it is necessary to be aware of this at the highest levels of individual economies. Oral health is also related to the issue of health. Oral health, along with growing awareness of the impact that limited dental coverage has on oral health and overall health and well-being, has received increased attention in recent years (Winkelmann et al., 2022). Therefore, it is necessary to pay considerable attention to the area of oral healthcare providers and to support dentistry and related fields. Therefore, attention should be paid both to dentists but also to various fields of providers and producers of services in the field of oral health care. According to Peres et al. (2019), the personal consequences of chronic untreated oral diseases are often severe and can include unrelenting pain, reduced quality of life, lost school days, disruption of family life, and reduced work productivity. The cost of treating oral diseases represents a large economic burden on families and healthcare systems (Bawaskar & Bawaskar, 2020). Oral diseases are undoubtedly a global public health problem, with particular concern over their increasing prevalence in many low- and middle-income countries linked to wider social, economic, and commercial changes (Peres et al., 2020).

It is also important to monitor certain socioeconomic inequalities in the health of the population (Do et al., 2010). Inequality in oral health is expected due to the growing socioeconomic inequality of people, and this has a direct impact on the functioning of dental businesses. In countries where socioeconomic differences are more pronounced, inequality in the area of oral health is also more pronounced (Do et al., 2010; Elani et al., 2012; Garcia & Tabak, 2011; Hosseinpoor et al., 2012). An interesting approach can be observed in the study of Pinilla and González (2009), which traces the relationships between dental health and the use of dental care with socioeconomic factors, human resources, and the financing and organisation of dental care systems in European countries. However, Pinilla and González (2009) found no evidence that better access (a policy aimed at improving access to oral health services) to dentists improved dental health in 12-year-old children. The main parameters that influence oral health and its development are income and level of education within countries. A higher number of dentists and a relatively young adult

population have a positive effect on the use of dental services.

The importance of providing dental medical care is clearly defined. For this, it is necessary to state that everything is related to finance. And the field of dentistry is very specific from the point of view of financing. Different approaches to the provision of publicly available dental care or elements thereof are adopted (Widström & Eaton, 2004). In general, it can be said that the expenditure on dental care is financed from several sources, i.e., from public sources and direct payments from households (Bailit & Beazoglou, 2008). Public resources are related to the health systems established in a given country. In Europe, there are two types of healthcare systems used. They are the Beveridge model and the Bismarck model. The Beveridge model is built on the principle of health care paid for through redistributive processes in the economy and thus from taxes (Lameire et al., 1999; Wendt, 2009). The Bismarck model is based on universal health insurance and health care is covered by public health insurance, which is mandatory (Deppe & Oreskovic, 1996; Marmor & Okma, 1997; Wendt, 2009). These two models are the basis of healthcare in European countries. So, it follows that medical dental care in European countries is partly paid for either from collected taxes or through insurance companies. But it is still true that in almost all countries, dental care is financed to a greater extent by private patient payments than in other sectors of health care (Widström & Eaton, 2004).

Funding in the field of dental care is highly debatable, with constantly changing attitudes in different countries, which can also affect the dental businesses themselves. In most countries, dental care is only partially covered by public health insurance, which can also have a certain impact on the general oral health of residents and households. On the negative impact of insufficient funding from public health insurance funding (Ahmadi et al., 2021). A study has been carried out that suggests that financing health care through households' direct finances results in "catastrophic health expenditure" and impoverishment of the population and their health in many countries. Liu et al. (2019) explain that, in general, catastrophic health expenditures represent out-of-pocket payments that exceed a specified threshold of household income or household ability to pay. The findings

of this study (Ahmadi et al., 2021) stated that dental services are the basis of catastrophic health expenditures, and these services must be covered to a greater extent by basic health insurance or from other public sources.

Another area that is gradually coming to the fore and is beginning to affect the financial stability of dental businesses is the pressure on the ecological sustainability of dental practice (Duane et al., 2019). Therefore, the area of sustainable dentistry is gaining importance. Duane et al. (2020) mention the global commitment to sustainability, and the fact remains that the demands for a sustainable world are growing. Within dentistry, it is possible to monitor the possibilities of improving the sustainability of the environment in several areas. The biggest burden is travelling to the dental office, which is often outside the patient's region, and this results in a further increase in carbon emissions, which also contributes to damage to human health. Other areas are materials and devices for dental practice. Larger dental organisations can influence their suppliers by choosing environmentally friendly products from sustainable companies. However, this is another area that can place a greater financial burden on dental companies. Currently, dentistry is also recovering from the effects of COVID-19. Pandemic and individual pandemic measures have greatly affected dental businesses (Patel, 2020).

The dental profession is gradually changing in all directions (Samson & Schwartz, 2019). Historically, dentists were largely owners of their businesses. Another option was to join an older dentist with a vision of buying the office in the future. The problem was a lack of knowledge of how to handle the management of one's business. There was a lack of basic knowledge in the field of business economics. Over time, a new trend emerged when larger groups of businesses were founded to which dentists belong. It is easier for these dentists to take over the concept of managing and managing their business. Levin (2003) mentions that dentists often struggle with dealing with the business side of their practices. With a better understanding of the business aspects, it is possible to redirect energy and create a successful practice while performing excellent dentistry.

The dentists' approach to their profits, which they achieve by providing care and subsequent payment from both sources, is also related to the financing and expansion of

the care they provide or the improvement of the quality of care. The goal of every entrepreneur is to make a profit and it is no different for private dental centers. It is then important to consider how to deal with the profit achieved. Demirbag et al. (2015) claim that the reinvestment of profits back into the business is the key to success. Reinvestment is described by Cull and Xu (2005) as the percentage of profit invested back into the company. McCarthy et al. (1993) state that it is a decision to expand an existing business. Variables that, according to Demirbag et al. (2015), are relevant to the extension of a firm's lifespan include factors for which reinvestment may be key, and these are a scale of operation (Bercovitz & Mitchell, 2007), resource utilisation (Bercovitz & Mitchell, 2007; Bradley et al., 2011) and strategy growth (Mata & Portugal, 2002).

Financial management and reinvestment decisions are particularly specific if the company has a different owner and manager (Coles et al., 2001). The OLS results suggest that ownership is significant for firm performance, but when endogeneity is taken into account, ownership is not statistically dependent on performance measures (Welch, 2003). Berle and Means (1932) were one of the first to deal with the relationship between a firm's ownership structure and its performance. He argues that as ownership diffusion increases, shareholders become powerless to control professional managers. He further argues that since the interests of management and shareholders are generally not aligned, corporate resources are not used efficiently in maximising corporate profits.

The size of the company can also be decisive in the decision to reinvest part of the profit back into the business. Small and medium-sized enterprises are likely less interested in reinvesting profits in their business. As Wellalage and Reddy (2020) say, the reinvestment of profits back into the business is affected by the presence of weak rules and regulations, a weak organisational and institutional environment, and a highly uncertain business environment. These aspects also make SME owners reluctant to reinvest profits into their businesses. Furthermore, there are different approaches to using profit for your business. Caselli and Negri (2021) present the pecking order theory, which states that companies prioritise their sources of financing and consider equity financing as a last resort. This theory states that businesses follow a hierarchy

of funding sources. First, internal funds are used, and when they are used, the loan option is used. Only when it is not possible to take another loan, the equity is used. Berger and Udell (1998) say that the hierarchy of financing used depends on the size of the firm and the level of development because, for each stage of growth, there is a certain level of information asymmetry and financing needs. This is also known as the "financial growth cycle."

Most dentists enjoy the clinical aspects of the dental practice but often find managing business systems and staff challenging. It is understandable. Most dentists lack business management training. The problem is that dentists train for several years in the practice of dentistry and then are thrown into the business environment without any specific business training (Levin, 2003). Dentists who run their practice must also consider how to approach earnings management, whether they will also use the reinvestment option. As part of the approach to the reinvestment of profits in one's business, it is also possible to observe a different approach from the point of view of the size of the enterprises. It can be assumed that small and medium-sized companies will tend to reinvest less than large enterprises. There may also be a difference in approaches to reinvestment within Europe. Dental businesses in Central and Eastern Europe are likely to be rather small and medium-sized. Wellalage and Reddy (2020) also mention in their article that SMEs reinvest profits in their business less. Different approaches to reinvestment, but also the form of dental businesses between the countries of Western Europe and the countries of Central and Eastern Europe, are not the only ones. Differences in other health areas are also evident. This difference is also addressed by Kolossváry et al. (2021). Thirty years after the transition period, starting in 1989, the countries of Central and Eastern Europe, representing one-fifth of the entire European population, share many historical, social, political, economic, and cultural characteristics. There is still a significant gap between Central and Eastern European countries and West European countries. Kolossváry et al. (2021) report that differences in risk factors and peripheral vascular care across Europe appear to be tangible and can be considered a signal of existing differences. Improvements in research and the development and cross-border sharing of scientific data are

essential to initiate and facilitate convergence in this area.

The difference in dentistry's approach to reinvesting profits into its business can also be seen across the healthcare systems used in a given country. The two aforementioned healthcare systems are used in the European Union. The Beveridge model (National Health Service System) is used by 12 EU countries: Denmark, Finland, Cyprus, Estonia, Greece, Ireland, Italy, Latvia, Malta, Portugal, Spain, and Sweden. The Bismarck model (Compulsory Universal Health Insurance System) is used by 15 EU countries: Austria, Belgium, Bulgaria, Croatia, Czech Republic, France, Germany, Hungary, Lithuania, Luxembourg, Netherlands, Poland, Romania, Slovakia, Slovenia. In other selected European countries (i.e., Great Britain and Norway) that are tested but are not part of the EU, the Beveridge model of the healthcare system is used.

Last but not least, in this particular case, according to Soliman (2008), DuPont analysis decomposes return-on-net-operating-assets (RNOA) into two multiplicative components, i.e., profit margin and asset turnover. Both are influenced by their affiliation to the industry. The use of DuPont analysis is also possible in the area of health economics data. This is also solved by Turner et al. (2015), who analyse the profitability of hospitals and, for these purposes, state that it is also possible to use DuPont analysis. This analysis is used to assess the quality of the income. By breaking down return on equity into profit margin, total asset turnover, and capital structure, DuPont's analysis reveals what drives overall profitability. Turner et al. (2015) find that investor-owned hospitals have larger profit margins, higher efficiency, and are more leveraged. Doorasamy (2016) also positively evaluated the DuPont analysis by pointing out that stock market volatility makes investment decisions controversial. Investing a certain amount of money requires a proper analysis to make the necessary decision. DuPont analysis can contribute to this. Profit breakdown is important for assessing profitability, and, further, a classification scheme improves profitability forecasts as well (Fairfield et al., 1996). Fairfield et al. (2009) mention that using an analytical model can improve performance prediction. An important finding is also that individual components of income can reveal significant impacts on industry, even

though this is not evident in overall profitability. Nissim and Penman (2001) also write about the elements of the necessary accounting information and the breakdown for a better forecast of profitability. In their study, Chang et al. (2014) also draw attention to the issue of using DuPont analysis for the healthcare sector. They say DuPont components are less informative accounting signals in healthcare compared to the industry-wide sample. Analysts say that the monitoring of the healthcare sector should focus on changes in profit margins rather than changes in asset turnover. Only then will the accuracy of profitability forecasts be improved. According to Soliman (2008), in practice, the use of financial ratio indicators adjusting the industry is less frequent, and a large part of research on the average return of profitability assumes whole-economy reversal goals.

## 2. Research methodology

Just to explain what DuPont analysis is focused on, the main relations are described by the next two equations (Chang et al., 2014; Soliman, 2008). The return on equity (ROE) using the earnings after tax (EAT) of  $i$  companies (excluding those with negative equity) in time  $t$  is described in Equation (1) as follows:

$$ROE_{it} = \frac{EAT_{it}}{Equity_{it}} \times 100 \quad (1)$$

To measure how effectively assets are used in dentistry, the return on assets (ROA) using earnings before interest and tax (EBIT) is described in Equation (2):

$$ROA_{it} = \frac{EBIT_{it}}{Total\ assets_{it}} \times 100 \quad (2)$$

Nevertheless, to estimate the leverage effect within ROE and the turnover of assets within ROA, the generalised method of moments (GMM) is used. The use of GMM when working with panel data is justified especially when working with a dynamic panel, when the delayed, explained variable on the right-hand side of the equation is also statistically significant, the observed period to estimate the regression coefficients is shorter ( $T \leq 10$ ), but the cross-section of the panel includes a larger number of companies. Because of the generalisation of the method of moments, the problem of heteroscedasticity of the residual component

is also solved when using the two-phase model. The method itself was constructed in their work by Anderson and Hsiao (1981) and subsequently by Hansen (1982) and further extended by Hansen et al. (1996). However, Arellano and Bond (1991) also contributed to its development by pointing out the problem of serial correlation of the idiosyncratic error, which can be understood as a residual component across the panel. Arellano and Bover (1995) subsequently modified the two-stage, differenced estimator, which differed from the previous version by rejecting homoscedasticity. In the following years, however, Blundell and Bond (1998) focused on the error component of the models, focusing in particular on the possible distortion of the results due to systematic errors in the estimation of the studied effects of the two-stage estimation. They constructed a systemic GMM model that allows the inclusion of a much larger number of instrumental variables. The problem of error correction was solved only by Windmeijer (2005), whose technical specification of the robust component of the model revealed not only falsely significant results but also different signs of significant coefficients. A robust error vector has become essential for correctly estimating the two-stage coefficients of the dynamic panel GMM model.

Kripfganz and Swarz (2019) subsequently constructed a modified version of GMM estimators with panel data, including many newly introduced diagnostic tests, including modifications of the Sargan and Hansen tests for use in Windmeijer estimation error correction discussed by Sanderson and Windmeijer (2016), lately suggested even by Hansen and Lee (2021). In the case of many studies, it is not even entirely clear how to test the lag setting of the instrumental variables, which do not enter the basic estimation equation but are related to the error component of the model with a robust error vector. Kripfganz and Swarz (2019) state that only if the homoscedastic residual component of the model is confirmed, the moments can be tested using the Hausman test. However, Andrews and Lu (2001) already present the MMSC test (model and moment selection criteria), which makes it possible to compare models precisely in terms of their setting of the moments of the variables of the regression equation, including the moments of the instrumental variables.

The system GMM model with a dynamic panel including intra-period data from part

of the missing data is generally described by the following Equation (3):

$$y_{it} = \sum_{j=1}^p \alpha_j y_{i,t-j} + x_{it} \beta_1 + v_i + \epsilon_{it} \quad (3)$$

$$i = 1, \dots, N \quad t = 1, \dots, T_i$$

where:  $\alpha_j$  – the total number of  $p$  parameters for estimating the explanatory variable ROE of  $i$  firms lagged by one year ( $t - 1$ );  $x_{it}$  means  $1 \times k_1$  vector of the predetermined variable ROA;  $\beta_1$  is  $k_1 \times 1$  vector of parameters exploring the leverage to be estimated;  $v_i$  – panel effects that can be correlated with regressors;  $\epsilon_{it}$  – the residual, i.e., the panel of idiosyncratic estimation errors, having a variance  $\sigma_{\epsilon}^2$ .

In our case of a two-stage GMM model and the examined period 2012–2021,  $T_i = 8$ , the predetermined variables are the macroeconomic indicators of the share of savings in GDP and the share of consumption in GDP in selected countries, and the endogenous microeconomic variable is the share of retained earnings among the regressors in the total assets of the group variable in the cross-section of the panel, firms  $i$ . The assumption of the functionality of the model is non-correlation  $v_i$  and  $\epsilon_{it}$ . In general, ROA and ROE are related through the DuPont analysis, with ROA serving as a component that influences ROE along with the financial leverage multiplier. A company that efficiently manages its assets and capital structure can achieve higher ROE and provide better returns to its shareholders (Chang et al., 2014; Soliman, 2008).

According to the ORBIS database, there were a total of 15,974 medium-sized companies operating in the Human Health Activities sector from 2012–2021. Of these, 6,954 companies were based in the CEE countries, while the remaining 9,020 companies operated in Western Europe. In particular, financial data from the balance sheet (i.e., total assets, equity), as well as the profit and loss statement (EAT, EBIT), within NACE 86: Human Health Activities, subcategory 862: The Medical and Dental Practice Activities Sector, which can also be divided into three categories, of another subcategory 8623: Dental Practice Activities. From the descriptive statistics in Tab. 1, two important pieces of information are drawn. Whereas profitability has decreased due to the COVID-19 pandemic among those dentistry companies with high ownership

concentration measured through the independence indicator reported by Bureau van Dijk, on the contrary, it has increased among those companies with lower ownership concentration. This does not mean that the pandemic positively affected earnings. However, losses and dividends could have decreased equity and total assets according to Equations (1–2) especially among companies with dispersed ownership. Of course, further analysis of the leverage effect of the DuPont framework using the GMM estimation is needed to prove precisely in which countries the leverage increased, on the other hand. The interquartile range demonstrates the variability of nonnormally distributed data (instead of the standard deviation while the data are normally distributed). Apparently, neither the comparison between ROE and ROA, nor their change due to the pandemic can give us similar results. The variability of ROE is at a higher level. Albeit, higher changes caused by the pandemic may be observed among dental companies with a low ownership concentration. According to the significant results, data have been obtained only for nine European countries: Belgium, Denmark, Finland, France, Great Britain, Italy, Norway, Portugal, and Spain. Due to the insignificant results or not reporting the information about their ownership structure, the total number of investigated companies is 1,128.

Technically, the STATA *xtpdgmm* command developed by Kripfganz (2019) has been deployed to get the two-step system GMM estimates in Tab. 2. In particular, it is the Blundell and Bond (1998) technique with the robust

bias-corrected variance-covariance matrix for standard errors, recommended by Windmeijer (2005). Surely, the Arellano-Bond test for zero autocorrelation in first-differenced errors to test zero hypothesis that conditions in the model are valid. Furthermore, according to Windmeijer (2018), the problem of underidentification has been tested by Cragg-Donald's robust comparative usability evaluation (Lagrange Multiplier version) and Kleibergen-Paap's robust limited information maximum likelihood (LM version). However, the problem of overidentification has been verified by the Sargan-Hansen tests. Only the results highlighted in bold are comparable. Dynamic panel data modelling is inefficient in cases with insignificant lagged L.ROE. Except for Portuguese companies with a low ownership structure, the COVID-19 pandemic has affected the technical diagnostics of GMM models in a good way, especially in the case of companies with a high ownership structure. Both cases of dentistry companies in Norway have been just false-significant due to the problem with the underidentification of models. All these cases are highlighted in grey in Tab. 2 within the next section.

### 3. Research results

Compared to the relevant reviewed literature, several differences should be highlighted before the discussion. Even though Soliman (2008) decomposes return-on-net-operating-assets (RNOA) using DuPont analysis, it has been different in this particular case. Specifically, cash and cash equivalents should have been included in assets, since companies earned at least

**Tab. 1: Descriptive statistics**

	Ex ante period 2012–2019		Pandemic period 2020–2021	
	HIGH	LOW	HIGH	LOW
<b>Median</b>				
ROE	31.30	30.96	29.73	33.41
ROA	21.22	20.96	19.52	22.56
<b>Interquartile range</b>				
ROE	28.82	26.91	30.70	30.31
ROA	17.56	15.75	17.21	19.05
Frequency	7,160	1,864	1,790	466

Source: own

some financial revenues during the COVID-19 pandemic. Liquidity and working capital would have received a considerable degree of attention concerning the pandemic in future research. Nevertheless, some recent studies used DuPont analysis within health economics research (Chang et al., 2014; Turner et al., 2015), investigating a specific industry, such as the dental industry, so-called dentistry, is much more efficient than investigating hospitals neither having the portfolio of only health business activities, nor focusing on a particular business related to one specific health issue. However,

the results of GMM estimates suggest that DuPont analysis can identify not only financially healthier companies but even reveal a potential investment opportunity comparing dentistry among different countries (Doorasamy, 2016; Fairfield et al., 2009; Nissim & Penman, 2001).

Furthermore, a sizable public dental service with salaried employees and equipment that is funded by general or local taxes is a hallmark of the Beveridge model, sometimes referred to as the National Health Service (NHS) system. When it comes to reducing the DMFT index (decayed, missing, and filled teeth), the Nordic

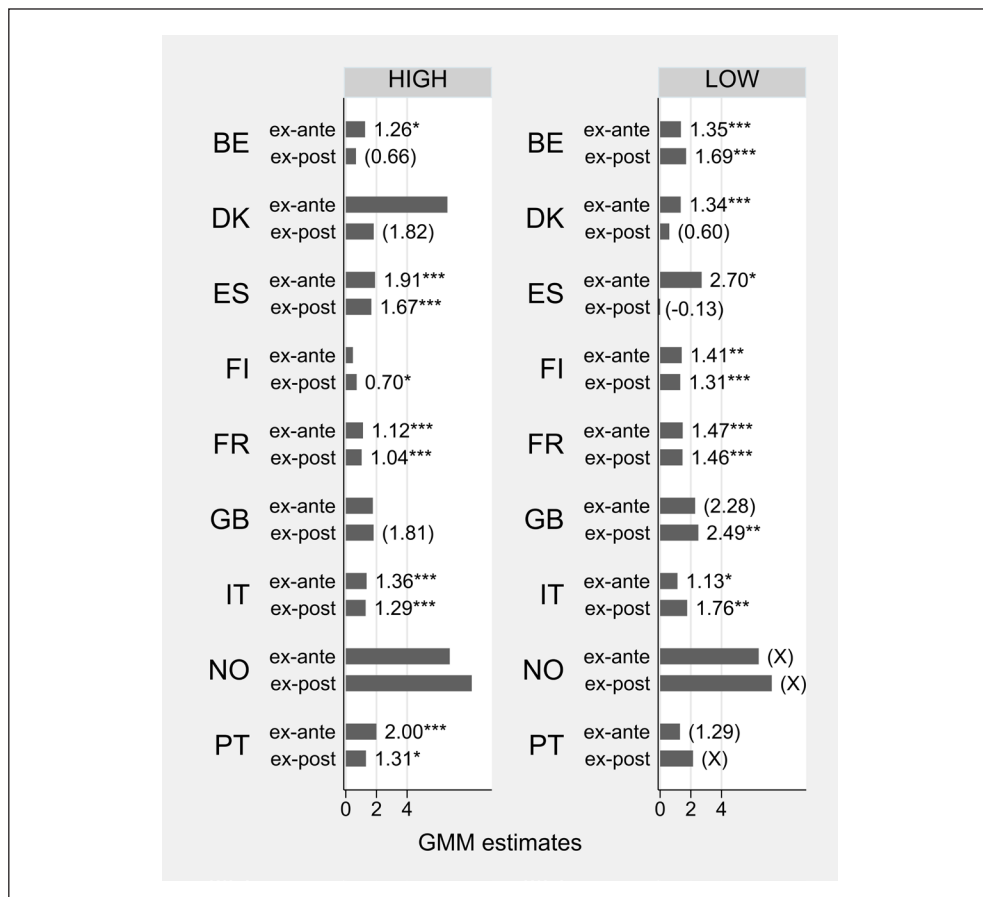


Fig. 1: Estimated DuPont financial leverage using GMM models

Note: \*\*\* $p < 0.001$ ; \*\* $p < 0.01$ , \* $p < 0.05$ ; (insignificant), missing non-robust, or (X) false significant results.

Source: own



nations and the UK have outperformed the Beveridge region in the field of stomatology (Pinilla & González, 2009). Several nations, including the UK, Denmark, Finland, Italy, Norway, Portugal, and Spain, have adopted this concept within the results. The Compulsory Universal Health Insurance System, or the Bismarck model, on the other hand, bases healthcare financing on mandatory salary payments. It is claimed that the economic downturn, political unpredictability, widening social divides, and rising unemployment rates make the implementation of the Bismarckian insurance program in many countries seem unfeasible. Countries in the FSE (former socialist economies) region are linked to this model. Although, Belgium and France have adopted this system for dentistry as well. Nevertheless, the material that is currently available omits important information regarding the precise application of the Bismarck model to stomatology, further also according to the ownership structure of dentistry companies (Deppe & Oreskovic, 1996; Welch, 2003).

The financial leverage multiplier magnifies the impact of ROA on ROE in Tab. 2 with the system GMM estimates. If a company takes on more debt relative to equity (higher financial leverage), a smaller ROA can still result in a higher ROE due to the increased financial leverage (Chang et al., 2014; Turner et al., 2015), i.e., those companies with a LOW concentration of ownership structure. The comparison is made from several points of view. First, the estimated leverage effect can be compared from the ownership concentration point of view. Except for the pre-pandemic period in Italy, the leverage effect of DuPont analysis measured by the equity multiplier tends to be slightly lower among dentistry companies with HIGH ownership concentration in Fig. 1. However, it tends to be lower during the pandemic period. It means that future profits will be many times more than the cost of borrowing amongst dentistry firms with more than one owner, which supports the idea of mergers amongst dentistry companies. This result does make sense if the LOW dispersed ownership allows the use of debt financing rather than equity. On the other hand, this result is supported by Caselli and Negri (2021), who argued that the owner uses equity rather than debt, i.e., the case of a HIGH concentrated ownership structure. Hence, more owners will either decrease the costs of capital, as well as allow

the usage of a higher level of debt capital. Second, the impact of the COVID-19 pandemic can be seen in selected cases among both groups of dentistry companies. The pandemic and the accompanying economic downturn have an impact on dentistry, just like they do on other healthcare sectors (Patel, 2020), and even from the DuPont financial leverage point of view, this impact is evident in Fig. 1. On the one hand, decreasing (or increasing) equity caused by the potential share of retained earnings (or reinvestments) during the pandemic will increase (or decrease) the profitability of a firm. On the other hand, any change will affect ROE more than ROA. However, we can see a negative change in the effect of leverage in France (1.12 ex-ante, 1.04 ex-post), Portugal (from 2.00 to 1.31), and Spain (1.91 and 1.67) among companies with HIGH ownership concentration. This result supports the idea of reinvestments during the pandemic developed in the previous paragraph. Quite the opposite is the massive positive change of leverage in Belgium (1.35 ex-ante, 1.69 ex-post) and Italy (1.13 and 1.76) among companies with LOW ownership concentration, caused by negative changes in equity. However, this result could have been caused by mergers in dentistry, not only by losses related to the pandemic.

In the Bismarck model (i.e., Belgium and France), dental care is dependent on social insurance contributions, where both employers and employees contribute to a health insurance fund. Hence, the profitability of dental care can be influenced by patient's ability to access and afford dental services based on their insurance coverage. Dentists can negotiate reimbursement rates with insurance companies, which can affect their income. On the other hand, in the Beveridge model (i.e., Italy, Portugal, and Spain), dentistry is primarily funded by the government through taxation, which means that dental care may be more likely to be included as part of the publicly funded healthcare system. The profitability of dentists can be influenced by government-set reimbursement rates, which may be lower than what they could charge in a purely private system. However, a consistent patient base and reduced administrative burden could offset this. Most importantly, the COVID-19 pandemic affected different economies at very different levels, while the Italian economy belongs to those most affected in the world. Perhaps that would

be a reason why we see differences even between the opposite impact of the leverage between Italy, Portugal, and Spain, or even between Belgium and France in the previous paragraph. Furthermore, the ownership structure has affected especially the Italian case, where we can see an increasing leverage effect among companies with LOW concentration and dispersed ownership. A decreasing effect may be even more obvious for companies with major owners in Portugal and Spain.

An interesting finding is that in terms of the comparison of financial leverage in Belgium and Italy, the leverage is close in both economies, even though different healthcare systems are used there. This is probably because Italy started to support its healthcare more during

and after the pandemic, as well as Belgium (in different health systems). They focused on improving the continuity and coordination of healthcare. Attention is paid to many aspects of the Italian national health system by transforming primary care into community care (Mauro & Giancotti, 2023). Concerning that, a reform of the health sector and healthcare support was introduced in Italy. This applies not only to primary care but also to other areas of health care provided, including dental care. A reform was also introduced in Belgium, which was already prepared before the pandemic but was not implemented until 2020 (Heede et al., 2023). There is, therefore, a clear similarity in the support of health care in these two countries and, therefore, also in the approaches

**Tab. 2: DuPont leverage effect using ROE as the dependent variable**

HIGH ownership concentration									
Pre-pandemic period									
	BE	DK	ES	FI	FR	GB	IT	NO	PT
L.ROE	0.4266 <sup>c</sup>	2.6898	-0.0230 <sup>c</sup>	-0.2697	0.0687 <sup>c</sup>	-0.0546	0.0159 <sup>c</sup>	0.3492	0.0193 <sup>c</sup>
ROA	<b>1.2575<sup>c</sup></b>	6.6252	<b>1.9075<sup>a</sup></b>	0.4627	<b>1.1202<sup>a</sup></b>	1.7631	<b>1.3566<sup>a</sup></b>	6.7772	<b>1.9972<sup>a</sup></b>
COVID-19 pandemic included									
	BE	DK	ES	FI	FR	GB	IT	NO	PT
L.ROE	0.8526 <sup>a</sup>	0.4776 <sup>c</sup>	-0.0102 <sup>c</sup>	-0.2494 <sup>c</sup>	0.1169 <sup>c</sup>	-0.0145	0.0582 <sup>c</sup>	0.3026	-0.0886 <sup>c</sup>
ROA	0.6623	1.8195	<b>1.6682<sup>a</sup></b>	<b>0.7049<sup>c</sup></b>	<b>1.0361<sup>a</sup></b>	1.8107	<b>1.2923<sup>a</sup></b>	8.2141	<b>1.3135<sup>c</sup></b>
LOW ownership concentration									
Pre-pandemic period									
	BE	DK	ES	FI	FR	GB	IT	NO	PT
L.ROE	-0.3059 <sup>a</sup>	0.3855 <sup>b</sup>	-0.0418 <sup>c</sup>	-0.0504 <sup>c</sup>	-0.0810 <sup>c</sup>	0.5108 <sup>a</sup>	0.0862 <sup>c</sup>	0.5205 <sup>a</sup>	-0.2173 <sup>a</sup>
ROA	<b>1.3550<sup>a</sup></b>	<b>1.3394<sup>a</sup></b>	<b>2.7039<sup>c</sup></b>	<b>1.4064<sup>b</sup></b>	<b>1.4703<sup>a</sup></b>	2.2816	<b>1.1297<sup>c</sup></b>	6.4255 <sup>c</sup>	1.2918
COVID-19 pandemic included									
	BE	DK	ES	FI	FR	GB	IT	NO	PT
L.ROE	-0.7109 <sup>c</sup>	0.6777 <sup>b</sup>	0.1792 <sup>c</sup>	-0.0384 <sup>b</sup>	-0.1331 <sup>c</sup>	0.4507 <sup>a</sup>	0.0166 <sup>c</sup>	0.0176 <sup>c</sup>	-0.0773
ROA	<b>1.6920<sup>a</sup></b>	0.5959	-0.1309	<b>1.3098<sup>a</sup></b>	<b>1.4566<sup>a</sup></b>	<b>2.4884<sup>b</sup></b>	<b>1.7611<sup>b</sup></b>	7.2767 <sup>b</sup>	2.1420 <sup>a</sup>

Note: Symbols <sup>a</sup> for  $p < 0.001$ , <sup>b</sup> for  $p < 0.01$ , and <sup>c</sup> for  $p < 0.05$ . Valid leverage effects highlighted in bold, otherwise grey cells. The two-step system GMM estimation technique by Blundell and Bond (1998) with the robust bias-corrected variance-covariance matrix for standard errors, recommended by Windmeijer (2005), and the STATA *xtpdgmm* command developed by Kripfganz (2019). Amongst diagnostic tests, the Arellano-Bond test for zero autocorrelation in first-differenced errors has been estimated to test whether the moment conditions in the model are valid, further, according to Windmeijer (2018), the underidentification tested by Cragg-Donald robust CUE-based (LM version) and Kleibergen-Paap robust LIML-based (LM version), and finally, overidentification tested by the Sargan-Hansen test.

Source: own

to health care financing. On the other hand, in France, where the effect of financial leverage is the opposite, a major reform has been launched since 2020, but this reform is being introduced gradually and, for the time being, does not affect the area of dental care provision. However, in the area of dental care, significantly high household expenses are defined compared to other areas of healthcare (Or et al., 2023).

## Conclusions

Focused on the DuPont framework, this article aimed to estimate the effect of leverage and its changes due to the COVID-19 pandemic among dentistry companies in selected European countries having either the Beveridge model (National Health Service System) or the Bismarck model (Compulsory Universal Health Insurance System). To answer those three research questions formulated within the Introduction: i) It is hard to argue that just a different healthcare system is crucial from the point of view of the pandemic impacts. This particular effect is not similar, especially among Italy, Portugal, and Spain, which have the Beveridge system, nor is it the same between Belgium and France, which have the Bismarck system; ii) The GMM technique is apparently not appropriate for the DuPont framework to evaluate these pandemic impacts due to post-estimation techniques such as over- and under-identification of the moments within the models. Hence, different techniques, i.e., heterogeneous difference-in-differences with different cohorts of companies, will be used in future research focusing on this framework regarding the pandemic. However, even though the data for ownership structure data were obtained only for its concentration, more leveraged effects based on DuPont analysis caused by the pandemic were evident either for those dentistry companies with a major owner in Portugal or for those companies with dispersed ownership structure, especially in Belgium and Italy; and iii) Additionally, mergers among dentistry companies are possibly evident among Portuguese dentistry companies that have a high concentration of owners or Belgian and Italian companies that have a low concentration. However, among these particular groups of companies, the use of debt financing is preferred to the use of shareholders' funds.

Although the results of this paper are robust, there are some limitations. Foremost, the leverage effect of the DuPont analysis was

not significant for dentistry companies in many countries. Due to this fact, the investigation was carried out only in nine European countries. It is not an argument to reject the DuPont framework to measure the impact of the pandemic in different business industries, though. Another point of view would be solved in future research focusing on differences between NUTS3 units, as dentistry would have been highly dependent on actual COVID-19 cases. A combination of a higher ROA and appropriate financial leverage can lead to a significantly higher ROE. However, it is crucial to note that increased financial leverage also comes with higher financial risk, as the company has to pay interest on its debt (Solomon, 2008). Therefore, finally, further research on ROA and the efficiency of asset management efficiency among European dental companies will be carried out.

Finally, we argue that the differences between different models of healthcare financing within financial performance relations according to the DuPont framework were apparent neither before nor during the period affected by the global pandemic crisis. Such results are further supported by Widström and Eaton (2004). Nevertheless, the impact of a different ownership structure is inevitable.

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