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Analysis of the Economic Situation of Energy Companies in Central and Eastern Europe

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ABSTRACT

Nowadays our everyday life is unimaginable without energy, because all the sectors are using different forms of energy. In our article we decided to analyse the following question: what is the current economic status and situation of the energy companies in Central and Eastern Europe? We prepared our primary research by the use of a standard fixed-effect panel regression model to analyse the capital structure of the energy industry companies. The capital structure regression gave similar results in terms of parameter sign, while the firm size, profitability (ROA) and liquidity ratio have significant coefficients in all cases from Poland, Czechia, Slovakia, Romania, and Hungary. Asset structure denoted the fixed assets over total assets. According to the estimates, larger companies have higher share of leverage and may have easier access to external financing sources. The profitability of the firms (captured by ROA) and leverage had a negative relationship, thus profitable firms were less likely to rely on external finance.

Keywords: Energy, Profitability, Leverage, Energy Industry, Technological Development, Regions, Central and Eastern Europe, Capital Structure
JEL Classifications: M10; M40

1. INTRODUCTION

One of the most discussed topics in public discourse currently is related to energy and energy supply. The energy sector is part of the everyday life of households and businesses, which are coming into contact in some way with the service providers and companies within the sector. Nowadays, in the context of global environmental challenges and sustainability objectives, energy companies are facing - probably - the biggest transformation in their history, in technological terms.

Life in the 21st century is unimaginable without energy and the demand for energy is continuously growing (Gothandam et al., 2018). Energy production has doubled in the last nearly 40 years. However, the contribution of renewable energy sources is only 19%, of which 10.3% is represented by "modern" energy sources such as wind, solar, hydro, geothermal, biofuels, etc. and another 8.9% by conventional biomass (Harangi-Rákos et al., 2017). Two-thirds of conventional biomass (firewood) is used for heating and cooking. The increase in energy production is due to an increase in demand for energy, i.e. the environmental impact of energy production can be substantially reduced by reducing energy demand. According to Holmberg and Erdemir (Holmberg, 2017), in the short term, energy consumption can be reduced mainly in transport and electricity production, while energy consumption in industrial production and households can also be reduced, but to a much lesser extent. Energy demand in the transport sectors could be significantly reduced by decreasing frictional effects. These trends are all shaping the future operation environment of the energy sector.

Accelerating population growth is drawing attention to the depletion of fossil fuels. The ability to use natural resources very cheaply for production, transport or simply to provide a more comfortable lifestyle has contributed greatly to economic growth in recent decades. Productivity also depends on technological progress and capital investment (Harangi-Rákos et al., 2017). The efficiency of energy use also has an impact on technological

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development both in cases of electrical and heat energy as well (Kowalska, 2019a) The energy sector has to face several risks during it operation (Kowalska, 2019b).

There are several trends on the energy market that affecting the economic operation of the energy sector. Demand for electricity has grown rapidly over the past 10 years. Electricity demand will grow by 4.5% in 2021. This is almost five times higher than the decline in 2020, which would raise the share of electricity within final energy demand to over 20%. Almost 80% of the projected demand growth in 2021 is in emerging markets and developing economies, with China alone accounting for half of the global increase. In developed economies, demand remains below 2019 levels (IEA, 2021). Renewable energy demand grew by 3% in 2020 and is set to increase in 2021 across all key sectors - power, heating, industry and transport - by 8% to 8,300 TWh, the largest annual increase in absolute terms (IEA, 2021). In several Central and Eastern European countries, such as in Poland, Czechia or Slovakia, the use of coal was partly replaced by renewable energy sources (Meyer et al., 2021), while in the European Union member states mostly used renewables to replace nuclear energy after the closures of nuclear plants (Magda et al., 2019). In case of the Central and Eastern European countries, the increase in the use of renewable energy sources is crucial, because they mostly import the traditional fossil energy soures while they have a large potential in producing renewable energy sources (Bozsik and Magda, 2018).

Global energy production has doubled in the last 35 years, while the share of renewable energy has increased from 13% to 19%. Within renewables, "modern" renewables (wind, hydro, solar, geothermal, biofuels, etc.) account for 10.3% and conventional biomass for 8.9%. Biomass accounts for just under 9% of final energy consumption (around 60 EJ) (OURWORLDINDATA, 2020). Recently, there has been a growing consensus that the sustainability of a fossil-based society is no longer assured due to the gradual decline and eventual disappearance of the availability of cheap oil. The huge economic growth of recent decades has been largely due to the extreme cheapness of resources for production, transport or a more comfortable lifestyle. The average per capita consumption of the global population continues to rise, and more resources would be needed to feed an unchanging population (Popp et al., 2018). This trend has an impact on the global energy sector as well, because the changing market trends and the changing sources used for energy production are causing a need for the reform of the sector.

Currently, energy companies are under pressure to transform, given the circumstances described above. Enterprises of the sector are driven by factors such as climate change, geopolitical tensions, increasing demand for energy from developing countries, and the increasing cost of renewable energy technologies (Schaeffer, 2015).

The aim of this article is to give a picture of the economic situation and capital structure of energy companies before the major reforms that are still underway today, based on the trends described in the introduction. As part of this, the characteristics of the management of firms involved in the energy industry are described. In the scope of the analysis the focus is specifically on the EU Member States of East-Central Europe.

2. LITERATURE REVIEW

The East-Central European countries were part of the Eastern bloc in the period before the local regime changes, with all the historical consequences that entailed. They were characterised by the dominance of state ownership before the regime change, which of course also affected the energy sector. The lack of state budgetary support and sources often led the governments to sell the state owned companies (Radić et al., 2021). Sutela (1998) argues that privatization in Central and Eastern Europe was aimed at achieving more efficient corporate governance and the separation of politics - i.e. the state itself - from the economy. Mohanty et al. (2010) find that in the Central and Eastern European region, the energy sector, including oil companies, which had previously been state-owned enterprises, underwent extensive privatization in economies that were shifting from a planned to a market economy. It is also typical that fuel company shares are listed in these countries on local stock exchanges established after the regime change. According to Szarzec and Nowara (2017), in the Central and Eastern European area, most of the state-owned companies are originating from the socialist period and operating in the natural resources and energy supply sectors.

In Romania, at the time of the regime change, the energy sector was state-owned, power plants operated with seriously outdated technology, distribution and transmission systems were inefficient, and the capacity of the cross-border pipeline systems was scarce. Recognising the key role of the sector for development, the Romanian government decided to privatise energy companies (Haar and Marinescu, 2011). In Poland, a tripartite division of energy sector companies by function emerged at the time of regime change. In addition to power plants, which produced energy, there were companies operating the high-voltage electricity grid and energy service companies with direct contact with users. Of these companies, the company that operates the high-voltage grid has a natural monopoly, since its role is essential in delivering electricity from the power plants to the users. In the privatisation of the Polish energy sector, the government ultimately favoured the acquisition of ownership by professional investors, while retaining a dominant stake of more than 25% in the companies sold. Privatisation has mainly taken place in power plants and retail distribution utilities, where technological modernisation has also led to increased efficiency in the use of human resources (Dąbrowski and Staniek, 2015). In the case of the Czech Republic, similar processes have taken place in the privatisation of the energy sector, with some local specificities. Indeed, energy production was a key sector in Czechoslovakia before the regime change, as steel and chemical industries had a high energy demand, and the state power created a specific situation by keeping energy prices low and communicating high energy consumption as an unquestionable sign of prosperity. After the change of regime in the Czech Republic, the former state-owned energy company was split into two levels, the first of which, where one company was created, was responsible for power generation and the high-voltage grid, while the second level was for energy companies serving residential and business

needs. Although the first company was also transformed into a listed joint stock company - while the majority of its ownership remained with the state, albeit indirectly - it was in the second level where privatisation took a more prominent role, although the most important change in the ownership structure was again the acquisition of municipal ownership. In the Czech Republic, as in all other countries in the Central-Eastern European region, consumer energy prices lagged behind the cost of production for a long period after the regime change (Kočenda and Čábelka, 1998). Privatisation in Slovakia took a unique form after the regime change. In 1995, the privatisation of several sectors, including energy companies, was removed by the government from the originally planned two-round privatisation process. The privatisation of the priority companies could also be started separately as a result of the adoption of special legislation, which made the privatisation process in Slovakia difficult to understand, even by regional standards. Privatisation in Slovakia finally gained momentum after the change of government in 2000-2001, when a number of state-owned enterprises were privatised alongside state-owned banks. This also required a significant increase in international investor confidence in Slovakia (Zhabianok, 2010), where the risk calculation and evaluation need to pay attention for some special national characteristics (Horváthová et al., 2014). In Hungary, the privatisation of energy companies took place at the end of 1995, raising interesting competition concerns. In this period, mainly companies from Western European EU Member States, also involved in the energy sector, acquired ownership in the privatised Hungarian companies as professional investors. However, some of these Western European companies were themselves at least partly state-owned, raising concerns in Hungary as to whether the separation of state and competition was sufficiently achieved in this form (Török, 1997). Moreover, in Hungary, as a result of a redefinition of the role of government, a number of previously privatised state-owned enterprises were purchased back from private investors between 2010 and 2014 (Mihályi, 2015). Between 1990 and 1996, the European Bank for Reconstruction and Development invested approximately 6 billion USD in foreign companies operating infrastructure systems in Central and Eastern Europe. While the largest share of this was allocated to the development of underdeveloped telecommunications networks, a significant share was also allocated to the electricity and gas sectors. The primary explanation for this was that telecommunications, electricity and road networks were the most underdeveloped in the former Eastern bloc countries (Buzády, 2010).

In Central and Eastern Europe, before the regime changes, gas provider companies were either stand-alone or integrated into fuel provider companies, but were all state-owned. The Eastern Bloc countries were characterised by the integrated operation of some functions of the oil and gas sector, i.e. all functions from pipeline transport, refining and processing to retail or residential distribution were performed by one company. In the countries under study, the pipeline network was very rudimentary, typically not built between countries, with oil and gas flowing only between some of the countries under study and the Soviet Union. The sector was also much less competitive than its Western competitors, the applied technologies were outdated, and the network of retail and residential connections was not only less developed than in Western countries, but also less developed than desirable. Moreover, the price of both natural gas and oil-based fuels was state-regulated, i.e. it did not follow world market trends at all. During the local regime changes, this area of the energy sector also required heavy investment, which could be addressed in two ways: either by direct investment and restructuring to increase the efficiency of the companies' operations and their presence in the domestic market, or by external assistance in the form of acquisitions (Buzády, 2010). In the energy sector, frequent social controversies related to privatisation have emerged, for example, in the case of the Romanian company Petrom, in which the Austrian-based OMV acquired a 51% share in 2004. Disputes over the sale price were still on the agenda years after privatisation, primarily on the grounds that the rising fuel prices would certainly have allowed a higher price to be asked for the share. The sale of the Romanian oil company was also necessary in order for the country to be awarded the status of a functioning market economy by the European Union. However, the fact that Romania did not sell its entire share meant that the state itself benefited from the increase in the value of the company, which, in addition to the rise in oil prices, was due in no small part to the technological innovations introduced following privatisation, the increase in efficiency and the stabilisation of management due to the new ownership structure (Hunya, 2007). Central and Eastern European investors are also sensitive to changes in the investment environment, preferring to invest in companies in which the state is a shareholder, including energy and utilities companies (Bistrova and Lace, 2010).

There are three major theories on the capital structure of companies today, which have been taken into account in the scope of the analysis of the energy sector. The first of these is the Static Tradeoff Theory, which focuses on the potential advantages and disadvantages of the phenomenon whereby a company chooses to issue debt over equity. Firms operating according to this theory target a debt ratio in the belief that achieving this ratio will maximise the value of the firm. Firms operating under the second theory (Pecking Order Theory) prefer to finance their investments with their own funds rather than with external funds. This operating model also determines the capital structure of firms. Finally, the third theory to be mentioned is the Agency Theory, according to which shareholders and debt holders play a role in the formation of the optimal capital structure, since the formation of the optimal capital structure is the result of minimizing the costs arising from the conflict between the two parties (Ghani and Bukhari, 2010).

The causality between energy consumption and GDP growth is one of the most widely studied economic effects. However, as the collection by Lee (2006) shows, the literature is far from consistent as to whether energy consumption increases as a result of higher revenues or whether revenues increase as a result of increased energy consumption. Lee and Chang (2008) further clarified this relationship by showing that, while in the short run there is no relationship between energy consumption and GDP, in the longer run, a decrease in energy consumption leads to a decrease in GDP. The question of the link between the development of the energy sector and economic growth is further complicated by the significant lobbying power of energy companies, in no small part

as a result of the economic circumstances described above, which allows energy companies to exert considerable influence on the development policies and plans of states. As a consequence, the link between the growth of energy companies and improvements in the economic performance of states, even as a result of the allocation of development resources, may be stronger (Apergis and Tang, 2013). However, the study of Paun (2017) on Romanian energy companies showed that financial difficulties can lead to a stalling of investments by firms, and financial difficulties can also lead to a change in market philosophy, with firms questioning the sustainability of market entry. The same study also found that the investments made are often opportunistic and are more often the result of the distorting effect of state aid rather than the longer-term financial performance of enterprise operations. Highlighting the above is important for the present study because the energy sector is one of the fastest growing sectors, whether in terms of its contribution to employment, national income or the global economy today. Therefore, the analysis of listed European companies active in the energy sector is of particular importance. A survey of a sample of such companies shows that there are statistically significant correlations between asset structure, working capital, equity turnover and leverage ratios. Thus, asset structure positively affects the leverage ratio for such firms (Berkman et al., 2016). Analysing energy companies listed on the Bucharest Stock Exchange, Diana et al. (2016) found that for the sampled companies either a significant negative correlation between leverage and performance or no correlation between leverage and performance could be observed, while they also found that the majority of the Romanian energy companies analysed had a markedly low debt ratio, while their financial stability ratio was outstanding. As a consequence of the analysis, the authors concluded that the underlying philosophy behind this operating philosophy of the companies under study is that energy companies rarely need to take risks in their operations and that they are likely to be invested in by economic entities who avoid risk in their investments. This is in line with literature that sees the future of energy companies as secure in the longer term, given the increasing use of energy by humanity. The conscious application of controlling processes also helps to increase efficiency in reducing the risk of corporate activity (Lakatos et al., 2018). In 2020 and after, the different waves of the COVID-19 pandemic caused several economic problems for the energy companies too. The world pandemic caused a break on the dynamic expand of the oil sector with the extremely low prices for a shorter term (Meher et al., 2021). Before the COVID-19 pandemic and economic crisis, Iovino and Migliaccio (2019) found that economic crises do not affect the financial structures of energy suppliers regardless to their geographic area or business market. On the other hand, we need to point out that in many cases the energy companies are state-owned public entities and in this case the better leverage of public funding and support is crucial because the energy efficiency can only be increased by more budgetary support. Energy saving reached by the financial reforms of the energy sector can become good policy instrument in order to boost private investments of the sector (Rohde et al., 2015).

The question arises, however, whether the consumption of energy from renewable sources will have a positive impact on economic growth, in addition to the decline of fossil energy sources. Alper and Oguz (Alper and Oguz, 2016) find that not all countries show a causal relationship between renewable energy consumption and economic growth, but where such a relationship can be identified, a significant positive effect was found in the relationship between the two. Hence, with the foreseeable changes in the energy sector, the relationship between energy consumption and economic growth will continue to be detectable. However, Esen and Bayrak (2017) also warns that the stimulus effect of energy consumption on economic growth decreases as the income level of a country rises. In practice, this shows that energy consumption can have little incentive effect on the level of development of a national economy after a certain period of time. It should also be pointed out that the efficient use of energy is at least as important for economic growth as energy consumption itself. Blokhuis, et al. (2012), examining the operation of Dutch local energy companies, also draw differentiated conclusions according to the energy production method used by the companies. They found that the economic performance of district heating companies is mainly influenced by the price at which they can sell district heating energy. This is highly dependent on the cost of production, but the profit margin was typically the same regardless of the selling price. The research also found that the lower cost of network deployment meant that district heating companies that served only a few larger blocks were able to operate with the best economic results. For wind power generation companies, it was found that returns are almost completely independent of external conditions - market and natural - as there are significant EU and national subsidies to encourage the exploitation of sustainable energy sources. Finally, for biomass-based energy companies, it can be concluded that the profits that can be achieved depend significantly on the availability of the feedstock used at no cost. In the Netherlands, only energy production companies based on the fermentation process have free access to biomass, which significantly improves the profitability of their operations.

The ROE indicator plays an important role in assessing the efficiency of different types of investments (Tömöri et al., 2021). Tailab (2014), examining the operations of energy companies in the United States, concludes that the total debt of such firms has a significant negative impact on both their ROE (return on equity) and ROA (return on assets). In comparison, the size of sales had an impact only on the ROE of the firms studied, but this can be characterised as a significant negative effect. Short-term debt, on the other hand, had a significant positive effect on the ROE of the firms under study. However, it can also be concluded that there is an insignificant correlation between long-term debt, equity debt and firm size, when viewed from the perspective of total assets and profitability. Examining ROE and debt/equity ratio, it was found that the correlation is positive but not very strong for energy firms (Herciu and Ogrean, 2017). Eyüboglu and Çelik (2016) investigated the operations of Turkish energy companies, thus analyzing firms operating in a different economic environment compared to the US. This is of particular relevance because the annual growth rate of energy consumption in Turkey of 6-8% is about 3-4 times higher than the 2% growth rate in developed countries - and this obviously has an impact on the financial results of the energy companies studied. The analysis carried out shows

that the most important factors in assessing the performance of Turkish energy companies, as a developing economy gradually opening up from agriculture to industry and services, are liquidity and profitability, followed by financial leverage and activity ratio.

Chakrabarti and Chakrabarti (2019) analysed the operations of Indian energy companies and found that the capital structure of the firms concerned was significantly determined by the age, liquidity, size and asset turnover ratio of the firms. However, it was not found that profitability, debt servicing capacity, non-debt tax shield, increase in sales ratio or tangibility factor had a significant impact on the capital structure of energy firms in India. There has also been a change in the operations of Indian energy firms, as historically profitability has been significantly negatively correlated to debt ratios, but the existence of this relationship has not been confirmed by more recent studies. In case of Pakistani companies, Akhtar, et al. (2012) realized that the companies which have a higher level of profitability, those can improve their financial performance if they can have a higher level of financial leverage. That means the financial leverage is positively associated with the better financial performance.

In their study, Feng, et al. (2018) identified new features related to the operations of companies involved in the energy sector, which allow for a new perspective on the analysis of the operations of the firms involved. By analysing the operations of Chinese energy firms, the study showed that there is a correlation between CSR (corporate social responsibility) and sustainable financial development, which can be explored mainly by considering the moderating effect of ownership structure. Accordingly, CSR has a positive impact on both short- and long-term economic performance and, as a result, contributes to sustainable financial development. In addition, it was also found for Chinese energy firms that changes in ownership structure are positively related to economic performance in the short run, i.e. as changes in ownership intensify, the short-term profitability of the firms under study increases. However, it can be concluded that the impact of CSR on short-term economic performance can be moderated by ownership structure. If the ownership of the firms concerned is concentrated in an overly concentrated group, the owners may take decisions that do not serve the interests of all key players. This process limits the positive impact of CSR on economic performance. In a study by Csedő, et al. (2018), analysing the governance structure of energy companies, they found that certain changes are needed as a result of the changes and challenges faced by companies in the sector. In the context of the need for innovation in the operation of firms, the achievement of objectives can be hampered by the emergence of external and internal barriers, as well as a lack of knowledge and experience. Where energy companies are setting up new organisational structures, for example a company exploiting conventional energy sources is opening up to the use of renewable energy sources, it is advisable to do so in a form separate from the parent company.

3. MATERIALS AND METHODS

We use a standard fixed-effect panel regression model (FE) to analyze the capital structure of the energy industry companies. Since these models are standard in the econometric and the capital structure literature, we provide here a detailed description of the methods based on Wooldridge (2010). The reason we used this model is that in most cases, several potential predictors are missing from the model, either because we are not able to observe the variable or simply, we don't have access to it. This is the so called unobserved heterogeneity and it causes omitted variable bias in the model. For example, in case of energy industry companies, the location of the company, the leadership management, the product scale or the individual differences in skills or preferences etc. could affect the operation of the company. We assume that this unobserved heterogeneity may differ between units, but constant within units, thus we call these as firm-specific fixed effects. The variation in the data could be attributed to the variation between units (i.e. firms) and to the variation within units. We choose the FE model, since it can control for heterogeneity bias by considering the within unit variation only (Wooldridge, 2010).

We estimated the following specification (illustrated with one explanatory variable):

Steps of the data analysis:

- Selection of variables: we choose the variables included in capital structure regressions according to the literature, see for example Cassar and Holmes (2003), Reinartz and Schmid (2016), Hang et al. (2018), Li and Islam (2019). Besides that, we required the total assets and the owners' equity of the firms to be greater than 0 and the total operating revenue to be greater than 10 thousand euro (in current terms). The 10 thousand euro threshold was arbitrarily chosen, we aimed to exclude the small companies from the list since many cases, they were missing data or were engaged in marginally related activities.
- Selection of years: we had access to the years 2017-2020, where we excluded the last year (2020), since it was incomplete yet (for example, it contained only one company in case of Hungary).
- Transformation of the variables: After calculating the financial ratios, we winsorized the ratios at the 2.5% and the 97.5% level, except the size of the firms. Size was measured as the natural log of total assets, as usually can be found in the literature. Furthermore, the asset structure and the liquidity ratio took positive values after the Winsorization, thus we were able to use the logarithmic transformation on these variables as well. We used the natural log transformation where it was possible, since usually the regression is much more "well-behaved" after the transformation, and more importantly, log transformation may help to facilitate the linearity among the variables.
- Calculation of the fixed-effect model on the cleaned and prepared dataset.
- Missing data imputation: Impute the missing data values by the multiple imputation method of Honaker and King (2010). We used m = 5, where m was the number of imputed dataset (the default value in the package).
- After the data imputation, we run the fixed-effect model on the imputed datasets (which resulted in m = 5 different estimation per country) and we combined these estimates according to Rubin's rule [55].

3.1. Variables

We used the following variables in the model, based on the company database called EMIS (2022):

Leverage: Leverage was defined as the total liabilities divided by the total assets.

Leverage = (Total liabilities)/(total assets)

asset structure: we defined the fixed assets over total assets as the proxy to analyze the effect of asset structure. After Winsorization, we used the natural log transformation. We assumed that higher fixed assets over total assets ratio implied higher leverage, since fixed assets could be used as collateral and represents lower risk for creditors resulting in a positive relationship between fixed assets and leverage.

Asset structure= (Fixed assets)/(total assets)

Size: Size was measured by the natural log of total assets. We expect the coefficient of size variable to be positive, which means that larger companies have easier access to outside finance. Large firms are less likely to face financial distress (Li –Islam, 2019). [54], furthermore, the Pecking Order Theory predicts a positive relationship as well (Hang et al., 2018).

Size = log(total assets)

Growth possibilities: the growth possibilities of the firms was measured by the net sales trend in percentages. It was a pre-defined variable in the database. We assumed that fast-growing companies find it more difficult to finance their growth and therefore have to resort to loans. Based on the empirical results and the Pecking Order Theory, we expected a positive relationship between leverage and the growth of the company (Hang et al., 2018).

profitability: profitability was measured by the return on assets (ROA). It was a pre-defined variable in the database. In this case, we built on the so-called Pecking Order Theory developed by Myers (1984) and Myers and Majluf (1984), furthermore the already existing, empirically supported results to form our assumptions. However, we do not rely on a single theory, since according to Hang et al. (2018), determinants of capital structure do not seem to follow one single theory. Possibly one of the most important conclusion of the Pecking Order Theory states that firms prefer internal finance to external finance. It states that more profitable firms borrow less, thus, a negative relationship between profitability and leverage can be expected. More profitable firms have more internal resources to finance growth (Myers, 2001). We expect a negative relationship between profitability and leverage, furthermore, the negative relationship between profitability and leverage is generally a very robust finding in the literature. Profitability is usually defined by ROA or a similar measurement in the literature.

ROA= (net income)/(total assets)

liquidity ratio: It was a pre-defined variable in the database. After Winsorization, we used the natural log transformation. As in case of profitability, we expect a negative relationship between liquidity and leverage.

Liquidity ratio= (current assets)/(total liabilities)

3.2. Database

Only those companies were included in the analysis that fell into the "Energy" category under the Industry (EMIS 14) classification (EMIS, 2022). Some of the companies were included in more than one category because of the diversified scope of their activities. In the absence of further information, it was not possible to identify the exact nature of the activity within the "Energy" classification, so enterprises with diversified activities were included in the analysis as well. Excluding them would have led to the violation of EMIS classification, which would probably have led to a bias in the estimate.

4. RESULTS AND DISCUSSION

The number of firms were more or less proportional to the size of the countries. However, large differences could be observed from year to year in some cases. On average, there were 613 and 520 companies registered in Czechia in 2017 and 2018, which has decreased to 348 in 2019. In Hungary, the same number was more stable, but decreasing as well from 786 in 2017 to 727 in 2019. Poland had the greatest number of companies. In 2017, the number of firms registered in the energy sector was 1666, which increased to 2390 in 2018 and 2348 in 2019. Romania had 1202 companies, which number has decreased moderately to 1136. Finally, there was 250 companies in Slovakia in 2017, which number has decreased as well to 240 in 2019. Overall, the number of companies indicate an increase in concentration, even with a short sample in terms of financial years (Table 1).

We calculated the so-called γ and ν parameters by Ahrens and Pincus (1981) to measure the balancedness of the dataset. With a balanced dataset, every unit (i.e. firms) have the same number of time period observed. After the data cleaning and preprocessing, the panel datasets had γ and ν parameters close to 0.9 in most cases. Czechia and Poland had slightly lower values due to the lower number of firms in 2019 and 2017, respectively. Overall, the different datasets had moderate or even less unbalancedness only, which could be easily handled by the econometric procedures (Table 2).

We consider the fixed-effect model to be suitable for our analysis, however we tested the difference between the random-effect and the fixed-effect model by the test of Hausman (1978), which is a

Table 1: Number of companies in the sample by years

	CZE	HUN	POL	ROM	SLO
2017	613	786	1666	1202	250
2018	520	769	2390	1151	252
2019	348	727	2348	1136	240

The number of firms corresponds to the analyzed sample properties, where we required the total assets and registered capital values to be greater than 0 and the total operating revenue to be greater than 10 thousand euro (in current terms). In Hungary, one company, while in Poland, two companies were excluded in addition. Source: Own calculation based on EMIS [56]

standard procedure. In all cases, the test indicated that the fixed-effect model is suitable over the random-effect model (Table 3).

The capital structure regression gave similar results in terms of parameter sign, while the firm size, profitability (ROA) and liquidity ratio have significant coefficients in all cases. Asset structure denoted the fixed assets over total assets. According to the literature, fixed assets can be used as collateral, which would imply that the higher share of fixed assets is associated with higher leverage. However, asset structure had negative relationship with leverage in Hungary and Romania, where the estimated parameters were significant. This was in contrast to the findings of (Hang et al., 2018) for example, who found that asset tangibility was positively associated with leverage. The growth of the company could be associated with higher leverage, since fast growing companies need external sources to finance their growth. This was justified in case of Czechia and Romania only. This implied that growth possibilities were associated with higher leverage of firms in the sample. We have to remark, that net sales trend is only a crude proxy for growth possibilities and other variables may results in different relationships. Size had an overall positive relationship with leverage in every countries.

According to the estimates, larges companies have higher share of leverage and may have easier access to external financing sources. The profitability of the firms (captured by ROA) and leverage had a negative relationship, thus profitable firms were less likely to rely on external finance. The negative association between profitability and leverage and the positive association between size and leverage were a very robust finding of the capital structure literature (Cassar and Holmes, 2003, Hang et al., 2018, Islam and Firm, 2019, Adair and Adaskou, 2015). This result supports the pecking order theory developed by Myers (1984) and Myers and Majluf (1984). The same sign was observed for the liquidity ratio as well, thus higher liquidity ratio implied less leveraged firms. The (within) R2 was between 20 and 55%, which can be considered good in case of capital structure regressions. We used clustered robust standard errors to overcome the problem of non-constant error variance and within-panel autocorrelation in the idiosyncratic error term.

Missing data was present in every datasets, the asset structure and the net sales trend were particularly affected by the presence of missing data. We used the Amelia algorithm by Honaker and King (2010) to impute the missing data. The number of imputation were m=5 by countries, where we estimated the fixed-effect models on each of the imputed dataset, then we combined the estimates into one single parameter. The relationship between leverage and the company size, profitability and liquidity ratio remained similar to what was previously detected in Table 4. However, asset structure was only significant for Poland, while net sales trend became a significant factor for Hungary as well. Asset structure and net sales trend had generally the highest shares of missing values recorded. The share of asset structure missing values were between 30 and 40% in case of Poland and Czechia, while 10-25% of net sales trend were missing as well (in other cases, the share of missing values were moderate, under 10% or even less). Only Poland and Czechia were seriously affected by the presence of missing values, so results should be treated accordingly. Furthermore, Li and Islam [54] also observed the mixed results in the literature for asset structure. The coefficients of net sales trend as a proxy for growth were mostly positive. In the literature, Cassar and Holmes (2003) and Adair and Adaskou (2015) obtained for example similar results. The energy industry is often associated with higher share of technological development, especially with the increasing pressure of climate change actions. This may explain the positive association of net sales trend with leverage, since fast-growing companies may need to rely on external financing

Table 2: The gamma (γ) and nu (ν) parameters as measures of panel balancedness

	CZE	HUN	POL	ROM	SLO
γ	0.78	0.93	0.84	0.89	0.91
ν	0.82	0.96	0.89	0.95	0.96

The parameters γ and ν are between 0 and 1. The closer they are to 0, the less balanced the panel data is. Source: Own calculation

Table 3: The results of the Hausman test

	CZE	HUN	POL	ROM	SLO
χ^2	63.91	416.07	265.05	374.91	86.67
df	5	5	5	5	5
P-value	0.00	0.00	0.00	0.00	0.00

df: Degrees of freedom. Source: Own calculation

Table 4: Fixed-effect capital structure regression for the V4 countries and Romania

Predictors	CZE	HUN	POL	rOM	SLO
	Estimates	Estimates	Estimates	Estimates	Estimates
Asset structure	0.013	−0.014*	−0.005	−0.015+	0.036
	(0.021)	(0.006)	(0.012)	(0.008)	(0.022)
Net sales trend	0.014*	0.001	0.000	0.002*	−0.002
	(0.005)	(0.001)	(0.001)	(0.001)	(0.003)
Size	0.211**	0.157***	0.200***	0.150***	0.162**
	(0.064)	(0.016)	(0.036)	(0.022)	(0.055)
ROA	−0.764***	−0.367***	−0.287***	−0.385***	−0.367*
	(0.171)	(0.049)	(0.054)	(0.037)	(0.162)
Liquidity ratio	−0.053**	−0.128***	−0.088***	−0.103***	−0.054*
	(0.017)	(0.010)	(0.018)	(0.010)	(0.023)
Observations	901	2189	2731	3334	676
R2 (within)	0.23	0.54	0.37	0.37	0.22
AIC	−2376.61	−6337.26	−8686.35	−7647.67	−1437.01

Clustered robust standard errors under the estimates. Stars: + P<0.10, *P<0.05, **P<0.01, ***P<0.001. In these models, missing values were dropped from the estimation.

Source: Own calculation

Table 5: Fixed-effect capital structure regression for the V4 countries and Romania on imputed datasets

Predictors	CZE	HUN	POL	ROM	SLO
	Estimates	Estimates	Estimates	Estimates	Estimates
Asset structure	0.000	−0.011	−0.024***	−0.012	0.009
	(0.009)	(0.007)	(0.007)	(0.007)	(0.012)
Net sales trend	0.014***	0.002+	0.002	0.002*	−0.002
	(0.005)	(0.001)	(0.001)	(0.001)	(0.003)
Size	0.177***	0.126***	0.104**	0.126***	0.169***
	(0.005)	(0.019)	(0.019)	(0.020)	(0.040)
ROA	−0.623**	−0.368***	−0.186***	−0.352***	−0.317*
	(0.192)	(0.052)	(0.060)	(0.038)	(0.143)
Liquidity ratio	−0.088***	−0.138***	−0.131**	−0.109***	−0.078***
	(0.022)	(0.011)	(0.012)	(0.010)	(0.023)
Observations	1481	2282	6404	3489	742
R2 (within)	0.231	0.519	0.168	0.374	0.267

Clustered robust standard errors under the estimates. Stars: + P<0.10, *P<0.05, **P<0.01, ***P<0.001. In these models, missing values were imputed by the Amelia algorithm.
Source: Own calculation

in these cases. The energy industry is a strategically important sector, as energy supply has not only an economic but also a political dimension. Therefore, it can be assumed that large and fast-growing enterprises will be given a prominent role in this field, which often involves external financing or support (Table 5).

4.1. Possible Future Developments

In the future, similar research could be improved by testing the robustness of variables. Many of the divergent result in capital structure theory partly from the wide selection of variables (Hang et al., 2018). Furthermore, financial ratios often suffers from large, extreme values. Winsorization partly solves the problem, but robust methods may provide new insight to the development of capital structure. This can be supported by alternative data transformation (however, these transformation may increase the difficulty of interpreting the relationships). Furthermore, industry specific effect may determine the capital structure as well (see for example, Li and Islam (2019), but these factor are excluded from the fixed effect model due to their time-invariant nature. It is also advised to distinguish between short-term and long-term debt, if possible (Cassar and Holmes, 2003).

5. CONCLUSION

The aim of the article was to analyze the economic situation of energy companies in Central and Easter Europe. In the literature review we underlined how important the energy is for the economic and technical development, and more: how important the energy is for the everyday operation of all the economic sectors. We also paid attention for the ownership relations of the energy companies in Central and Eastern Europe, where – after the changes of the political regimes – the private ownership became dominant while before the 1990-es the states owned all the parts of the energy sector. We also stated how important the fiscal resources are for the energy sector: it needs enough resources even for regular operation, while the modernization and the development of the sector have more need for fiscal sources. In the literature review part we also analysed the different fiscal aspects of company operations with special regards to the energy sector. We also tried to focus more on the Central and Eastern European region with its specialities.

In our primary analysis we used a standard fixed-effect panel regression model (FE) to analyze the capital structure of the energy industry companies. With the completion of the analysis we found that, according to the literature, fixed assets can be used as collateral, which would imply that the higher share of fixed assets is associated with higher leverage. However, asset structure had negative relationship with leverage in Hungary and Romania, where the estimated parameters were significant. The growth of the company could be associated with higher leverage, since fast growing companies need external sources to finance their growth. This was justified in case of Czechia and Romania only.

The capital structure regression gave similar results in terms of parameter sign, while the firm size, profitability (ROA) and liquidity ratio have significant coefficients in all cases. Asset structure denoted the fixed assets over total assets. According to the literature, fixed assets can be used as collateral, which would imply that the higher share of fixed assets is associated with higher leverage. However, asset structure had negative relationship with leverage in Hungary and Romania, where the estimated parameters were significant.

We also found that larger companies have higher share of leverage and may have easier access to external financing sources. The profitability of the firms (captured by ROA) and leverage had a negative relationship, thus profitable firms were less likely to rely on external finance.

As a final conclusion we also would like to underline the importance of all the research dealing with topics related to the energy sector, the energy industry. The global need for energy is continuously increasing as the global population is growing and as the global industrial, service, and agricultural sectors both need more energy for their operation. The energy sources used for energy production are also continuously changing: the renewable energy sources can have a more important share while the traditional fossil energy sources are losing positions on the global energy market. In the European Union the renewable energy sources are mostly used to replace nuclear energy, while in Central and Eastern Europe the renewable energy sources mostly replace coal. This trend can also cause a debate on the role of the nuclear energy in the European Union, but this debate is more extended and complicated than to be

summarized in a few sentences. The energy sector is in the focus of international, or global debates. The states have to decline the emission related to the energy production, otherwise the global warming will become more intensive in the near future. The global warming and its ecological effect have an impact on the economic and fiscal operation of energy companies too. As most of the energy companies in Central and Eastern Europe are still state-owned companies (mostly with a historical background originates from the socialist era), the potential for using the budgetary sources in an effective way is crucial.

The scientific, social and political debates mostly paying attention for the different energy production methods. Pros and cons also appear during the debates and we only know that countries should increase the share of renewables. But shifting to modern and more developed technologies in energy production needs more and more fiscal resources. This is the most important reason for the intensive need of economic analyses of energy companies.

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