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Article

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Case Study in the Transport Sector

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THE ANALYSIS OF THE IMPACT OF ENERGY AND ENVIRONMENTAL POLICIES OF THE EUROPEAN UNION ON THE ECONOMIC PERFORMANCE OF COMPANIES. CASE STUDY IN THE TRANSPORT SECTOR

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Abstract

The macroeconomic reason and objectives, in a normative framework, reside to a large extent in the support, catalysis, and efficiency of activities at the microeconomic level, the gear through which they are built. Responsible behaviour at the macro and microeconomic level involves the dynamic revelation of dysfunctions and conflicts, generated within each sphere, in their relationship, as well as in the involved normative framework, in order to establish effective mechanisms for balance and development. The purpose of this approach is to analyse the micro-macroeconomic convergence from the perspective of the link between economic performance and energy consumption from the point of view of ensuring the necessary resources and the efficiency of their use, with impact on the environment. The study covers the transport sector at the level of the member countries of the European Union in the period 2011-2020, the collected data being processed with the regression method. The growth in energy efficiency and energy dependence are, against the background of the increase in the volume of activity, factors that lead to an increase in the gross operating rate. From the analysis, it emerges that the use of renewable energy to a greater extent, as a result of sustainable development, does not constitute a significant factor for improving the economic performance of companies in the transport sector. The contributions of the two-dimensional approach conducted consist of mediating the conflict between the objectives of economic profitability and the environmental constraints, targeting both the microeconomic level, through the analysis of the gross operating rate in correlation with energy consumption and CO₂ emissions, as well as the macroeconomic level, constituting a benchmark in policies substantiation.

Keywords: gross operating rate, energy efficiency, energy dependence, renewable energy, CO₂ emissions.

JEL Classification: E21, M21, O52, Q43, R49.

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Introduction

The concerns of the European Union regarding the energy policy at the level of the member states for the period 2020-2030 have materialised in the elaboration of Directives (EU): 2018/2001 on the transition to the use of energy from renewable sources and 2018/2002 on energy efficiency, as well as Regulation (EU) 2018/1999 on the governance of the energy union and climate actions. All these provisions are components of the package of rules "Clean energy for all Europeans" and take into account compliance with the 2015 Paris Agreement on climate change, as well as the European Union's climate and energy policies for the period 2020-2030.

Directive (EU) 2018/2001 establishes common rules, in order to support the use of renewable energy, also applicable in the transport sector. As a mandatory objective for the year 2030, at the level of this sector, is the use of a 14% share of energy from renewable sources and as a secondary objective - the use of advanced biofuels in a proportion of 3.5%, under the conditions of a mandatory global objective of 32%. A new directive proposed in July 2021, COM(2021)0557, envisages increasing the global target for energy from renewable sources to 40% by 2030. In the same period, the fifth energy package "Achieving the objectives of the European Green Pact" was published, aiming to harmonise the energy objectives with the European desire according to which, by 2050, the countries of the European Union should become neutral in terms of CO₂ emissions. This package pays attention to air and sea transport, as well as renewable energy sources, energy efficiency, energy taxation, and buildings. Following the invasion of Ukraine by Russia, a new amendment modifying the revised Energy Efficiency Directive was proposed through the REPowerEU plan in May 2022, increasing the mandatory target for the share of energy from renewable sources in the EU's energy mix to 45% by 2030.

In 2004, the International Energy Agency (IEA) defined renewable energy as "energy that is derived from natural processes that are constantly renewed (solar, wind, biomass, geothermal, hydropower, oceanic resources - sea and waves) and biofuels, electricity and hydrogen derived from those renewable resources".

Sustainable development is a topic of worldwide interest, with the United Nations summarising the main objectives in a set of goals to be achieved by the international community in the future, also assumed at the level of the European Union. According to goal 7: Clean and affordable energy (SDG7), until 2030, the intensification of the use of renewable energy is promoted to increase its share in the global energy mix. For the best possible return of all countries after the COVID-19 pandemic, as well as to ensure the continuity and development of all economic and social activities, at the community level, during the crisis period generated by the Russian-Ukrainian military conflict, energy, as well as access to energy, sustainable and easy, in the long-term play a significant role. One of the main directives in the field of environmental protection is the reduction of CO₂ emissions. Goal 9: Industry, Innovation, and Infrastructure (SDG9) identifies the role of introducing technical progress and international collaborations in the field of clean energy research and renewable energy, in terms of energy efficiency.

The concerns regarding the study of the impact of the energy policy of the European Union on the companies and economies of the member countries aimed at a diverse issue: the role of renewable energy on international relations, the energy revolution through the use of new technologies with a high degree of energy efficiency, the evaluation of economic

development performances within the field of transport from a sustainable perspective, the cause-effect relationship that can be established between economic growth and sustainable energy consumption, the link between corporate responsibility and the role of the bioeconomy in the intelligent use of renewable energy sources.

Transport represents an important sector of activity, both by participating in the generation of the gross domestic product and as a result of the large number of jobs created. Global competition in this field is a permanent challenge for companies in Europe, with sustained concerns about the implementation of efficient and qualitative transport systems adapted to the new sustainable development measures. The current context, characterised by the global energy crisis, is circumscribed by the economic recovery after the period of the COVID-19 pandemic, under the conditions of the Russian military invasion of Ukraine in February 2022. The transport sector was affected both as a result of the increase in the price of fuels due to the rise in oil price at a level higher than in 2008, as well as as a result of the pressure created by the measures proposed at the EU level regarding the countering of the energy crisis. Given the importance of logistics in the economy, the adverse effects of this sector have spread in synergistic processes throughout the entire economic system. Higher transport costs are reflected in the increased prices of goods transported, affecting beneficiary industries, employment, and the purchasing power of the population. With the reduction of sea and road transport routes, the closure of the airspace over Ukraine, and the avoidance of Russian airspace, transport rates are increasing. Strengthening European economic resilience requires the cooperation of national governments in order to prevent social problems and the deepening of the global economic crisis.

The purpose of this study is to analyse the micro-macroeconomic convergence in terms of economic performance under the influence of the energy issue. Considering the two-dimensionality of the approach, the contributions of the paper can be found both at the microeconomic and at the macroeconomic level. First, this study constitutes an innovation in economic performance research, addressing the connection between the gross exploitation rate and the indicators that characterise the entities' internal and external environment from an energetic point of view. Thus, the main measures that can be implemented at the microeconomic level regarding energy consumption are defined, both from the perspective of ensuring the necessary resources and the efficiency of their use, in order to increase performance. Second, the study finds its applicability in the substantiation of macroeconomic policies, being relevant for the assessment of energy efficiency and, respectively, the impact on the environment. Thirdly, benchmarks are provided in order to reduce the conflict between the requirements for a greener world and energy saving, on the one hand, and the behaviour of economic entities circumscribed by the objective of profitability, on the other hand, increasing the interest of decision-makers in assuming a proactive role in energy conservation and emission reduction.

In the following sections, the review of the literature is carried out, formulating the hypotheses that will be tested. The research methodology, empirical results, and their discussions, conclusions, and future research directions are presented below.

1. Literature review

In order to identify the main concerns in the energy field within the European Union, a text analysis was carried out. The source of the scientific publications included in the analysis

was the Web of Science academic platform, accessed on November 10, 2022. Taking into account the topic addressed, the following keywords were considered relevant: "energy European Union". 8,420 articles were identified. The data was processed using the VOSviewer program, using the binary counting method, considering a minimum number of 10 occurrences of a term. Of the 135,634 terms, 3,869 met the threshold. For each term, the relevance score was calculated, selecting the most relevant terms (2,321). Complementarily, a keyword co-occurrence was analysed, considering a minimum number of two occurrences of each keyword. Of the 23,304 keywords, 1,863 reached the set threshold. The key words between which the strongest links were determined and thus the following areas of interest at the level of the European Union were identified: energy, renewable energy, energy efficiency, CO₂ emissions, economic growth, and energy consumption.

In the study on renewable energy and economic performance in the context of the European Green Pact, Simionescu et al. (2020) explained the causal relationship between economic growth and renewable energy consumption, evaluating the link between gross domestic product and renewable energy consumption, as well as the global competitiveness index, as a measure of competitiveness, and renewable energy consumption. Given that the development of European states contributes to the increased use of renewable energy with consequences on improving energy security and sustainable economic growth, narrowing the scope of research to the field of transport, we set out to study the impact of the use of renewable resources on performance. Dominković et al. (2018) assessed the main alternatives to current fossil fuel systems and quantified their potential, in order to determine the resources needed to transition to a fully renewable transport sector. The continuously growing energy demand of this sector, representing about a third of the total energy demand at the level of the European Union, the possibility of using different renewable resources to replace existing sources, were the premises of our study in order to identify the relationship with the economic performance in the field transports. Overland (2015) defined geopolitics as that intense competition for access to strategic locations and natural resources, to later (2019) consider it as that deterministic causal relationship between geography and international relations, focused on permanent rivalry, territorial expansion, and strategies military of the imperial powers. Geopolitics and renewable resources were analysed in parallel by Vakulchuk et al. (2020), highlighting the impact of renewable energy on international relations.

The prevailing economic growth model in today's society generates negative externalities in the environment, especially through high CO₂ emissions (Zafar et al., 2021). The profound changes in society and the world economy, generated by the expansion of international trade and investments, on the one hand, and cultural exchanges, on the other, accelerate the rate of growth, noticing a significant positive statistical link between globalisation and CO₂ emissions, as well as between GDP growth and CO₂ emissions (Xia et al., 2022). Adebayo et al. (2021), starting from the United Nations Sustainable Development Goals (SDG7) and (SDG9), study the relationship between urbanisation, CO₂ emissions, capital formation, energy use, and economic growth in South Korea, for the period 1965-2019, revealing the existence of a one-way causal relationship between CO₂ emissions – energy consumption – economic growth, which leads to major implications for macroeconomic indicators in South Korea. Recent concerns of researchers in Asia also existed at the level of Thailand, for the period 1971-2018. Adebayo and Akinsola (2021) identified the positive correlation between GDP growth and CO₂ emissions. Waheed et al. (2019) carried out an analysis regarding the reflection in the literature of the issue concerning CO₂ emissions – energy consumption –

economic growth, following the methodologies used, the approach from a geographical point of view - at the level of a single country or multi-state studies, the existing correlation by types of states classified in terms of their development. The conclusion of the study highlights the importance of using renewable energy sources for different fields of activity, including transport. The sustainable development of society involves large-scale sustainable energy systems that ensure the reduction of CO₂ emissions, with the mention of the need to replace oil in the transport sector and to ensure a supply-demand balance regarding renewable energy resources with fluctuating production (Lund and Kempton, 2008).

Environmental performance is significantly associated with economic performance (Al-Tuwaijri et al., 2004). Firms that reduce polluting emissions improve their economic performance by increasing demand and productivity (Nishitani et al., 2011). Georgiou (2015) carried out an econometric study covering the period 2000-2012, for a number of 18 states, joining some European countries, Japan and the USA, demonstrating that energy (oil) dependence does not have an unfavourable influence on economic growth.

Improving energy efficiency is a strategic objective given its potential to save money, enhance environmental quality, and reduce the foreign trade deficit (Hirst and Brown, 1990). Circumscribed to the sustainable behaviour of companies, energy efficiency is a significant factor in ensuring future competitiveness (Moreno et al., 2014; Drake and Spinler, 2013). Ensuring the competitiveness of an economic entity implies an improvement in the efficiency of the use of the resources involved (Gopalakrishnan et al., 2001). For intensive-energy companies, reducing energy consumption and increasing energy efficiency generates a growth in financial performance (Fan et al., 2017). Considering the fact that transport constitutes the sector with the highest energy consumption (EUROSTAT; Bel and Joseph, 2018), as well as its share in the total consumption of companies in the transport sector, any increase in energy efficiency will generate a decrease in costs, ensuring competitiveness and profit. In the study carried out by Feng and Wang (2018), it was highlighted that the energy efficiency in the transport sector in China decreased, the positive effect generated by technological progress did not compensate for the unfavourable impact induced by the decrease in management efficiency and the expansion of the regional technological gap in energy efficiency. There is a gap between actual and potential energy efficiency in energy consumption (Jaffe and Stavins, 1994). Industrial companies do not always implement energy efficiency management, even if they are profitable (Andersson et al., 2018). This is explained by the existence of structural and market barriers that inhibit the adoption of measures to make energy consumption and costs more efficient. Structural barriers are represented by fuel price distortions, uncertainty about future fuel prices, limited access to capital, government fiscal and regulatory policies, and insufficient development of supply infrastructure. Behavioural barriers aim at attitudes towards energy efficiency, the risk related to investments in increasing energy efficiency, and the lack of information and incentives (Hirst and Brown, 1990). Regarding the impact of energy efficiency on the result indicators at the level of the national economy, studies in the field have highlighted the existence of a unidirectional causality from GNP/GDP to energy (Kraft and Kraft, 1978; Xia et al., 2022).

Identifying the paradox of energy, Jevons (1865) claimed that a growth in energy efficiency increases consumption, the viable solution to environmental problems not being a higher efficiency, but a decrease in consumption.

The Joint Research Centre proposed a set of tools for evaluating the measures taken in order to implement the main provisions of the EU policy in the transport sector, considering aspects

related to increasing the efficiency of the transport system (through the technical-economic analysis of emerging technologies, the analysis of the impact on transport demand, costs, emissions, congestion, accessibility and economic impact), strengthening the competitiveness of European industry, innovation in transport and reducing CO₂ emissions and other externalities.

In the academic literature, the studies that investigate the macro-microeconomic determinisms from the perspective of the impact of the implementation of the energy strategy on the performance of the companies reveal complex aspects with multiple incidences. There is a direct two-way relationship between financial performance and sustainable development measures. The application of sustainability measures can contribute to increasing performance, but cannot be applied or implemented with reluctance depending on the financial situation of the companies (Madaleno and Vieira, 2020). Hojnik and Ruzzier (2016) highlighted that the eco-innovation of processes, through technological and non-technological solutions to reduce the costs of materials and energy, ensures the increase of companies' performance in terms of growth, profitability, and competitive advantage. Improving energy efficiency and decoupling the use of resources from economic growth are solutions through which small and medium-sized enterprises can increase their productivity and competitiveness, generating growth (Özbuğday et al., 2020). The implementation of the energy policies generates behavioural changes in the economic environment, with direct implications on financial performance being observed at the enterprise level. In the case of companies operating in high energy-consuming industries, the strict application of the provisions of the energy strategy causes an increase in financial expenses, a slowdown in the speed of rotation of stocks and receivables, affecting financial performance (Liu et al., 2021). Different measures considered at the macroeconomic level in the energy field did not have the intended effect at the microeconomic level. Thus, the EU emissions regulations, through the EU Emissions Trading Scheme, initially did not have a significant impact on companies' performance and employment (Anger and Oberndorfer, 2008).

Considering the aspects found in the literature as well as our own expectations, the following hypotheses will be tested:

- H1: Energy efficiency generates an increase in the economic performance of companies in the transport sector;
- H2: There is a positive, statistically significant link between energy dependence and economic performance;
- H3: Increasing the degree of use of renewable energy is a potential source of improving the economic performance of companies in the transport sector;
- H4: There is a positive link between economic performance and CO₂ emissions.

2. Research methodology

The analysis of the micro-macroeconomic convergence from the perspective of the energy issue, with impact on the environment, at the level of the transport sector, corresponding to the specific problems identified, is carried out on the basis of the following variables considered relevant (Table no. 1):

Table no. 1. Description of variables

Variables	Abreviation	Significance
gross operating rate	GOR	the profitability indicator that highlights the share of the gross operating surplus in the turnover. The gross operating surplus is generated by the operating activities being adjusted with the remuneration of the labour factor. The turnover represents the total of services provided (without VAT) in the considered period
turnover	CA	reference of the activity carried out
share of renewable energy in gross final energy consumption	PEngReg	the indicator measures the share of renewable energy consumption in gross final energy consumption according to the Renewable Energy Directive
energy dependence	DepEng	the indicator highlights the extent to which an economy relies on imports to meet its energy needs
transport CO ₂ emissions	CO ₂	the indicator measures CO ₂ emissions related to transport
energy efficiency	EfEng	the efficiency indicator is determined as a ratio between energy consumption in transport and the added value generated at the sector level

Performance evaluation at the level of the transport sector is achieved on the basis of the gross operating rate, as an expression of the degree of vertical integration. The closer the value of this ratio is to 1, the greater the degree of capitalisation of technical and financial resources, which contribute significantly to the realisation of the product. Ensuring efficiency requires careful monitoring of the consumptions involved in the degree of integration, their structure, and evolution, with incidences on exploitation risk and profitability (Anghel et al., 2022). The turnover accomplished in the transport sector has a double meaning in this approach: from a microeconomic perspective, it highlights the volume of activity carried out, with direct and indirect effects (through the necessary consumption) on performance; from a macroeconomic perspective, it involves energy consumption on the one hand, and high CO₂ emissions on the other, given that transport is one of the most polluting sectors of activity. Ensuring the sustainability of the energy sector and combating climate change is an important objective of the European Union, as provided for in SDG7. The significant increase in the share of energy from renewable sources in the global energy mix is promoted. Transport involves high fuel consumption, and it is necessary to significantly change their structure by focusing on renewable, non-polluting sources. Energy dependence is an indicator included in the Resource Efficiency Scoreboard, which is used to monitor the progress that the European Union member countries are making in this regard (European Commission, 2017). A high level of energy dependence exposes a country's economy to the risk generated by the volatility of prices on the world market and, implicitly, to the risk of supply shortages. Accelerating the transition to an accessible, reliable, and sustainable energy system is a priority of the European Union. CO₂ emissions related to transport constitute a relevant

reference in this approach as a result of the link between energy consumption, pollution, and microeconomic performance. A higher consumption of polluting energy generates lower costs and superior performance at the microeconomic level, with multiple consequences at the macroeconomic level. Energy efficiency, assessed from the correlation between energy consumption and the added value created by the transport sector, is a necessity at both the microeconomic and macroeconomic levels. Its increase, highlighted by a decreasing value of the rate, ensures a superior performance at the level of the entity providing transport services, and, cumulatively at the national level, a superior value of the gross domestic product.

The studied sample includes the EU member countries, in 2022, with the exception of Malta and Ireland, which did not report the information for the entire considered interval. The data was collected from the Eurostat Database (EUROSTAT, 2022) for the period 2011-2020, with an annual frequency. For the entire period covered by the study, to ensure the comparability of the information and the reliability of the conclusions, we collected data for 25 countries out of the 27 EU member countries in the year 2022. Great Britain was not included in the sample, as it was no longer a member of the EU at the time of the research. In order to obtain consistent results, the turnover and CO₂ emissions data were transformed into their logarithmic form.

In order to determine the links that are established between micro- and macroeconomic indicators from the perspective of the energy issue, regression analysis was used as a statistical modeling tool. The regression model is presented as follows:

$$GOR_{it} = \alpha + \beta_1 \times PEngRe g_{it} + \beta_2 \times EfEng_{it} + \beta_3 \times DepEng_{it} + \beta_4 \times CA_{it} + \beta_5 \times CO2_{it} + \varepsilon_{it} \tag{1}$$

where:

- i=1,2,...n, represents the country;
- t=1,2...T represents the time (period 2011-2020);
- α is the intercept;
- β1-5 represent the regression coefficients; εit is residual, for i=1,2,...n (the number of cross sections);
- t=1,2,...T (the period).

The verification of the stationary nature of the series was carried out by applying the unit root tests and, respectively, the ADF (Augmented Dickey-Fuller) test. The transformation of the data in order to obtain the stationary series was done by differentiation. Within the econometric model, the redundancy test (Redundant Fixed Effects) rejects the null hypothesis, according to which fixed effects are redundant, both for individual effects and specific effects over time, as well as for the combination of individual fixed effects-specific effects over time, the associated probabilities being below the 5% threshold. Based on the Hausman test, the hypothesis of random individual and/or time effects is rejected, the associated probabilities being lower than the 5% threshold. The regression equation was estimated using the Ordinary Least Squares (OLS) method, with corrections for panel data fixed effects. The data was processed using the EVIEWS program.

3. Results and discussions

3.1. Particularities at the level of the member states of the European Union

At the level of the sample, there is an increased heterogeneity in terms of the diversity of the countries' situation regarding the performance of the transport sector, CO₂ emissions, and the energy indicators considered, as well as their variation. Table no. 2 presents the descriptive statistics of the variables recorded by the European Union member countries.

Table no. 2. Descriptive statistics of variables

	GOR	CA	PEngReg	DepEng	EfEng	CO₂
Median	12.75	19,327.75	6.34	97.91	0.76	7,600,378
Maximum	23.10	340,661.60	31.85	130.20	1.82	96,892,289
Minimum	2.00	2,262.90	0.00	-48.12	0.25	202,868
Std.Dev.	3.46	71,516.44	5.01	22.28	0.31	20,186,129

The gross operating rate shows values that vary between 2% (Hungary, 2020) and 23.10% (Croatia, 2015), with a median of 12.75%. Cyprus, Finland, France, Sweden, and Hungary show values below the average over the entire period analysed, while Austria, Bulgaria, Croatia, Greece, the Netherlands, Poland, Slovakia, Slovenia, and Spain consistently register above average performances. The largest increases of the indicator (Figure no. 1) are achieved by Luxembourg and Denmark, and the most severe reductions are presented by the performance in the transport sector in Hungary, Portugal, and France.

The share of renewable energy in the final gross energy consumption in the transport sector records maximum values of 31.85% (Sweden, 2020), with a median of 6.34%. All EU member countries currently use renewable energy in transport, Austria and Sweden being the countries that use this energy in a higher proportion than the average over the entire period analysed, while Croatia, Cyprus, Estonia, Greece, Latvia, Lithuania, and Spain register constantly below average values. The largest increases in the indicator (Figure no. 2) are achieved by Finland, Estonia, Bulgaria, and France, with the specification that Bulgaria and France are positioned in 2020 below the EU average. In 2020, the highest values are recorded by Sweden, Finland, and the Netherlands.

The highest energy dependence is presented by Estonia (130.20%, 2020), and the lowest by Denmark (-48.12%, 2011), with a median indicator of 97.91%. In the period 2011-2020, Belgium, Bulgaria, the Czech Republic, Cyprus, France, Luxembourg, Portugal, Slovakia, Slovenia and Spain are countries whose imports necessary to satisfy energy needs are above the EU average, and Denmark, Romania, Croatia, Hungary, and Italy present a share of imports lower than the average of the European Union. Regarding the variations of this indicator (Fig. no. 3), no significant increases/decreases are noticed, with the exception of Denmark, which goes from energy independence in the transport sector to the import of necessary resources, Estonia, Sweden and Romania, with the mention that while Romania maintains its values below the European Union average, the other two countries increase their unfavourable gap.

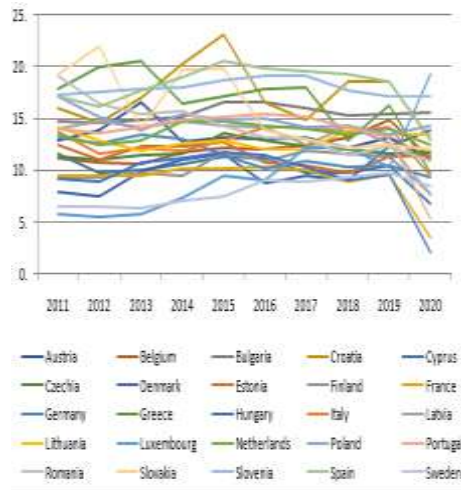


Figure no. 1. The evolution of the gross operating rate - transport

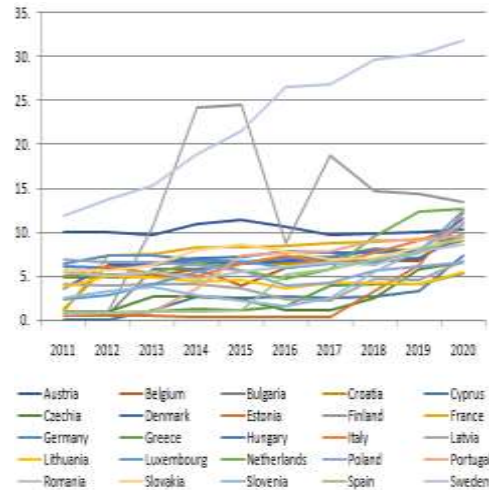


Figure no. 2. The evolution of the share of renewable energy – transport

Energy efficiency reveals different situations at the level of the countries, Denmark showing the highest efficiency (0.25, 2020), and Bulgaria the most inefficient use of energy in transport (1.82, 2012), the EU median being 0.76. Bulgaria, the Czech Republic, Cyprus, Croatia, Estonia, Greece, Luxembourg, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, and Hungary show values above the average over the entire analysed interval, with the specification that in the case of Bulgaria, Poland and Romania the rate shows above-unit values, energy efficiency in Denmark, the Netherlands, Sweden, Belgium, and France being above the EU average. The decrease in the rate in the considered period (Fig. no. 4) reveals a tendency to improve the efficiency at the level of the majority of the European Union member countries, the exception being Latvia, Hungary, Cyprus, and Finland with a deterioration of the efficiency, under the conditions of higher than average rates in the year 2020.

Germany registers the highest turnover in the transport sector (340,661.60 million euros); at the opposite pole is Cyprus (2,262.90, 2014). The median of the indicator is 19,327.75 million euros, with a standard deviation of 71,516.44 million euros. At the EU level, there is an increasing trend of turnover in the sector (Figure no. 5), with higher rates in Lithuania, Bulgaria (where the turnover in 2020 is below the sector median), and Romania.

Relative to turnover, the highest CO₂ emissions from transport are recorded in Germany (96,892,289 tons, 2018), and the lowest in Cyprus (202,868 tons, 2015), with median values of 7,600,378 tons and standard deviations of 20,186,129 tons (Figure no. 6).

During 2019-2020, there are decreases in both CO₂ emissions and turnover, against the backdrop of the COVID-19 pandemic, with the exception of Estonia and Luxembourg, respectively, with CO₂ emission reduction rates below those of the decrease in the figure of business in Belgium, Czech Republic, Croatia, Denmark, Greece, Latvia and Romania. In Estonia, CO₂ emissions from transport increase against the background of a decrease in the volume of activity. Over the entire period analysed, the Czech Republic, Croatia, Estonia, Greece, Latvia, Lithuania, and Luxembourg show unfavourable correlative developments.

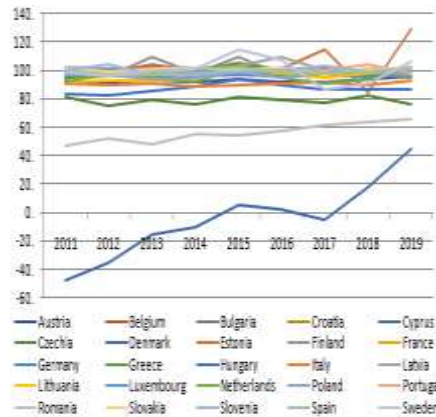


Figure no. 3. The evolution of the energy dependence

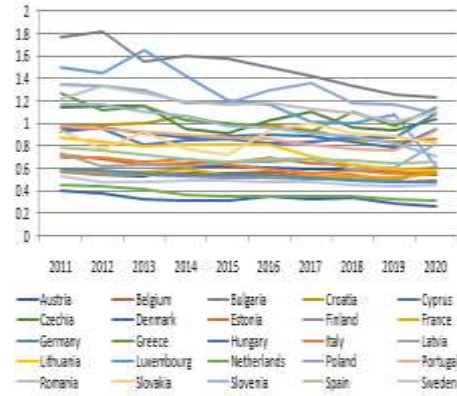


Figure no. 4. The evolution of the energy efficiency – transport

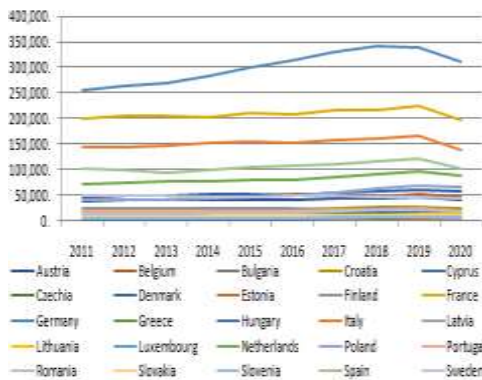


Figure no. 5. The evolution of the turnover - transport

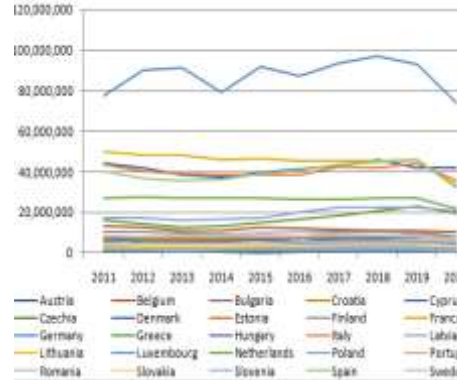


Figure no. 6. The evolution of the CO2 emissions – transport

The highest turnover is registered by Germany, Italy, and Spain. In 2020, Germany showed a value of the gross operating rate at the level of the European Union average, the use of renewable energy to a lower extent than the average, a lower energy dependence, and a higher energy efficiency, with a pace of reducing emissions of CO₂ higher than the decrease in the volume of activity. In 2020, Italy presents a gross operating rate 0.01 percentage points higher than the European Union average, a share of renewable energy and an energy efficiency higher than the European Union average, a lower energy dependence, and a higher CO₂ emission reduction rate than the rate of decreasing in the volume of activity. In 2020, Spain records a gross exploitation rate in transport of 12.8%, higher than the EU average of 9.30%, the highest share of renewable energy used at the level of the European Union, an energy dependence above average, an energy efficiency lower in relation to the average and a rate of reduction of CO₂ emissions higher than the decrease in the volume of activity. At the opposite pole are Cyprus, Croatia, and Estonia, with the lowest volume of activity in transport. In 2020, Cyprus presented a gross exploitation rate of 6.8% lower than the European Union average, with a lower share of renewable energy and energy efficiency, in the conditions of an energy dependence higher than the European Union average; the rate of reduction in CO₂ emissions is higher than the decrease in the volume of activity. Croatia

registered a gross operating rate of 13, higher than the European Union average, with a share of renewable energy lower than the European Union average, a higher energy dependence compared to the European Union average, a value of energy efficiency greater than 1 and with a decrease in the figures of business superior to that of CO₂ emissions. In Estonia, the gross operating rate is higher than the average of the European Union, with a greater use of renewable energy, a high energy dependence, and a below average energy efficiency; CO₂ emissions from transport increase as the volume of activity decreases. Denmark, whose volume of activity is at the level of the average of the European Union in the period analysed, presented a high and growing gross rate of exploitation in transport (2nd place in the European Union), a low energy dependence (1st place), an energy efficiency high (1st place), with a favourable correlative decrease in business figures and CO₂ emissions in 2020 compared to those in 2019, but with a share of renewable energy below the European Union average in 2020.

3.2. Analysis of micro-macroeconomic convergence at the level of the European Union

The study of micro-macroeconomic determinisms at the level of the European Union in the energy field, with impact on the environment, is carried out on the basis of regression analysis, the estimation results being presented in table no. 3.

Table no. 3. The estimation of the gross operating rate analysis model (M1)

The dependent variable: GOR				
The independent variable	Coefficient	Standard Error	t-Statistic	Probability
PEngReg	1.46E-06	0.0368	3.95E-05	1.0000
EfEng	-9.5352	1.0837	-8.7988	0.0000
DepEng	0.0383	0.0178	2.1587	0.0323
CO ₂	0.4935	1.0031	0.4919	0.6234
CA	5.6457	1.8582	3.0383	0.0028
R-pătrat: 0.5514				
R-pătrat ajustat:0.4523				

The R-squared presents a value of 55.14%, indicating a high degree of connection between the performance in the transport sector and the relevant indicators from the energy point of view. At the level of the variables, particular meanings and statistical significances are found.

Between the performance of the transport activity and the energy efficiency, there is a significant statistical link, the decrease in the efficiency of energy consumption, reflected by the increase in the rate, generating the decrease in the performance. The favourable dynamics of energy consumption in relation to that of added value (decrease in energy consumption in conditions of increase in value added or its decrease to a lesser extent; increase in energy consumption at a rate lower than that of value added), as a result of a higher degree of energy resource utilisation, will generate performance.

In order to notice the impact of energy efficiency on performance, we estimated a model that includes all explanatory variables except this one. The estimation results are presented in Table no. 4.

The same meaning and the same statistical significance of the link at the level of common variables is found, specifying that the inclusion of energy efficiency (M1) in the model generates a higher R-squared, which reveals a higher degree of performance explanation based on the considered variables.

Table no. 4. The estimation of the gross operating rate analysis model (M2)

The dependent variable: GOR				
The independent variable	Coefficient	Standard Error	t-Statistic	Probability
PEngReg	0.0283	0.0444	0.6373	0.5248
DepEng	0.0444	0.0215	2.0650	0.0405
CO ₂	0.1956	1.2138	0.1612	0.8722
CA	7.3833	2.2371	3.3004	0.0012
R-squared: 0.3383				
Adjusted R-squared: 0.1971				

The transport sector is of increasing concern due to its environmental impact and vulnerability in terms of energy security. These aspects have placed the sector within the main concerns from the perspective of energy efficiency. Also, the sector operates in a competitive environment, with fuel being an important factor in the performance of the activity, any improvement in its energy efficiency, supported by investments in technological development, or the reduction of the purchase price generating a significant effect on the profit. *The H1 hypothesis is, thus, confirmed regarding the increase in the economic performance of companies in the transport sector under the conditions of energy efficiency.* Subject to the field of activity and the way of determining the indicators used, our results are consistent with those obtained by Subrahmanya (2006), Brahmana and Ono (2020), Andersson et al. (2018), Fan et al. (2017), and Gopalakrishnan et al. (2001), their studies highlighting the fact that improving energy efficiency generates increased performance. On the other hand, the study carried out by Pons et al. (2013) claims that there is no clear and significant relationship between energy use and economic performance.

From the analysis carried out, it was found that *there is a positive, statistically significant link between activity performance and energy dependence, confirming hypothesis H2.* A higher degree of energy dependence determines the increase in transport performance; the situation can be explained by the constraints of a more efficient use of insufficient resources generated at the level of national production.

The volume of activity positively determines performance, with a significant statistical link. The development of the transport sector, measured by the increase in turnover, generates a growth in performance.

The increase in the share of renewable energy in the transport sector generates the improvement in the gross operating rate, revealing a potential direction of performance. However, there is *no statistically significant relationship between the performance obtained by companies in the transport sector and the use of renewable energy, disproving H3.* Transport remains a sector with a low share of renewable energy, given that it is an important polluter. The use of energy from renewable sources (such as liquid biofuels, hydrogen, biomethane, electric batteries, etc.) has an impact on environmental performance, not constituting a factor of economic profitability at the company level. The insufficient

development of the supply infrastructure, the low autonomy provided by renewable energy, and the financial constraints necessary for technological improvements are causes of the use of this form of energy in transport to a lesser extent.

According to the Renewable Energy Policy Network for the 21st Century, the energy demand for transport shows the greatest growth, given that this sector still relies heavily on fossil fuels and uses renewable sources to a small extent. Approximately three-quarters of the global transport energy consumption is involved in road transport. Within it, in the total of fuels used for the transport of goods, a weight of 89.5% is owned by diesel, while in the case of the transport of people, it represents only 16% (International Energy Agency, 2019).

There is no statistically significant relationship between CO₂ emissions and performance in the transport sector, which disproves hypothesis H4. Greenhouse gas emissions contribute to the global phenomenon of climate change, constituting a major concern for the European Union. The high share of CO₂ in greenhouse gas emissions and the large contribution of transport, as a pollutant, required the taking of specific measures by type of transport. Given the growing concern about the environmental impact of air transport, regulators have issued several measures. At the European Union level, the first concrete multilateral measures are stipulated in Directive 2008/101/EC, which amends the existing Emissions Trading System (ETS) to include aviation activities. Under the provisions of this directive, carriers receive allowances based on their past emissions levels, and all flights (except government, military, etc.) arriving or departing from airports in the European Union are subject to measures to reduce or offset greenhouse gas emissions. Maritime transport makes an important contribution to the economy of the European Union, being one of the most efficient modes of transport in terms of energy and, at the same time, an important and growing source of greenhouse gas emissions. Effectively solving the problem of greenhouse gas emissions from maritime transport requires a global approach, the measures adopted by the European Union aim to achieve climate neutrality in Europe by 2050. Reducing the intensity of greenhouse gases (CO₂) is an important measure in order to reduce the total energy consumption (fossil) and CO₂ emissions in the road transport sector. The main measures aimed at improving energy efficiency and fuel quality, concluding a voluntary agreement with the car industry to reduce CO₂ emissions from new cars. We note, however, that improvements in energy efficiency generate a decrease in the fuel price per km, which generally induces a higher use of transport and an increase in total energy consumption. Complementary measures are needed in this regard, by resorting to the use of taxes or other policy instruments, to avoid that improvements are counteracted by increasing the number of vehicle km or the introduction of vehicles with high fuel consumption. The reduction of greenhouse gas emissions in the European Union and its dependence on energy imports, especially in the context of the Russian-Ukrainian crisis, implies that the development of energy from renewable sources is closely correlated with the increase in energy efficiency. In this way, the social and environmental wishes are harmonised with the economic ones, both at the microeconomic level, as well as by the country and the European Union, ensuring the premises for sustainable development.

Conclusions

The study represents the development of managerial approaches to performance, by including the energy dimension as a problem with significant incidences, constituting a

reference for the assessment of energy efficiency and the impact on the environment. Also, this study is relevant to substantiate the measures at the country and European Union level. Thus, first of all, the member countries of the European Union must truly assume the understanding of the relationship between economic performance-energy performance-environmental degradation, noting the existence of different practices at the level of the member states. Second, it is necessary to support investments in the development of technologies for renewable energy and the specific infrastructure, which will smooth out the conflict between the constraints of profitability, environmental protection and energy security.

In the context of the continuous growth of consumption, in general, determined by the degree of development of society, we consider it necessary to focus on renewable, non-polluting resources. Avoiding energy waste through an optimised and energy-conscious production is important in harmonising the objectives of increasing performance with those of the environment. The paradigm shift aims to achieve more efficient use of energy resources, as it is necessary to improve technological processes and the business model.

The contributions of the study circumscribe the issue of performance objectives from the perspective of sustainable development. A first contribution aims at the microeconomic level, analysing the connection between the gross operating rate and energy consumption, with the identification of its extensive and, respectively, intensive factors. At the same time, in the context of a high energy dependence at the European Union level, the threats generated by climate change under the impact of CO₂ emissions and a slow progress in the field of energy efficiency, the present study is useful in substantiating policies at the macroeconomic level. The convergence of the microeconomic objectives of profit growth with the macroeconomic objectives of energy conservation and environmental protection ensures the mediation of the conflict and the foundation of strategies subordinated to sustainable development.

One of the limits of this study is that the analysis is carried out for the entire transport sector, referring to the heterogeneity generated by the specificities of different types of transport (road, rail, air, sea, etc.), without a deepening through particular empirical studies. In addition, the data used in this study covered the period 2011-2020, with incidences of the health crisis. Currently, the Russian-Ukrainian crisis generates a special context in the evaluation of this issue, with the sharpening of some constraints of an energetic nature. Considering the mentioned limits, the main future research directions aim to investigate the particularities of the link between economic performance and energy indicators by types of transport. Likewise, the range of study can be expanded, the periods marked by crises (political-military, economic, financial, sanitary, etc.) will be delimited, and the link between economic performance and energy performance can be analysed, including the impact on environmental degradation.

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