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State Aid Impact on Central and Eastern Europe Economies

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State aid is a fairly common phenomenon in the European Union, and, in the context of the COVID-19 pandemic, the number of companies receiving state aid has even increased. However, scientific research confirms that, depending on the macroeconomic, political and social situation as well as on industry specifics, state aid can have a dual effect - positive or negative. To date, there is no clear answer to the question of what impact and under which conditions state aid has on national economies in the long run. This article contributes to filling a gap in the literature because to date researchers have focused on the cases of large, heavily populated European Union countries, but the research into the impact of state aid on the Central and Eastern EU economies, where the level of state aid as percentage of GDP is higher than the EU average, is still scarce. In addition, the mixed results obtained in previous studies caused confusion over the effects of state aid and its relevance for economic development. In our research, we applied correlation analysis, Granger causality test, ARDL, PTR models and evaluation of multipliers for the analysis of the panel data set representing 11 Central and Eastern EU countries over a 20-year period (from 2000 to 2019). We found that state aid does not promote economic development in most Central and Eastern EU countries under certain conditions in the long term. This paper contributes to a deeper understanding of the state aid-economic development relationship at the national level in the Central and Eastern Europe and has implications for policy makers.

Keywords: *State Aid; Economic Development; Competitiveness; Central and Eastern Europe Countries.*

Introduction

Each economic shock raises the number of companies receiving state aid, which again provokes new discussions among scientists about the impact of this state intervention on the economy in the short and long run. In the face of the 2007–2008 global financial crisis, state aid has become a critical factor in preserving financial stability, addressing the risk of bank insolvency and resuming lending to prevent corporate bankruptcies and rising unemployment (Lowe, 2009). Since 2010, there has also been a growing tendency by both the European Commission and the European Union Member States to use public funds to extend or accelerate the deployment of broadband infrastructure, in particular through state aid (Bourreaua *et al.,* 2020). Many governments around the world have extended COVID-19 state aid to businesses to minimize the negative effects of the COVID-19 pandemic and its consequent public health measures on the economy (Groenewegen *et al.,* 2021). State aid in the European Union is strictly regulated, but in the context of the crisis, some flexibility in providing state aid is allowed. In the wake of the COVID-19 crisis, the European Commission has relaxed state aid rules and introduced additional types of state aid that are considered harmonized. The multifaceted nature of state aid (sectoral, horizontal and regional aid) as well as new economic contexts (new market conditions caused by economic crises, such as the new reality caused by the COVID-19 pandemic) call for a regular analysis and monitoring of the economic impact of state aid. At the moment, it is still too early to draw definitive conclusions about the effects of the COVID-19 state aid in the long run, despite the fact that COVID-19 business support measures have saved many firms and jobs in the short run. Nevertheless, the historically low bankruptcy rates in many economies have also triggered the question whether these measures have led to misallocation of resources and an increase in so-called 'zombie' firms (Groenewegen *et al.,* 2021).

Business support to firms by governments is legitimized when the economy would be worse off without these interventions. However, scientific studies provide mixed results concerning the impact of state aid on national economic development, competitive conditions or regional convergence (macroeconomic scope) as well as on corporate performance and investment (microeconomic scope). Depending on the national macroeconomic, political and social situation as well as on industry specifics, state aid in some cases compensates for market failures and promotes socio-economic development, while in other cases it may lead to distortions in the market competition and adversely affect competitive conditions and international trade. Having assessed the impact of public policies on broadband penetration in 30 OECD countries, Belloc et al (2012) found that most policies are effective, but the effectiveness depends on the stage of technology diffusion.

Scientific discussions do not provide any consensus on the economic impact of state aid; it is recognised that the effects of state aid can be bidirectional – positive and negative. It should also be noted that some studies (Tunali & Fidrmuc, 2015) identify neutral effects, i.e. they provide the results that state aid does not affect the economic growth and investment in the EU member states or state aid does not lead to slower economic growth.

Stollinger & Holzner (2016), Ramboer & Reynaerts (2020), Bronzini & Piselli (2016) and Criscuolo et al (2012) identified the positive impact of state aid on the macroeconomic indicators in the EU countries and treated state aid as an appropriate tool to promote economic development. State aid to industry has a direct impact on the value added in industrial export, which, in its turn, promotes the development of the industrial sector and national economic growth (Stollinger & Holzner, 2016). Regional aid promotes employment and business creation in the supported region (Criscuolo *et al.,* 2012; Ramboer & Reynaerts, 2020). Some scientists (Heim *et al.,* 2017; Nulsch, 2014; Gual & Jodar-Rossel, 2006; Cayseele *et al,* 2014; Sergant & Cayseele, 2018) argue that state aid contributes to reducing the number of corporate bankruptcies and increasing corporate productivity, in particular, if corporate activities are constrained by a lack of funding. Firms in difficulty are more likely to survive in the market if they receive state aid (Nulsc, 2014; Heim *at al.,* 2017). Groenewegen et al's (2021) empirical analysis showed that the COVID-19 state aid mainly reached the firms that needed it in the short run and that, on average, were likely to be viable in the longer run as measured by the quality of their management practices. The degree of deadweight loss and substitution effects in government aid therefore seems to be limited in the Netherlands. Duso et al (2017) found that state aid was successful in expanding coverage of broadband, without impeding competition. Bronzini & Piselli (2016) found a positive effect of state aid on R&D activities and the number of patent applications. Some other researchers (Polemis & Stengos, 2020; Tunali & Fidrmuc, 2015) question state aid because of its negative impact on economic growth and a lack of efficiency. Polemis & Stengos's (2020) research revealed a significant inverse relationship between state aid and economic growth. Briglauer et al (2019) concluded that state aid does not contribute to closing the economic divide regarding employment in rural areas. Tunali & Fidrmuc (2015) found that state aid does not have any significant impact on economic growth and investment in the EU, which shows that state aid is not an effective tool for promoting economic growth and investment. As stated by Ferruz & Nicolaides (2013) and Chindooroy at al (2007), inefficiencies occur for a number of reasons: the benefits are less than the state aid granted; a large proportion of companies that have received state aid still withdraw from the market, etc. Researchers also single out the negative effects of state aid by analysing the relationship between regional state aid and corporate productivity and growth. It is argued that state aid leads to slower corporate productivity growth when comparing subsidized and non-subsidized enterprises where productivity growth is faster. It is emphasized that in the long run, insufficient productivity growth outweighs the positive short-run effects of state aid on employment, investment and output growth (Bernini & Pellegrini, 2011). Scientists (Mollgaard *et al.,* 2005; Buts & Jegers, 2012; Schweiger, 2011) found that state aid provision has a significant negative effect on the competitive environment by enabling a beneficiary to become dominant in the market and thus increase the market share.

The use of state aid is very heterogeneous across the EU member states, with a few (large) countries contributing significantly more than the others, both in terms of the number of notifications and the budget (Bourreaua *et al.,* 2021). The levels of public support to certain industries and individual firms were significantly higher in the Central and Eastern European countries than in the EU-15; the priorities of the type of horizontal aid also varied significantly between the CEECs and the EU-15 (Holscher *et al.,* 2017). Scientific literature tends to focus on the cases of the old EU member states with a deeper history of competition policies, namely Italy, France, Germany, Spain, the Netherlands and the United Kingdom. The research focused on the situation in the Central and Eastern European countries is, however, scarce. It should be noted that the heterogeneity of state aid across the EU countries and its ambiguous effects at the micro and macro level call for an urgent discussion on what impact and under which conditions state aid has on the Central and Eastern EU economies, and whether this impact is adequate to the scope of state aid. Although there is no significant lag in application and institutional enforcement of the EU law among the CEECs either prior to or after the accession, these countries have a shorter history of their competition policies and are characterised by a shorter term of their market economy development based on a competitive and dynamic corporate structure. The CEECs have a strong tradition of governmental intervention resulting from the planned economy system, and state aid still plays an important role in their national policies (Holscher *et al.,* 2017). Reorientation of industrial policies is a time-consuming process, so a deeper investigation into the relationship between state aid and economic development in the CEECs is relevant because it allows rethinking the public spending policies aimed at raising the potential of economic development.

Within the given context, *the purpose of this article* is to investigate the impact of state aid on the Central and Eastern EU economies. The research contributes to filling the gap in scientific literature because previous results regarding the relationship between state aid and economic development at the national level in the Central and Eastern EU countries are scarce and mixed. The study aims at providing the insights that can be relevant for developing the policies of effective state aid in the context of economic development.

In this article, we employ an institutional and market regulation approach to investigate the relationship between state aid and economic development. The research methods include a systematic, comparative and logical analysis of scientific literature, correlation analysis, Granger causality test, ARDL, PTR models, and evaluation of multipliers. The data covers 11 Central and Eastern European countries for a period of 20 years (the 2000–2019 period). The research panel includes 220 observations.

This paper makes several important contributions. First, it contributes to the literature on economic development and competition policies by clarifying the nature of the interaction between state aid and economic development in the CEECs and identifying the economic conditions that determine the direction of the effects. Second, it provides the original empirical evidence which can be useful to policymakers for developing the policies of effective state aid in the context of economic development.

The paper is organized as follows. Section 2 presents the theoretical analysis of the major state aid purposes, its compliance with the rules of fair competition, the potential effects and specifics of state aid in the CEECs. Subsequently, the data and research methodology, and the empirical research results are presented. The paper ends with a discussion of the results and conclusions.

Article 107(1) of the European Union Act defines state aid as "any form of aid granted by a member state or from its state resources, which, by supporting certain companies or the production of certain goods, distorts competition or may distort it and affects trade between member states". The European Parliament in 2018 clarified that the EU funds channelled through the management institutions of member states become state resources and can be state aid if all other criteria of Article 107, paragraph 1 are met. In contrast, the EU funds allocated directly to companies outside the control of a member state authority cannot be considered state resources. It follows that such direct EU funding is not state aid. The article will rely on the latter interpretation of state aid.

Literature Review

State Aid: Purposes and Compliance with the Rules of Fair Competition

Government intervention into the free market is usually needed to remedy certain market failures, but in some cases government interventions are aimed at fulfilling particular political objectives, which can disrupt corporate activities, reduce consumer welfare and diminish economic competitiveness (Stanikunas, 2010). In the EU, state aid is considered incompatible with the domestic market due to its negative effects on trade between the member states and distortion of competition, but there are cases when government intervention is necessary for successful economic development. In the latter case, state aid is intended to promote positive economic development, prevent unfavourable, negative processes (see Table 1).

Table 1

Reasons for Granting State Aid

Reason	Explanation	Author(s)
Market errors and inefficiencies	Market is inefficient due to existence of the market failures, namely imperfect competition, existence of public goods, externalities, market insufficiency, information asymmetry, unemployment, inflation. Market inefficiencies justify state intervention in the form of state aid. The free market cannot eliminate the negative effects associated with the subjective and selfish population's behaviour. An alternative to the free market is state intervention, or state aid, that addresses market failures.	Bartniczak (2017), Fijor (2011), Syszczak (2011), Tunali & Fidrmuc (2015), Bronzini & Piselli (2016)
Economic inequality and the need for social cohesion	State aid allows allocating resources to improve economic equality and social cohesion.	Syszczak (2011)
Environmental purposes	State aid motivates businesses to take action to protect the environment	Macek (2014)

Horizontal state aid, which applies to all companies, usually pursues the specific EU policy objectives related to employment, R&D and the environment (Schito, 2021). Sectoral state aid aims at providing support to specific sectors of the economy, in particular, agriculture, forestry, broadband networks, films and audio-visual works, fisheries and aquaculture, shipbuilding, shipping, railways and roads (Tunali & Fidrmuc, 2015). Sectoral aid also covers the so-called ad hoc, or rescue and restructuring aid to individual firms in difficulty (Riess & Valila, 2006). Regional state aid is a mixture of sectoral and horizontal aid, and is mainly aimed at economic development (Schito, 2021) and job creation (Kolodziejski, 2020) in disadvantaged areas.

In any case of state intervention, there is a risk of distortion of competition. There is a general consensus (Schito, 2021; Radukic & Vucetic, 2019) that horizontal aid, which applies to all economic operators, has the least effect on distorting competition in the market, while sectoral aid, which applies to individual companies or economic sectors, is more distortive. Distortions of competition are often associated with the problem of "selecting winners". Due to information asymmetries, governments are not capable of identifying and selecting the companies, sectors, industries or regions that are facing market errors and inefficiencies. The effectiveness of state aid depends crucially on transparency of the national political system and functioning of the public institutions. State aid can cause corruption; in addition, entrepreneurs tend to spend much time seeking help rather than looking for new ways to reduce costs (Tunali & Fidrmuc, 2015). When considering state aid measures, national governments may not take into account the potential negative spillover effects on other countries. Some member states may have incentives to use state aid strategically to meet national economic interests and to develop particular activities in their territory, although this may harm the common market and the common European interests. If state aid redirects particular activities, this can be detrimental to other member states, especially less developed ones. State aid with significant cross-border effects may motivate other member states to provide larger subsidies. This situation can lead to excessive subsidization at the expense of taxpayers OECD (2011).

State Aid: Economic Impact Types and Objects

The effects of state aid are felt at both the microeconomic and macroeconomic levels. Scientific opinions concerning the impact of state aid on national economies are still mixed: both positive and negative effects are identified. Researchers who analyse the impact at the macroeconomic level usually emphasize that state aid leads to growth in exports, employment, the number of enterprises and the number of patents, while others indicate that state aid does

not promote economic and investment growth (see Table 2). When analysing economic growth through GDP, authors (Polemis & Stengos, 2020) often do not detail the results for each EU member state.

Table 2

Impact of State Aid at the Macroeconomic Level

Type	Object	Explanation
Positive	Value-added exports	A 10% increase in state aid to industry leads to an average increase of 0.56–0.67 % in value-added exports in a EU member state. In an open economy, any measure that raises a firm's productivity can promote additional exports. Therefore, state aid, if granted in a non-discriminatory manner, can at the same time increase exports and be compatible with the EU competition law (Stollinger & Holzner, 2016).
	Employment	A 10 % increase in state aid to industry leads to an average increase of 2.9 % in employment or creation of 111,000 jobs in the UK each year (Criscuolo *et al.,* 2012). State aid expenditure on industry led to a 10 % increase in employment and a 15 % increase in the number of enterprises between 1994 and 2005 in Flanders, Belgium (Ramboer & Reynaerts, 2020).
	Number of enterprises	State aid expenditure on industry led to a 15 % increase in the number of enterprises between 1994 and 2005 in Flanders, Belgium ((Ramboer & Reynaerts, 2020).
	Number of patents	$206-310 thousand of state aid attracts one additional patent application in Italy (Bronzini & Piselli, 2016).
Negative	Economic growth	A 10 % increase in state aid leads to an average 1.6 % decrease in annual real GDP per capita growth in the EU countries (Polemis & Stengos, 2020). State aid expenditure does not affect/stimulate economic growth in the EU countries (Tunali & Fidrmuc, 2015).
Neutral	Investment	State aid expenditure does not affect/stimulate investment in the EU countries (Tunali & Fidrmuc, 2015)

State Aid: Economic Impact Evaluation Methods

The impact of state aid expenditure on national economies is evaluated by employing different methodologies, which indicates that there is no uniform and universally accepted evaluation methodology (see Table 3). The methods, most commonly used in scientific literature, can be divided into three groups: a) the methods based on econometric models, b) the methods based on theoretical models, and c) the methods based on statistical analysis. The methods based on econometric models are most common for more accurate and reliable results they provide in some cases, theoretical models are also used to explain the nature of the impact with reference to the classical economy theory. In rarer cases, statistical analysis is employed. It is important to note that when researching the impact of state aid at the microeconomic level, the research requires corporate data which are often not publicly available. Meanwhile, when researching the impact of state aid at the macroeconomic level, the research is based on the aggregate national, regional or sectoral indicators, available in public statistical portals

Table 3

Econometric Methods for Evaluating the Impact of State aid at the Macro Level

Author(s)	Method	Variables
Stollinger & Holzner (2016)	Regression analysis: fixed-effect OLS model	Dependent variable: value-added exports in an industrial sector. Independent variables: state aid expenditure, real effective exchange rate, foreign GDP, monthly labour costs per person in the industrial sector, World Bank government efficiency indicator
Criscuolo *et al* (2012)	Regression analysis: OLS model, IV model	Dependent variable: regional employment Independent variable: state aid expenditure
Ramboer & Reynaerts (2020)	DID method based on CEM and IPTW models	Dependent variables: number of enterprises, number of the unemployed, number of new vacancies in the region. Independent variable: a two-dimensional variable of state aid expenditure.
Bronzini & Piselli (2016)	RDD method	Dependent variable: patent applications Independent variable: a two-dimensional variable of state aid expenditure.
Polemis & Stengos (2020)	Regression analysis: fixed-effect OLS model, 2SLS	Dependent variable: growth rates of real GDP per capita. Independent variables: state aid expenditure, real GDP per capita in previous period, population, gross fixed capital formation, government expenditure, trade openness measured by the amount of imports and exports, human capital index, inflation.
Tunali & Fidrmuc (2015)	Regression analysis: OLS model, 2SLS model	Dependent variable: value added (GDP) growth (per capita). Independent variables: State aid expenditure to GDP ratio, gross fixed capital formation to GDP ratio, population growth, technological progress, depreciation. Dependent variable: gross fixed capital formation to GDP ratio Independent variables: state aid expenditure to GDP ratio, economic freedom, political stability

Although there are research (Heim *et al.,* 2017; Nulsch, 2014; Gual, & Jodar-Rosell, 2006; Cayseele *et al.,* 2014; Sergant & Van Cayseele, 2018; Chindooroy *et al.,* 2007; Bernini & Pellegrini, 2011; Buts & Jegers, 2012; Schweiger, 2011) which evaluate state aid impact at the micro level, however following Stollinger & Holzner (2016), when

researching the impact of state aid, the major focus should fall on the effects at the macroeconomic level, because firm-level results not necessarily reflect industrial or national economic trends. This article aims at evaluating the impact of state aid on the CEE economies.

CEECs and State Aid

The CEECs used to have a strong tradition of government intervention resulting from the planned economy system; however, after the EU accession (in 2004 and 2007), these countries all had to transfer from their centrally planned economies, where state aid is an essential element, to market economies. With the accession to the European Union, the acceding countries transferred the EU law into the national law and changed their political practices regarding the levels of state aid and the objectives for which state aid is used (Holscher *et al.,* 2017). Most of the CEECs are small open economies. Only one country, namely Poland, is considered a large economy, such as the US, China, Japan, Germany and the UK, and it is argued that a large open economy can affect global markets. An SOE is, however, assumed to be too small to affect the level of global output (Carlin & Soskice, 2003), and SOEs usually adjust to the policies carried out by large countries. According to Chen et al (2018), SOEs possess the following features: 1) their business cycle volatility is usually comparable in size to that seen in large wealthy economies, 2) their consumption is less volatile than output, and 3) their interest rates are procyclical (an increase in economic activity is usually associated with an increase in interest rates today and in the near future). It can be argued that in order for small economies to thrive, they need to focus on open trade through partnerships, and the main challenge for SOEs is competitiveness.

On average, the EU state aid expenditure is less than 1 % of GDP (0.81 % in 2019). Following Holscher (2017) and based on the European Commission (2020) data (see Table 4), state aid expenditure is larger in the countries that are relatively less developed and later accessed the EU (e.g. Latvia, Hungary, the Czech Republic, Poland, Croatia, Malta) compared to the older and stronger EU economies (e.g. Luxembourg, Ireland, the Netherlands, Austria, the United Kingdom (a former member)).

Table 4

State Aid, Mln. Euro

Years	Bulgaria	Czechia	Estonia	Croatia	Latvia	Lithuania	Hungary	Poland	Romania	Slovenia	Slovakia	EU average
2000	0,00	1 476,76	5,97	0,00	59,04	41,19	565,35	1 764,86	0,00	186,23	123,60	1646,75
2010	18,89	987,26	15,79	0,00	148,12	86,68	1 846,70	2 898,66	195,69	289,60	247,32	2338,19
2019	257,11	2 984,40	326,94	699,89	299,65	820,33	2 434,60	5 440,89	1 430,22	399,35	562,02	4806,74

In addition, state aid expenditure growth in the CEECs is faster than in the rest of the EU. Between 2000 and 2019, state aid expenditure in the CEECs increased by 0.40 percentage points, while in the remaining EU countries it increased by 0.28 percentage points. The priorities of the type of state aid vary significantly between the CEECs and the rest of the EU. Environmental protection in the CEECs accounts for a lower share of expenditure compared to the trends across the EU. It can also be observed that regional development in the CEECs accounts for a significantly larger share of expenditure – 22 % compared to the EU rate (8 %). Finally, it can be pointed out that sectoral development in the CEECs accounts for a smaller share of state aid expenditure (3 %) compared to the EU rate (7 %).

Research Methodology

This section presents the methodology for analysing the impact of state aid on the Central and Eastern EU economies. The units of the research are 11 CEECs in the EU. The following sampling filters were used for characterising the CEECs (see Table 5):

- Small population. Traditionally, population size is used as the metric to identify a small economy. This paper defines a small population as up to 20 million people, according to the Eurostat database population statistics.

- Advanced economy. The International Monetary Fund (2018) compiles an advanced economy list based on per capita income, export diversification and degree of integration into the global financial system.

- Trade openness - exports plus imports as % of GDP. This paper filters the countries by the trade openness rate (following The Global economy, 2019) of more than 100 %.

Table 5

CEECs in the Research Sample

Group	CEECs	Population	Advanced economy	Trade openness (%)
Advanced SOEs	The Czech Republic	10.610.055	+	150.76
	Latvia	1.934.379	+	118.37
	Lithuania	2.808.901	+	161.95
	Slovakia	5.443.120	+	192.35
	Estonia	1.319.133	+	145.66
	Slovenia	2.066.880	+	160.94
	Hungary	9.778.371	+	163.38

Group	CEECs	Population	Advanced economy	Trade openness (%)
	Bulgaria	7.050.034	+	129.09
	*Croatia**	*4.105.493*	+	*101.25*
Advanced small closed economy	Romania	19.533.481	+	87.14
Advanced big open economy	Poland	37.976.687	+	107.42

** - the country eliminated from the empirical research*

The impact of state aid on the Central and Eastern EU economies was analysed at the macroeconomic level. When researching the impact of state aid at the macroeconomic level, the problem of data unavailability was encountered because the relevant data are not publically available. The state aid impact indicators were identified based on previous studies (Stollinger & Holzner, 2016; Tunali & Fidrmuc, 2015; Ramboer & Reynaerts, 2020; Bronzini & Piselli, 2016; Criscuolo *et al.,* 2012; Heim *et al.,* 2017; Nulsch, 2014; Gual & Jodar-Rosell, 2006; Cayseele *et al.,* 2014; Sergant & Van Cayseele, 2018; Polemis & Stengos, 2020; Ferruz & Nicolaides, 2013; Chindooroy *et al.,* 2007; Bernini & Pellegrini, 2011; Mollgaard, 2005; Buts & Jegers, 2012). Due to the specifics of presenting the state aid expenditure data, the empirical study was conducted by employing the aggregate state aid expenditure indicator. The independent variable in the empirical research was the aggregate state aid expenditure in the country (% of GDP at current prices), and the dependent variables included:

- Export (% of GDP at current prices);
- Employment (% of the employed in the total population aged 20–64);
- Number of enterprises;
- Number of patent applications per million inhabitants (to the European Patent Office);
- Fluctuations in real GDP per capita (% compared to the previous period);
- Business investment (% of GDP at current prices).

The latest state aid data provided by the European Commission is available only for 2019. Thus, in the general case, the investigation covered the 2000–2019 period, while the research of the impact covered a shorter period due to the limited availability of particular indicators or statistical data for particular countries. The research of the impact of state aid on the number of enterprises and the number of patent applications was also limited to shorter periods, 2010–2019 and 2004–2019, respectively. For Bulgaria and Romania, the research covered the 2002-2019 period, and for Croatia – the 2013–2019 period. The data for the research was extracted from the *Eurostat* and the European Commission database.

Based on the econometric models applied by Neusser (2016), Stigum (2015) and Tong et al (2011), namely correlation analysis, Granger causality test, autoregressive distributed lag (ARDL), error correction model (ECM), pair linear regression (PTR) and pair nonlinear regression (PNR) models, the econometric modelling of the impact of state aid was performed by employing the "Eviews 11" software. The econometric modelling revealed the relationship between state aid expenditure and fluctuations in the dependent variables. The normality of distribution of the variables was evaluated by employing the Jarque-Bera criterion. If a time series was not normally distributed, a variable was transformed and that transformation was used for further analysis. The variable representing state aid expenditure in Croatia did not meet stationarity criteria even after double differentiation, so Croatia was excluded from the further empirical research.

Logical sequence of the econometric modelling:

1. Based on the unit root method, stationarity of the time series was verified.
2. Based on the Pearson correlation coefficient, correlation between the variables was verified.
3. Based on the Granger causality test, causalities between the variables were verified. The Granger test is expressed as follows:

$$y_t = \alpha_0 + \alpha_1 y_{t-1} + ... + \alpha_i y_{t-i} + \beta_1 x_{t-1} + ... + \beta_i x_{t-i} + \varepsilon_t \quad (1)$$

$$x_t = \alpha_0 + \alpha_1 x_{t-1} + ... + \alpha_i x_{t-i} + \beta_1 y_{t-1} + \ldots + \beta_i y_{t-i} + \varepsilon_t \quad (2)$$

$H_0: b_1 = b_2 = ... = b_i = 0$ (acceptance of H_0 means that x does not Granger-cause the fluctuations in y in the first equation, and y does not Granger-cause the fluctuations in x in the second equation).

4. Depending on the stationarity evaluation and Granger test results, the autoregressive distributed lag (ARDL) model was developed. It is expressed as follows:

$$Y_t = \alpha + \rho Y_{t-1} + ... + \rho_p Y_{t-p} + \beta_0 X_t + \beta_1 X_{t-1} + ... + \beta q X_{t-q} + U_t \quad (3)$$

5. Depending on the Granger test results, the long-term multiplier of the ARDL model was estimated. It is expressed as follows:

$$\frac{\beta_0 + \sum_{i=1}^{q} \beta_i}{1 - \sum_{j=1}^{p} \rho_j}, \sum_{j=1}^{p} \rho_j < 1 \quad (4)$$

6. Depending on the stationarity evaluation, correlation coefficient and Granger test results, the pair linear regression model (PTR) was developed. It is expressed as follows:

$$y = b_0 + b_1 x \quad (5)$$

Research Results

State aid expenditure in the Central and Eastern EU countries in the 2000–2019 period had an upward trend. In 2000, state aid expenditure in the region amounted to 0.93 % of GDP, while in 2019 it amounted to 1.19 % of GDP. State aid expenditure was at a record high in 2003 when it amounted to 1.98 % of GDP. In 2019, Hungary provided the largest amount of state aid (% of GDP) - 1.96 % of the country's GDP. Slovakia, meanwhile, had the smallest state aid expenditure at 0.52 % of GDP. The countries, where state aid expenditure (% of GDP) in 2019 was larger than the average of the Central and Eastern EU countries, are Hungary, the Czech Republic, Croatia and Lithuania. State aid expenditure in these countries ranged from 1.32 % to 1.96 % of GDP.

Pearson's correlation analysis (see Table 6) showed that there is a significant direct relationship between the fluctuations in state aid expenditure and the changes in exports in Latvia and Romania, between the fluctuations in

state aid expenditure and the changes in the employment rate in Poland and the Czech Republic, and between the fluctuations in state aid expenditure and the changes in the investment rate in Romania. In addition, there is a strong significant inverse relationship between the fluctuations in state aid expenditure and the changes in the number of enterprises in Romania. No significant linear relationships were found between any the other variables.

Table 6

Correlation Coefficients of Differentiated Variables

Country	Pearson's correlation coefficient					
	Export	Employment	Number of enterprises	Number of patent applications	Fluctuations in real GDP per capita	Business investment
Correlational relationships are significant						
Romania	**0.7547****	-0.6092	**-0.7342****	-0.1013	0.3779	**0.8095****
The Czech Republic	-0.4819	**0.5184****	0.3792	0.1381	-0.6008	0.2812
Latvia	**0.7847****	0.15035	0.6080	-0.3585	-0.2023	0.6973*
Poland	0.2481	**0.8270****	-0.1599	-0.1893	0.2135	-0.2733
Correlational relationships are insignificant						
Lithuania	0.2103	-0.4841	-0.42	0.4335	0.0747	-0.2320
Bulgaria	0.2148	0.2357	0.2511	0.5361	-0.1184	-0.1779
Estonia	-0.1801	0.2321	0.2248	-0.1003	-0.0579	-0.2091
Slovakia	-0.5076	-0.0773	0.0801	0.6049	0.1020	0.3080
Slovenia	0.5485	-0.0176	0.3591	-0.2815	-0.1687	0.2173
Hungary	0.1749	0.4279	-0.1785	-0.1003	-0.3127	0.0694

** p<0.1;**p<0.05;***p<0.01*

The results of Granger causality test are presented in Appendix A (Tables A1-A6); they lead to the conclusions that:

a) fluctuations in state aid expenditure in the long run do not affect the changes in exports in the Central and Eastern EU countries.

b) there exists a causal relationship between the fluctuations in state aid expenditure and the employment rate in the Czech Republic, Poland and Slovenia. It is important to note that this relationship in the Czech Republic was observed only in the first year, in Poland – in the third and fourth year, and in Slovenia – in the second year under consideration. This result can be interpreted as a fact that the fluctuations in state aid expenditure in the Czech Republic affects the changes in the employment rate in the current year, i.e. there is no lag effect, but the effect is short-term. The effect of the fluctuations in state aid expenditure in Poland and Slovenia is lagged: in Poland, the effects can be observed only in the 3rd-4th year, and in Slovenia – in the 2nd year. In both Slovenia and the Czech Republic the effect is short-term (up to 1 year).

c) the causal relationship between the fluctuations in state aid expenditure and the number of enterprises in Estonia can be observed only in the first year, i.e. the effect of the fluctuations in state aid expenditure occurs without a lag in the first year, but the effect is short-term.

d) the fluctuations in state aid expenditure affect the number of patent applications in Latvia, Lithuania and Slovenia. It is important to note that in all cases the effect is short-term, i.e. up to 1 year. However, in the case of each country, the effect occurs in different periods: in Lithuania – in the second year, in Latvia – in the first year, in Slovenia – only in the third year.

e) the fluctuations in state aid expenditure affect the changes in real GDP per capita in Hungary. The effect occurs in the first year and is long-term (up to 3 years).

f) no causal relationship between the fluctuations in state aid expenditure and the changes in business investment was identified, which leads to the conclusion that the fluctuations in state aid expenditure in the long run do not affect the changes in business investment in the Central and Eastern EU countries.

Econometric modelling of the fluctuations in state aid expenditure and the relevant indicators lead to the conclusions that:

- PTR models have shown that state aid does not affect exports to Latvia and Romania.

- ARDL models have shown that changes in state aid expenditure do not have a significant effect on employment changes in Poland and Slovenia. On the other hand, relationship is significant between state aid expenditure and the employment rate in the Czech Republic (see Table 7), i.e. a 1 percentage point fluctuation in state aid expenditure caused the fluctuation in the employment rate by 5 percentage points in the same direction in the short run, and by 9 percentage points in the long run.

Table 7

ARDL Model Values

Independent variables	ARDL(2,3) values
C	32.3289***
d (Employment, 2 (-1))	-0.3128**
d (Employment, 2 (-2))	-0.5142***
d (State aid expenditure)	4.7174***
d (State aid expenditure (-1))	-1.3981***
d (State aid expenditure (-2))	-0.0017
d (State aid expenditure (-3))	-0.8540***
Employment (-1)	-0.5072***
State aid expenditure (-1)	4.3995***

* p<0.1;**p<0.05;***p<0.01

- The PTR models have shown that State aid does not have a significant effect on the number of companies in Estonia and Romania.

- The PTR model has shown that the change in State aid expenditure does not have a significant effect on the change in business investment in Romania.

- The developed ARDL models showed that the change in state aid expenditure does not significantly affect the change in the number of patent applications in Latvia, Lithuania and Slovenia.

- ARDL model showed significant relationship between state aid expenditure and real GDP per capita in Hungary (see Table 8), i.e. a 1 percentage point fluctuation in state aid expenditure caused the fluctuation in the real GDP per capita by 0.12 percentage points in the opposite direction in the short run, and by 0.27 percentage points in the long run.

Table 8

ARDL Model Values

Independent variables	ARDL(1,2) values
C	15.7938**
d (State aid expenditure)	-0.1235
d (State aid expenditure (-1))	3.0625***
d (State aid expenditure (-2))	2.6835
d (RGDP (-1))	-4.3558
State aid expenditure (-1)	-0.9440
RGDP (-1)	-3.4873***

* p<0.1;**p<0.05;***p<0.01

Discussion

The research of the impact of state aid expenditure on the macroeconomic indicators in the Central and Eastern EU countries has revealed that state aid does not promote economic growth and development in most countries under consideration. The findings of our research are in line with Polemis & Stengosm's (2020) and Tunali & Fidrmuc's (2015) results, which state that state aid does not promote economic growth in the EU member states and we clarify the conclusion that state aid does not promote economic growth and development in the Central and Eastern EU countries. Thus, in the case of the Central and Eastern EU countries, state aid is not an appropriate measure to promote economic growth and competitiveness because it is not an effective tool for promoting exports, employment, number of companies, number of patent applications, real GDP and business investment.

The research also revealed that the size of state aid compared to national GDP affects impact in CEECs. The empirical results proved that state aid effects were observed in Hungary and the Czech Republic, which are characterised by the highest state aid expenditure compared to the other countries under consideration. In the Czech Republic and Hungary, the state aid expenditure is close to 2 % of GDP and the significant effects of state aid on employment and real GDP can be observed. This also leads to the statement, that in order for state aid to have a significant effect at the macroeconomic level in CEECs, it must be of a significant amount.

The inverse relationship between state aid in Central and Eastern EU countries does not imply that state aid is completely meaningless. It suggests that state aid effects are "absorbed" by firms or micro-level indicators and the macro-level effects become intangible in CEECs. It may have an effect on micro level through employment growth. However, looking comprehensively at the results of our empirical study, we can state, that the problems of business "survival in the market" are solved at the expense of state aid, but state aid does not promote business competitiveness, which at the same time stimulates economic growth.

Given that state aid effect in CEECs is seen at micro level, state aid in the CEECs should be combined with improvements in corporate governance. Following Cayseele et al (2014), Sergant & Cayseele (2018), the effect of state aid is not long-lasting if a company lacks funding due to poor corporate governance. Consequently, the more efficiently a company operates, the more efficiently state aid is used.

Considering the fact that state aid is often provided to business companies, it is relevant to evaluate the impact of state aid not only at the macro, but also at the micro level. When researching the impact of state aid at the microeconomic level, the problem of data unavailability is encountered because the relevant data are not publicly available. Meanwhile, when researching the impact of state aid at the macroeconomic level, the research is based on the aggregate national, regional or sectoral indicators, available in public statistical portals. To improve the methodology for evaluating the impact of state aid, the state aid database should be enlarged, i.e. more detailed statistics on state aid expenditure, including quarterly amounts of expenditure, characteristics (size, financial indicators, etc.) of the companies that have benefited from state aid for the relevant periods before, during and after receiving state aid, should be provided. The detailed statistics would allow a more accurate evaluation of the effects of state aid expenditure and the impact of state aid at the macroeconomic level.

Conclusion, Limitations and Further Research

The results support the scientific consensus which proposes that state aid does not promote economic growth and development in most Central and Eastern EU countries. The results of this research lead to the conclusion that, on one hand, state aid is not an appropriate measure to promote economic growth and competitiveness, and thus can be treated as an inefficient way to fulfil the above-mentioned objectives; on the other hand, to evaluate the overall impact of state aid on economics, the sectoral and market-level effects should also be considered, and the analysis should include not only economic, but also the relevant social indicators.

The research introduced in this article covers a period of normal economic functioning, but for the second year in a row, the whole world has been facing the challenges posed by the COVID-19 pandemic. During the period of the COVID-19 pandemic, state aid is not only justified, but also necessary to prevent mass bankruptcies of businesses companies and loss of employee income. During the period of the pandemic, the impact of state aid is short-term, but based on the results of this research, the long-term impact of state aid can be expected to be small, though more positive than negative. Another important point is that the impact of state aid is not only economic, but also social, so future studies should address the impact of state aid in recent years in a comprehensive way, considering both economic and social aspects of the effects.

Despite the difficulties in comparing state aid across time and different countries, particular commonalities can be identified. In order for state aid to have a significant effect at the macroeconomic level in the CEEC, it must be of a significant amount. The significant amounts of state aid in the CEECs are reflected in employment growth, but have a negative impact on real GDP. We also concede that some

data-related *limitations* hampered our research. Selection of the indicators as well as the time period under consideration was based on data availability and forecast accuracy. Only macroeconomic-level indicators were included in the empirical research. When researching the impact of state aid at the micro-economic level, the problem of data unavailability was encountered because the firm-level data are not publicly available.

There are several potential *future research directions* because the issue addressed in this article is still novel in the literature on the economic development in the CEECs. The conceptual research into the state aid impact measurements at different scales would be relevant for developing the policies of effective aid. Another option is selection of a larger sample of countries that would allow to compare the impact of state aid on SOEs, large economies and non-EU SOEs. To evaluate the overall impact of state aid on economics, the sectoral and market-level effects should also be considered, and the analysis should include not only economic, but also the relevant social indicators. We also recommend developing and improving scenario-based models to elaborate upon state aid implementation patterns.

Appendix A

Table A.1

State Aid Expenditure and Exports Causality Test Results

Country	State Aid Expenditure → Export				
	l=1	l=2	l=3	l=4	l=5
Bulgaria	0.6270	0.6083	0.8477	0.6220	NA*
The Czech Republic	0.5012	0.7737	0.4715	0.9079	0.8991
Estonia	0.5598	0.6716	0.7907	0.8764	0.1020
Latvia	0.2691	0.4707	0.9423	0.9758	0.9929
Poland	0.2700	0.1560	0.0730	0.2443	0.2052
Lithuania	0.2842	0.1802	0.3060	0.7350	0.0844
Romania	0.7919	0.9192	0.9723	0.9761	NA
Slovakia	0.6130	0.2913	0.7928	0.0697	0.0861
Slovenia	0.4410	0.6573	0.9198	0.9621	0.7129
Hungary	0.9498	0.8955	0.9757	0.9930	0.9539

**NA – due to the lack of time series values, the probability of F-statistics is not calculated*

Table A.2

Results of the Causality Test for the Variables State Aid Expenditure and Employment

Country	**State Aid Expenditure → Employment**				
	l=1	**l=2**	**l=3**	**l=4**	**l=5**
Bulgaria	0.6386	0.2862	0.1432	0.4911	NA*
The Czech Republic	**0.0255**	0.6618	0.6466	0.0776	0.5464
Estonia	0.9302	0.6186	0.7876	0.5699	0.5698
Latvia	0.2691	0.4707	0.9423	0.9758	0.9929
Poland	0.4563	0.3835	**0.0223**	**0.0432**	0.2559
Lithuania	0.6244	0.4724	0.7032	0.8278	0.9591
Romania	0.9359	0.8129	0.5948	0.8295	NA
Slovakia	0.9070	0.3664	0.2502	0.3087	0.7251
Slovenia	0.4555	**0.0421**	0.0548	0.5019	0.4355
Hungary	0.3246	0.6046	0.3977	0.7636	0.9547

**NA – due to the lack of time series values, the probability of F-statistics is not calculated*

Table A.3

The Results of the Causality Test for the Variables State aid Expenditure and Number of Enterprises

Country	State Aid Expenditure → Number of enterprises				
	l=1	l=2	l=3	l=4	l=5
Bulgaria	0.9966	NA*	NA	NA	NA
The Czech Republic	0.7720	0.7747	NA	NA	NA
Estonia	0.0378	0.2815	NA	NA	NA
Latvia	0.5952	NA	NA	NA	NA
Poland	0.3894	NA	NA	NA	NA
Lithuania	0.3222	NA	NA	NA	NA
Romania	0.1661	0.1563	NA	NA	NA
Slovakia	0.9433	NA	NA	NA	NA
Slovenia	0.5088	NA	NA	NA	NA
Hungary	0.6362	NA	NA	NA	NA

**NA – due to the lack of time series values, the probability of F-statistics is not calculated*

Table A.4

Variables State Aid Expenditure and Number of Patent Applications Causality Test Results

Country	State Aid Expenditure → Number of Patent Applications				
	l=1	l=2	l=3	l=4	l=5
Bulgaria	0.1640	0.4194	0.4278	0.0859	NA*
The Czech Republic	0.1092	0.2224	0.3604	0.4062	NA
Estonia	0.0657	0.1353	0.4047	0.2610	NA
Latvia	0.0238	0.1022	0.3655	0.8697	NA
Poland	0.4219	0.9298	0.8786	0.8903	NA
Lithuania	0.4398	0.0260	0.2096	0.0771	NA
Romania	0.9694	0.9134	0.9630	0.5139	NA
Slovakia	0.4073	0.8485	0.1480	0.3442	NA
Slovenia	0.3203	0.2712	0.0402	0.2782	NA
Hungary	0.7395	0.8291	0.6808	0.1885	NA

**NA – due to the lack of time series values, the probability of F-statistics is not calculated*

Table A.5

The Variables State aid Expenditure and Change in Real GDP per Capita, Causality Test Results

Country	State Aid Expenditure → Change in real GDP per capita				
	l=1	l=2	l=3	l=4	l=5
Bulgaria	0.9148	0.9664	0.9746	0.8535	NA*
The Czech Republic	0.7722	0.8241	0.8502	0.6639	0.7426
Estonia	0.8243	0.8835	0.8729	0.6424	0.8005
Latvia	0.6559	0.5788	0.6345	0.7872	0.5648
Poland	0.3876	0.4402	0.0995	0.2326	0.7956
Lithuania	0.3001	0.7315	0.1687	0.2238	0.5319
Romania	0.7839	0.8983	0.3166	0.3824	NA
Slovakia	0.7297	0.0610	0.2100	0.1456	0.4935
Slovenia	0.8815	0.8676	0.5803	0.5107	0.5894
Hungary	0.0166	0.0027	0.0210	0.1865	0.3754

**NA – due to the lack of time series values, the probability of F-statistics is not calculated*

Table A.6

Results of the Variables State aid Expenditure and Business Investment Causality Test

Country	State Aid Expenditure → Business investment				
	l=1	l=2	l=3	l=4	l=5
Bulgaria	0.8896	0.7321	0.7928	0.9271	NA*
The Czech Republic	0.0945	0.5240	0.0625	0.2776	0.1444
Estonia	0.7180	0.8685	0.9161	0.8939	0.9383
Latvia	0.7619	0.8260	0.7666	0.6199	0.5042
Poland	0.6788	0.6988	0.2491	0.4722	0.4341
Lithuania	0.2779	0.3993	0.7099	0.6715	0.6254
Romania	0.6625	0.2828	0.3646	0.3312	NA
Slovakia	0.5321	0.1527	0.2062	0.3381	0.0867
Slovenia	0.0911	0.3366	0.4469	0.5070	0.3773
Hungary	0.5035	0.5921	0.8141	0.8755	0.9836

**NA – due to the lack of time series values, the probability of F-statistics is not calculated*

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