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Determinants of industrial development in Central European countries: Empirical evidence from a dynamic panel analysis

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ABSTRACT

This study investigated the determinants of industrial development in ten (10) Central European countries from 1990 to 2021. We used a panel ARDL method to study the effects of key economic factors on industrial growth to achieve this goal. These factors included credit to the private sector, market size, internet access, and trade openness. The results showed the following: Firstly, trade openness had a positive and significant effect on industrial development in Central Europe. This evidence implies that trade openness is a major factor that drives industrial development forward. However, market size and internet accessibility had a negative and significant effect on industrial development in Central Europe. This finding implies that the major economic factors that drive industrial development backward in Central Europe are market size and internet accessibility. Therefore, this study recommends that since trade openness is the major economic factor that propels industrial development forward in Central Europe, policymakers in this economic bloc should embark on a dynamic trade policy that will integrate Central Europe with other emerging markets. Furthermore, the practical implication is that policymakers in Central Europe should embark on policies that expand their domestic market by encouraging their citizens to patronize locally manufactured products.

Contribution/ Originality: The motivation for embarking on this study with reference to Central Europe lies in the fact that little or no empirical studies are currently available in the literature to establish the direction and magnitude at which economic and financial factors have driven industrial development in this subregion.

1. INTRODUCTION

The industrial sector has been one of the engines of economic prosperity across the globe. This is because the industrial revolution has been an unprecedented catalyst for a rise in global production, job opportunities, and income generation, which could be a strategy for achieving sustainable development. The indispensable role that the industrial sector occupies in the transformation of the global market has always been the major argument of the growth model (Kaldor, 1967). Consequently, the urgent need to create a viable industrial base as an avenue to generate decent work for all activated the institutionalisation of the Sustainable Development Goals (SDGs) (United Nations, 2015). Given the statement above, this study is designed to examine the determinants of industrial development in Central Europe. This research is highly imperative because the advancement of manufacturing output has been identified as a critical driver of gross domestic product growth (Pacheco-López & Thirlwall, 2013). As such, any internal or external shocks from the business cycle fluctuations might spell doom for the industrial sector in particular

and the entire economy as a whole (Behun, Smetana, & Capoca, 2018). Since COVID-19 began, the manufacturing sector has been one of the adversely affected sectors of the economy. Globally, about 54% of the workers in this sector were vulnerable due to the precaution measures adopted in order to contain the spread of the virus (International Labour Organisation Monitor, 2020). In 2020, the Eurozone experienced the biggest decline in industrial activities since World War II ended (Badkar & Greeley, 2020).

Meanwhile, before the advent of COVID-19, most of the countries in Central Europe had gone through substantial dynamics in terms of their economic structure, characterized by a decline in the contribution of manufacturing value added alongside the level of employment (Damiani & Uvalic, 2014; European Commission, 2013). For instance, in Germany, the share of employment by manufacturing sector dwindled from 28.3% in 1990 to 19% in 2007. In the same vein, the EU-13 experienced a 5% decrease in the share of manufacturing employment within the same period (OECD, 2014). This is evidence that industrial performance had been facing a lot of challenges in Central Europe before COVID-19 started. The critical research question that deserves an urgent response in addressing the current industrial crisis in this region of the world is, what are the potential variables that drive industrial development in Central Europe?

However, theories and empirical research have identified numerous factors as significant drivers of industrial development in various economies worldwide. According to (Lucas, 1988), human capital drives the growth of the industrial sector. Whereas McKinnon (1973), Stiglitz (2002), and Atiq (2014) emphasized the significance of financial liberalization and development in propelling industrial activities. Some new studies have found that macroeconomic factors such as trade openness, GDP growth rate, FDI, inflation, market size, agricultural output, infrastructure development, credit availability, and exchange rates significantly influence the growth of the industrial sector in many Asian and African countries (Aransiola, Olasupo, Ogunwole, Abalaba, & Aderemi, 2022; Kumar, Batra, & Dixit, 2017; Maroof, Hussain, Jawad, & Naz, 2019; Samouel & Aram, 2016; Singh & Kumar, 2021). It is important to stress that the motivation for embarking on this study with reference to Central Europe lies in the fact that little or no empirical studies are currently available in the literature to establish the direction and the magnitude at which economic and financial factors have driven industrial development in this sub region of Europe. Therefore, the objective of the study primarily focuses on investigating the impact of market size, credit to the private sector, trade openness, and infrastructure on industrial development from 1990 to 2021 using a sample of selected Central European countries.

The structure of this paper is outlined as follows: besides the introduction in section one, section two involves a literature review and the stylized facts about determinants of industrial development in Central European countries. Methodology was discussed in section three. Section four encompasses the presentation and discussion of the paper's results and policy recommendations.

2. LITERATURE REVIEW

Aiyedogbon and Anyanwu (2015) utilized the ordinary least squares method to analyze the influence of macroeconomic factors on industrial productivity in Nigeria from 1981 to 2013. The findings from the study show that the exchange rate had a major and positive impact on Nigeria's industrial productivity. Whereas the consumer price index, the total money supply, and credit to the manufacturing sector harm industrial productivity, interest rates, foreign direct investment, and real GDP, interest rates have favorable effects. In another study, OU (2015) assessed the impact of industrial development on the development of the Nigerian economy from 1973 to 2013 using PC. The author asserted that inflation adversely influenced the Nigerian economy. However, economic development was favorably and adequately impacted by industrial development. Amoah and Jehu-Appiah (2022) used two-stage least squares analysis to explore the factors that affected industrialization in Africa from 1990 to 2018. The study found that foreign direct investment, the overall amount of natural resources, and financial development exerted a considerable favorable influence on industrialization. Trade openness significantly and negatively impacted industrialization, while human capital and inflation had little impact.

Aransiola et al. (2022) used annual data from 1990 to 2019 to investigate the factors influencing industrial development in Nigeria. The study analyzed the data using Fully Modified Ordinary Least Squares (FMOLS) and the Granger causality test. It was discovered that the size of the market, agricultural output, trade openness, GDP growth rate, and exchange rate are not significant factors that can propel industrial development in Nigeria. Beaudry and Schiffauerova (2009) looked at how much MAR and Jacobs' externalities contributed to innovation and growth. One of the objectives of the study was to determine a threshold at which either of the two ideas becomes dominant by a careful assessment of 67 previously completed research projects. According to the authors, almost 70% of the studies that were analyzed discovered evidence of MAR externalities, whereas a similar percentage (75%) discovered evidence of Jacobs' externalities. Marshall Externalities typically only show adverse effects, unlike Jacobs's externalities. Such results could imply that diversification is more likely to promote local economic growth than regional specialization, which could restrict it.

Biatour, Dumont, and Kegels (2011) analyzed how total factor productivity was calculated in Belgium between 1988 and 2007. R&D is a key determinant, whether it is research and development accumulated within the industry (intra-industry) or R&D accumulated by other domestic or foreign industries (inter-industry), according to the data from the study that employed econometric technique. The study also discovered compelling evidence that the factors influencing total factor productivity vary significantly among industries. Cheremukhin, Golosov, Guriev, and Tsyvinski (2017) investigated Russia's industrialization and economic growth from 1885 to 1940. The dataset, which spans the periods of Soviet Russia from 1928 to 1940 and Tsarist Russia from 1885 to 1913, was created using a two-sector neoclassical growth model. The study found little proof that Soviet expansion was aided by "Big Push" mechanisms or that Tsarist agricultural institutions were a significant impediment to worker migration to manufacturing. Chernenko (2013) examined the factors that contributed to industrial growth in Ukrainian cities between 2001 and 2009. The majority of the findings were substantial and concurred with earlier research by Glaeser, Kallal, Scheinkman, and Shleifer (1991). According to the study's findings, variety and local competitiveness help Ukraine grow. Diversity benefits all sectors equally, but competitiveness benefits manufacturing businesses significantly more. Specialization and firm size severely hinder industrial growth. Combes (2000) assessed the France's economic structure and regional development between 1984 and 1993. According to the study, industry diversity and density promote job growth in the service sectors of the economy while inhibiting it in the industrial sectors. According to Combes (2000), inter-sectorial knowledge spillovers and the existence of sizable client and supplier bases are the main causes of this. For neither the industrial nor the service sectors were localization economies or effects of specialization on urban or industry expansion discovered. Certain industries, like the apparel or auto industries, have shown growth limitations due to competition. Services typically grow more quickly in denser areas than industrial sectors do in less dense areas.

Elfaki, Handoyo, and Ibrahim (2021) examined the impact of industrialization, trade openness, financial development, and energy consumption on Indonesia's economic growth from 1984 to 2018. The authors used Autoregressive Distributed Lag technique to assess the objective of the study, it was discovered that industrialization, energy consumption, and financial development (as measured by domestic credit) all had long-term positive effects on economic growth. However, trade openness and financial development showed a detrimental impact on economic growth. Similarly, Jawad, Maroof, and Naz (2019) explored the factors influencing industrial development in China, the European Union, and the United States. The study provided evidence that equity openness, trade openness, and foreign direct investment were major determinants in the European Union. Governance, trade openness, and capital account openness, however, are important predictors in China; in the United States, governance, exchange rate, foreign direct investment, private investment, and public investment are important. Kublina and Ali (2021) evaluated the development of industrial diversification and related factors in Germany. According to the study's findings, the two-digit sectorial shares of the entropy component of the Regional Variety index are more dominating than the actual two-digit sectorial shares. They also evaluated the firm's entrances and exits regions with the highest and

lowest RV scores. According to the survey, the overall number of industries increased in both the top and bottom regions. This suggests that the creative destruction effect, which drives out inefficient old industries, leads to a growth in regional variety. Also, Maroof et al. (2019) used panel autoregressive distributed lag and the Granger causality test to look at the factors that affected industrial growth in South Asian countries from 1996 to 2015. The study revealed that inflation, equity openness, and foreign direct investment significantly contributed to the industrial development of South Asian nations.

Ndiaya and Lv (2018) assessed the impact of industrialization on Senegal's economic development using Ordinary least square to analyze data from 1960 to 2016. The outcome demonstrated that economic growth would increase with an increase in industrial output. This suggests that industrialization significantly impacts Senegal's economic growth. Otalu and Anderu (2015) evaluated the factors that contributed to Nigeria's industrial sector's development. We examined the study using the error correction model. The study revealed that the factors influence industrial output more permanently than temporarily. Additionally, labor and capital significantly impact the industrial sector, while the industrial sector has a positive and significant influence on the exchange rate. Öztürk and Ağan (2017) investigated the factors affecting industrial production in Turkey. Evidence from the study, which used the E-views 6.0 package program and the vector autoregressive (VAR) model, showed that every regressor was found to be significant in explaining industrial outputs.

Samouel and Aram (2016) looked at the factors influencing industrialization in 35 African nations between 1970 and 2012. The study's use of the dynamic panel model revealed that financial development, governance, and labor market regulation have a substantial impact on industry, whereas the industrialization process is negatively impacted by exchange rate appreciation. While socioeconomic factors matter more for the western and southern countries than the northern and eastern countries, differences in the power of the industrialization determinants are not likely to emerge. Instead, financial and institutional factors are the main drivers of industrialization in both of these regions.

Soyyiğit (2010) deduced that imports, rather than exports, account for Turkey's development. Studies covering decades following the 1980s may have produced inconsistent outcomes because the export-led growth plan was not properly implemented.

Vertakova, Plotnikov, and Culicov (2015) examined the elements influencing industrial development in Russia. The study concluded that Russia's state industrial strategy and strategies for the growth of industrial companies needed to be adjusted. Industry in Russia should compete on global markets in the current environment by introducing new technology and raising the quality of its products rather than by lowering prices. Willmore (1989) investigated the factors influencing Brazil's industrial structure. The study shows that concentration ratios for 119 Brazilian sectors are reflected by combining the capacity of the suboptimal sector, the proportion of new firms entering, and scale effects. There are many factors that can lead to suboptimal entry and capacity, which in turn leads to industrial concentration. These include foreign ownership, indigenous ownership, tariff protection, geographic concentration, exports, minimum effective scale, advertising, and capital intensity.

In summary, it is important to stress that from the reviewed papers, although various drivers of industrial development in various countries and regions of the world have been enunciated in the past studies, there is a lack of studies on this subject matter in central European countries. This underscores the significance of the present study.

3. METHODOLOGY

This chapter focuses on the procedures and analysis of the data collected. Additionally, the chapter briefly emphasizes the theoretical framework of the study, the model specification, a priori expectations, data sources, and the technique of estimation of the study.

3.1. Research Design

This study adopts *an ex-post facto* research design. The *ex-post facto* research design is the best to employ for this study because the study's main interest lies in the exploration of a viable relationship, as well as the validation of how the explanatory variables (determinants) predict variation in the dependent variable (industrial development).

3.2. Theoretical Framework

In determining various factors that propel industrial development over the time, various arguments have been enunciated historically in theoretical literature as follows: Shaw (1973) and McKinnon (1973) emphasized that inflation instigated by low-interest rate policy could be an impediment to industrial development because inflation rate in the market discourages saving, and when saving is discouraged, investments will follow suit. This restricts the amount of funds available to manage the supply chain, ultimately leading to a slowdown in industrial growth. In the submission of Solow (1956), financial openness, whose strategic components are capital account, trade openness, and equity capital, drives industrial sector expansion in emerging nations via the instrumentality of capital movement from the economies that are capital sufficient to the economies that are capital deficient. Furthermore, the endogenous growth model's propositions, as articulated in the popular works of Lucas (1988), Romer (1990), and Romer (1986), emphasize the critical and significant role of technological innovation, research and development, and trade openness in driving industrial sector, which are the catalysts for economic development.

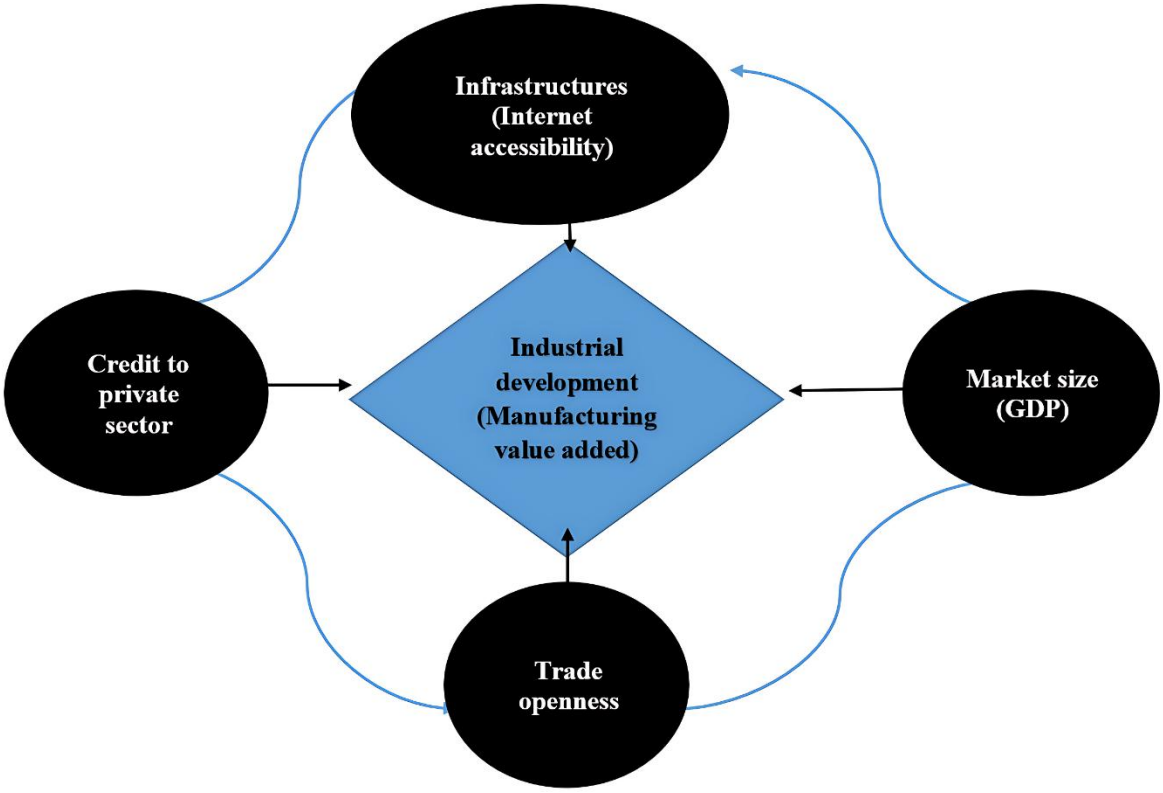

Figure 1. Conceptual framework of determinants of industrial development in Central Europe.

3.3. Model Specification

Having established various macro-economic variables that propel industrial development in the conceptual framework of this study in Figure 1, the model to estimate their relationship is adapted from the works of Olanipekun, Oloke, Lateef, and Aderemi (2022) and Aransiola et al. (2022), in which the functional form of the model is enunciated as follows:

$$Industrial\ Development\ =$$
$$f\ (Market\ Size, Credit\ to\ Private\ Sector, Trade\ Openness, Infrastructures) \quad (1)$$
$$ID\ =\ f\ (MS, CPS, TP, AI) \quad (2)$$

If Model 2 is linearized, this gives birth to the following models.

$$ID_t = \alpha_0 + \beta_1 MS_t + \beta_2 CPS_t + \beta_3 TP_t + \beta_4 AI_t + u_t \quad (3)$$

Restating Model 3 in a panel format therefore brings about Model 4 we have.

$$ID_{it} = +\alpha_0 + \beta_1 MS_{it} + \beta_2 CPS_{it} + \beta_3 TP_{it} + \beta_4 AI_{it} + u_{it} \quad (4)$$

If Model 4 is restated in the form of an ARDL panel model, we have Model 5 as follows;

$$ID_{it} = \sum_{i=1}^{p1} \beta_0\, ID_{it-i} + \sum_{i=1}^{p1} \beta_{01}\, MS_{it-i} + \sum_{j=1}^{p2} \beta_{02}\, CPS_{it} + \sum_{k=1}^{p3} \beta_{03}\, TP_{it} + \sum_{k=1}^{p3} \beta_{04}\, AI_{it} + \theta ECM_{it} + \sum_{i=1}^{p1} \beta_5\, \Delta\, ID_{it-i} + \sum_{j=1}^{p2} \beta_6\, \Delta MS_{it} + \sum_{k=1}^{p3} \beta_7\, \Delta\, CPS_{it} + \sum_{i=1}^{p1} \beta_8\, \Delta\, TP_{it} + \sum_{j=1}^{p2} \beta_9\, \Delta AI_{it} + u_{it} \quad (5)$$

p is the lag length, t represents periods of analysis from 1990 to 2021, u is the error term, and i stands for the number of countries in the panel model, which includes Austria, Croatia, the Czech Republic, Germany, Hungary, Poland, Serbia, Slovakia, Slovenia, and Switzerland.

3.4. A priori expectation.

It is expected that the outcomes of the estimated model should follow this pattern B_0 to $\beta_9 > 0$ and $\theta < 0$. The short-run parameters are denoted by B_0 to β_{05} and the long-run parameters are represented by B_5 to β_9 respectively. However, θ stands for the adjustment speed existing between the short-run and long-run parameters, which is expected to have a negative sign and be significant as well.

3.5. Nature of Data

The study made use of secondary data within the period from 1990 to 2021. It is important to report that few missing data points were observed in the dataset, which this study addressed by following the approach of Benchani and Swis (2019). Consequently, the missing data points were replaced using the mean value of the dataset's last four most recent years. This technique, therefore, enhanced the panel dataset to be strongly balanced.

Table 1. Measurement of variables.

Abbreviation	Description	Unit of measurement	Source
ID	Industrial development. In measuring this variable, manufacturing value added as a percentage of GDP was utilized.	Percentage	World Development Indicators of the World Bank (WDI)
MS	Market size. GDP was employed to proxy market size	Billion dollars	WDI
CPS	Credit to the private sector	Billion dollars	WDI
TP	Trade openness. This is calculated from the adjustment between imports and exports as a percentage of GDP	Percentage	WDI
AI	Access to the internet is proxied by the number of people who have access to the internet as a percentage of the country's population.	Percentage	WDI

Table 1 presents measurement of variables of interest of the study.

3.6. Estimation Techniques

In choosing the best estimation technique for this study, we first embarked on several pre-estimation tests, such as a test for panel unit roots, in order to have a clue to the appropriate estimation technique. Consequently, the preliminary test of the dataset established that the study's variables consist of I (0) and I (1). This outcome informed our decision

to employ a Panel ARDL as the appropriate technique of estimation following the submission of Pesaran, Shin, and Smith (1999); Pesaran and Pesaran (1997); and Pesaran, Shin, and Smith (2001).

Table 2. Descriptive statistics.

Descriptive statistics	LCPS	LGDP	AI	PAE	IVA	TO
Mean	3.99	27.4	47.0	99.9	27.8	103
Median	3.04	27.3	56.5	100	27.4	98.0
Maximum	5.13	31.3	95.5	100	36.1	189
Minimum	-1.68	23.8	0.00	99.6	19.7	13.3
Std. deviation	0.62	1.92	33.3	0.03	3.26	36.5
Skewness	-2.30	0.01	-0.27	-8.63	0.10	0.40
Kurtosis	23.2	2.34	1.45	79.0	3.04	2.59
Jargue-Bera	587	5.72	35.5	807	0.56	10.7
Probability	0.00	0.05	0.00	0.00	0.75	0.00
Sum	127	876	149	318	886	330
Sum sq. dev.	122	117	353	0.34	339	424
Observations	319	319	319	319	319	319

4. RESULTS AND DISCUSSION

4.1. Pre-Estimation Results

We estimated descriptive statistics to show the distribution of the dataset we used in this study, and Table 2 presents the results. Both credit to the private sector (LCPS) and real GDP (LGDP) are in log form. Both have mean and median values that are identical. Their mean values are also bigger than the values of their respective standard deviations. This indicates a normal dispersion of LCPS and real LGDP from the mean.

However, other variables are percentages; therefore, there is no need to represent them in log form. From 1990 to 2021, the mean percentage of the population in Central Europe with internet access (AI) is 47.01%. The mean value exceeds the variable's standard deviation, indicating a normal dispersion of AI from its mean over time. Similarly, the percentage of people having access to electricity (PAE) in Central Europe has a mean value of 99.9%. This percentage means that from 1990 to 2021, almost everybody has had access to electricity in Central Europe. The variable's standard deviation, significantly less than the mean value, suggests a normal dispersion of PAE data from its mean.

Furthermore, manufacturing value added as a percentage of GDP (IVA) from 1990 to 2021 has a mean value of 27% in Central Europe. This number implies that manufacturing industries contribute to about 27% of economic outputs in this subregion over time. Since the mean value exceeds the standard deviation, this data typically exhibits dispersion from its mean. In the same scenario, trade openness (TO) has a mean value of 103%. This graph shows that Central Europe's TO registers about 103% in the past three decades. The implication of this finding is that the economies of Central Europe are active players in the global market. The data for this variable has a moderate dispersion from its mean due to the lower value of its standard deviation compared to its mean value.

In summary, there is a close relationship between the mean and median values of each variable. This finding signals the confirmation of the normal distribution behavior of the variables. Hence, further econometrics techniques could be applied to estimate these variables in the study.

Table 3. Correlation matrix.

	LCPS	LGDP	PAE	AI	TO
LCPS	1.00	-0.16	0.07	0.25	0.02
LGDP	-0.16	1.00	-0.10	0.07	-0.16
PAE	0.07	-0.10	1.00	-0.01	0.05
PAI	0.25	0.07	-0.01	1.00	0.33
TO	0.02	-0.16	0.05	0.33	1.00

4.1.1. Correlation Analyses

In ensuring that the estimation of the study`s model is free from multicollinearity, we took a further step to check the correlations among the independent variables of the study, of which the results were presented in Table 3. The results in the above table show that low and weak correlations exist between the various pairs of correlations in the study. This suggests that the regressors do not have a tendency to exhibit a multicollinearity problem.

Table 4. Levin, Lin & Chu t* test and Im, Pesaran, and Shin W-stat test.

Variables	Levin, Lin & Chu t* test				
	Level	**Probability**	**1st diff.**	**Probability**	**Remark**
IDV	-3.50	0.00	-	-	I(0)
LCPS	-0.71	0.23	-7.18	0.00	I(1)
LGDP	-1.14	0.12	-	-	I(0)
PAE	-3.14	0.00	-	-	I(0)
PAI	-0.76	0.22	-2.22	0.01	I(1)
TO	-1.63	0.05	-9.92	0.00	I(1)
Variables	Im, Pesaran and Shin W-stat test				
	Level	Probability	1st Diff	Probability	
IDV	-2.55	0.00	-	-	I(0)
LCPS	-0.67	0.25	-8.60	0.00	I(1)
LGDP	-3.03	0.00	-	-	I(0)
PAE	-3.08	0.00	-	-	I(0)
PAI	2.85	0.99	-3.96	0.00	I(1)
TO	-0.00	0.49	-10.6	0.00	I(1)

4.2. Panel Unit Root Tests

Testing for the stationarity property of data is a critical aspect of this study that cannot be ignored because this study utilized data that is trended over time. Therefore, failure to exercise appropriate caution could lead to the emergence of spurious results, potentially invalidating the study's policy recommendations. To curb the issue of spurious results, we estimated panel unit roots, the results of which were presented in Table 4.

The results in the table show that three variables have an integration order of zero, while the remaining three have an integration order of one. In light of the above, this study estimated a panel ARDL to address its objective, following Pesaran et al. (2001).

Table 5. Appropriate lag length selection criteria.

Model selection criteria table					
Dependent variable: ID					
Sample: 1990 2021					
Included observations: 319					
Model	LogL	AIC*	BIC	HQ	Specification
1	-300	2.36	3.14	2.67	ARDL(1, 1, 1, 1, 1)

Table 5 presents the criteria for selecting lag length. Before estimating the panel ARDL, there is a need to determine the correct lag length to get the best estimates. All the information criteria suggest that lag one is the best lag for the ARDL model.

The results of the panel ARDL estimation of determinants of industrial development in Central Europe were presented in Table 6. It is important to stress that the Error Correction Model, which represents the speed of adjustment, has a coefficient that is both negative and significant. This suggests that the long run corrects 28% of the error-induced short-run disequilibrium in the model. Meanwhile, the coefficients of the short-run aspect of the ARDL model are not significant at the 5% significance level. While the majority of the long-run coefficients are significant,

this indicates that certain factors influencing industrial development in Europe are long-term phenomena. This study fully considers the long-run ARDL estimates.

Table 6. Results of the panel autoregressive distributed lag model of the determinants of industrial development in Central Europe.

Dependent variable: ID						
Regressors	**Long-run coefficient**	**T-statistics**	**Prob.**	**Short-run coefficient**	**T-statistics**	**Prob.**
LCPS	-0.28 (0.33)	0.85	0.39	-0.32 (0.93)	0.34	0.73
LMS	-3.76* (0.90)	4.17	0.00	8.20*** (4.40)	1.86	0.06
TP	0.02* (0.00)	3.23	0.00	0.02*** (0.01)	1.81	0.07
AI ECM	-0.03* (0.030) -0.28*	6.24 5.52	0.00 0.00	-0.00 (0.01)	0.16	0.87

Note: The value in parentheses denotes the standard error. *Significant at 1%, ***significant at 5%.

Firstly, private sector credit and industrial development have a negative but insignificant relationship in Central Europe. A unit change in private sector credit brings about a 0.29% reduction in industrial development in the countries considered for the study. Similarly, market size and industrial development in Central Europe have a significant inverse relationship. If the market size changes by one unit, industrial development will fall by 3.7% in Central Europe. Furthermore, the number of people who have internet accessibility and industrial development have a significant negative relationship in Central Europe. As the number of people who have access to the internet changes by a unit, industrial development falls by 0.03% in Central Europe. However, trade openness and industrial development have a significant positive relationship in Central Europe. A unit change in trade openness leads to a 0.03% rise in industrial development. The above suggests that credit to the private sector has a minor but negative impact on industrial development. This result contradicts the finding of Amoah and Jehu-Appiah (2022) in a similar study focusing on Africa. On the other hand, market size and internet accessibility have a significant negative impact on industrial development. It is only trade openness that has a positive and major effect on industrial development. This finding is in line with the arguments of Jawad et al. (2019) in a related study in Europe, Elfaki et al. (2021) in Indonesia, Maroof et al. (2019) in South Asia & Öztürk and Ağan (2017) in Nigeria.

Table 7. Results of panel dynamic least squares (DOLS).

Dependent variable: ID			
Regressors	**Coefficient**	**T-statistics**	**Prob.**
LCPS	-0.63 (0.67)	0.93	0.34
LMS	0.86 (1.25)	0.68	0.49
TP	-0.03* (0.01)	3.04	0.00
AI	-0.00 (0.00)	0.05	0.95
R-squared	0.87		

Note: The value in parentheses denotes the standard error. *Significant at1%.

4.2.1. Robustness Check

Further effort was made to perform the robustness check to verify if the results obtained from the long-run panel ARDL are valid or otherwise. We used the same dataset to run a panel DOLS. Table 7 reports that the coefficient of LCPS is negative and insignificant, as it is in the panel ARDL. The coefficient of AI is negative, as it is in the panel ARDL. Furthermore, the coefficient of TP is significant at the 1% level of significance, as it is in the panel ARDL.

5. CONCLUSION AND POLICY IMPLICATIONS

This study investigated determinants of industrial development in Central Europe from 1990 to 2021. Our goal was to find out how the following strategic economic factors—credit to the private sector, market size, internet access, and trade openness—affect industrial development. We used a panel ARDL method and came to the following conclusions:

- Firstly, trade openness had a positive and significant effect on industrial development in Central Europe. This evidence implies that trade openness is a major factor that drives industrial development forward. This is an indication that countries in Central Europe are active participants in the global market.
- However, market size and internet accessibility had a negative and significant effect on industrial development, whereas credit to the private sector had an insignificant effect on industrial development in Central Europe. This implies that the major economic factors that drive industrial development backward in Central Europe are market size and internet accessibility.

In view of the above, this study recommends that since trade openness is the major economic factor that propels industrial development forwards in Central Europe, the policymakers in this economic bloc should embark on a dynamic trade policy that will integrate Central Europe with other emerging markets. Furthermore, the policymakers in Central Europe should embark on a policy that will expand their domestic market by encouraging their citizens to patronize locally manufactured products. All stakeholders in the manufacturing subsector in Central Europe should embark on improving the internet infrastructure in the industrial sector.

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Data Availability Statement: Upon a reasonable request, the supporting data of this study can be provided by Timothy A. Aderemi.
Competing Interests: The author declares that there are no conflicts of interests regarding the publication of this paper.

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