

A Panel Regression Analysis of the Role of Globalization and Internet Penetration on Economic Development in the Czech Republic and Slovakia

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Abstract: It is evidently clear that globalization is seen widely in recent times as a means of knowledge-based economy, and more importantly, an instrumental indicator to influence economic development. For this reason, some researchers are increasingly interested in how globalization impacts our society leading to economic growth. In this paper, we investigate the relationship between globalization, internet penetration, and economic development in Czech Republic and Slovakia. Panel Regression analysis is employed to analyze a twenty two-year panel data (from 2000 to 2022), using secondary data from the World Bank, OECD, and UNDP database of the selected countries. We analyze globalization variables such as trade openness, internet penetration as independent variables and used infrastructural investment, political instability index, and labor force participation rate as control variables. Also, with economic development as a dependent variable, we used Human development index, and GNI per capita to ascertain the effect of globalization and internet penetration on economic development. The results showed a significant positive correlation between trade openness with HDI and GNI in both Czech and Slovakia. The analysis also found that internet penetration has a significant impact on HDI and GNI in Czech, but not on GNI in Slovakia. This study highlights the important role that globalization and internet penetration play in economic development and provides valuable insights for policymakers in Czech and Slovakia. The findings of this study contribute to the existing literature on the relationship between globalization, internet penetration, and economic development.

Keywords: Globalization, Internet, Economic development, Knowledge, Regression analysis

1. Introduction

The integration of nations through globalization and the development of digital technologies have resulted in significant changes in the world economy (Malik, 2018). Countries have been seeking to participate more in the global economy to improve their economic development. Trade, capital flows, and technological advancements have provided new opportunities for economic growth and development. The internet has revolutionized how businesses operate, allowing individuals and firms to engage in global trade and exchange information (Kagermann, 2014). The Czech Republic and Slovakia, both former socialist countries, faced challenges during their transition to a market-oriented economy, including high unemployment rates, inflation, and political instability (Leff, 2018). However, both countries have made considerable progress in recent years, and their economies have been growing steadily.

Globalization refers to the integration of economies, societies, and cultures through trade, communication, and the exchange of goods and services (Marginson, 1999). With the advent of the internet, the process of globalization has accelerated, making it easier for countries to engage in international trade and collaborate on various projects. The Czech Republic and Slovakia have taken advantage of the opportunities offered by globalization and the internet to achieve significant economic growth (Carayannis & Popescu, 2005).

Internet penetration refers to the extent to which a country's population has access to and uses the internet (Brandtzæg, et al., 2011). The internet has transformed the way people interact, communicate, and access information, and has also had a profound impact on businesses and the economy. The Czech Republic and Slovakia have experienced a rapid increase in internet penetration in recent years, with both countries according to the world bank data ranking for 2021 showing 89% for Slovakia and 83% for Czechia and these figures are amongst the highest levels of internet usage in Europe. Bayar et al. (2021) in their research on the effect of internet usage on financial inclusion in 11 countries of European Union using data between 1996 to 2017 in a causality analysis. Found that internet usage poses both negative and positive effect on financial inclusion. The researchers indicate limitation of the study to sample size and data availability. This research responds to the call for future research to explore further the recent trend analysis using current data.

Moreover, research exploring the role of Information communication technology and globalization play on economic development in Organization for economic cooperation and development countries through the

ordinary least square analysis found that, ICT and globalization positively contribute to economic growth. The weakness of this study is the reliance on OECD countries without recourse to a comparative analysis (Kurniawati, 2020). By way of filling the gap, the current study employs a comparative analysis for the selected CEE countries. Myovella, et al. (2020) in their paper examined the contribution of digitalization to economic growth of Sub-Saharan Africa (SSA) in comparison with the OECD economies. The results show that digitalization has a positive contribution to economic growth in both countries. The limitation of the data on digital transformation restricts the studies to only use ICT usage. The need to explore more Digital transformation variables was highly recommended of which this study employs.

As elaborated, most of the studies have concentrated on just Globalization impact on economic development and most often relied on a measure for digitalization using ICT or the effect of globalization on economic development. However, the question of whether the knowledge of globalization (Trade openness) and internet penetration affect economic development in a model remains unanswered. To address the above-mentioned gap, we aim to examine the role of globalization and internet penetration on economic development in the Czech Republic and Slovakia. By using composite variables which were calculated from different set of factors based on a secondary data set. Specifically, we examine the impact of a key globalization variable: trade openness and internet penetration on economic development. We also use infrastructural investment, political instability index, and labour force participation rate as control variables. Economic development is measured through two indicators: the Human Development Index (HDI) and Gross National Income (GNI) per capita.

To the best of our knowledge, less to no study explores the link between knowledge of Globalization and internet penetration and economic development in Czech Republic and Slovakia. This study will give policy experts and the EU some implications to support and improve the ways in which globalization and digital technologies can contribute to economic development. We contribute to science by adding empirical and practical recommendations based on our review of the existing literature and econometric analysis.

The rest of the paper is organized as follows. The next section provides a brief review of the existing theories and literature to distinguish our paper from existing studies and help explain the contribution of our paper. In Section 3, we briefly describe our methodology and data sources. Section 4 outlines the empirical findings and In Section 5, we present Discussions and the conclusions and recommendations presented in chapter 6.

2. Theoretical Background and Literature Review

The theoretical background of this research topic, "The Role of Globalization and Internet Penetration on Economic Development" delves into the understanding of globalization and the internet, and their impact on economic development (Marginson, 1999; Brandtzæg, et al., 2011). The study of globalization and its impact on economic development has been a topic of interest for many economists (Gurgul & Lach, 2014). Some have argued that globalization has led to increased economic growth and development (Ali & Malik, 2021; Boriçi, 2016; Brown, & Lauder, 1996), while others have argued that it has led to increased inequality and destabilization (Milner, 2021; Sachs, 1998). In the context of this research, the focus will be on the relationship between globalization and internet penetration and their impact on economic development.

One of the key theoretical frameworks used to understand the impact of globalization on economic development is the New Economic Geography (NEG) theory. According to this theory, globalization leads to the concentration of economic activity in certain regions (Fujita, et al., 2001; Martin & Sunley, 1996). The theory suggests that globalization leads to increased competition, which leads to a reallocation of economic activity to regions that have a competitive advantage.

The impact of the internet on economic development has also been studied (Czernich, et al., 2011; Koutroumpis, 2009). The internet has been identified as a key driver of economic development, with many countries investing in internet infrastructure and technology to enhance their competitiveness (Salahuddin & Gow, 2016). Internet penetration has also been seen as a tool for reducing information asymmetries, leading to increased efficiency and productivity (Aboody & Lev, 2000).

In the context of the Czech Republic and Slovakia, this study is particularly relevant for both countries as they have undergone significant economic transformation since the fall of the Soviet Union, with both countries becoming integrated into the global economy and investing in internet technology (Roztocki & Roland Weistroffer, 2008).

2.1 The Role of Trade Openness and Economic Development

In this chapter, we reviewed the trade theory of factor proportions. According to this theory, countries will tend to specialize in producing goods that use their abundant factors of production relatively intensively, while importing goods that use their scarce factors relatively intensively (Samuelson, 1948). This suggests that openness to trade may also be related to the intensity of capital and knowledge, which are both important production factors (Agénor, 2004). This is consistent with the idea that trade involves the exchange of not just final goods, but also the production factors used to create those goods (Faeth, 2009). Literature on trade openness and economic development has grown significantly in recent years (Xu, et al., 2021). Researchers have been examining the impact of trade openness as a measure of globalization and other factors on economic development (Munir & Ameer, 2018; Silajdzic & Mehic, 2018; Tahir, et al., 2014). Studies on this topic have consistently shown that increased trade openness is either positively or negatively correlated with higher levels of economic growth. On the one hand, Hye & Lau (2015) in a study of trade openness and economic development in India, used an auto regressive analysis and the results reveal that, trade openness in a short run is found to be positively related to economic development. Researchers explored the link between trade openness and human development index and the findings reveal that, trade openness is positively related with human development index (Hamid & Amin, 2013). This relationship has been found to be particularly strong in developing cities, where trade openness is a critical factor for economic development. Yakubu & Akanegbu (2018) in their study of trade openness and economic growth found that trade openness significantly influences per capita income.

On the other hand, some studies have found a negative influence between trade openness and economic development. For example, Wang, et al. (2018) found that, improved openness in trade influences human development negatively. Silajdzic & Mehic (2018) in their research contend that trade openness may not necessarily lead to positive economic outcomes, particularly in less advanced transition economies like the CEE countries. Similarly, Atici (2009) in the research of CEE countries found that, trade openness is negatively related to human development. For our study, we will explore two measures of economic development: Gross national income and human development index. Based on the above existing literature, we hypothesize that:

H₁: Trade openness significantly affects the Human development and Gross national income per capita in Czech and Slovakia.

2.2 Internet Penetration and Economic Development

The Internet has become a crucial component of modern society, with the number of devices connected to it growing rapidly. The Internet of Things has emerged as a significant trend in the digital transformation of businesses and the economy in recent years (Chan, 2020). The portion of the population with access to the Internet is measured by Internet penetration. The higher the Internet penetration, the greater the potential for people to access and share knowledge, thereby enabling new ways of doing business. In this context, trade openness can be compared with Internet penetration to see how traditional economies relate to the "new" economy (Guillén, & Suárez, 2005). High levels of Internet penetration can lead to increased access to knowledge. Thus, as traditional economies transition to the "new" economy, higher levels of both trade openness and Internet penetration could potentially drive economic growth (Urban, Oosthuizen & Chen, 2022). In terms of internet penetration, research has shown that higher levels of internet access are positively correlated with higher levels of economic growth and development. This relationship has been observed across different countries and regions (Billon, et al., 2018).

Several studies have examined the relationship between internet penetration and economic development in different countries and regions. A study by Qiang and Rossotto (2009) found a positive relationship between internet penetration and economic growth in developing countries. The study argued that the internet has the potential to increase productivity, enhance innovation, and facilitate trade, all of which can contribute to economic growth and development. A study by Salahuddin & Gow (2016) examined the impact of the internet on economic growth and development. The study found that internet penetration has a positive and significant effect on economic growth and development, as measured by GNI per capita. The study argued that the internet provides access to information and enhances communication, which can lead to increased productivity, innovation, and competitiveness.

Another study by Czernich et al. (2011) analysed the impact of broadband internet on economic growth and development in OECD countries. The study found that broadband internet has a positive and significant effect on economic growth and development, as measured by HDI and GNI per capita. The study argued that

broadband internet can enhance productivity, increase innovation, and facilitate access to markets, all of which can contribute to economic growth and development.

In contrast, a study by Amaluddin (2020) found a mixed relationship between internet penetration and economic growth in African countries. The study argued that while the internet has the potential to increase productivity and facilitate access to markets, it can also lead to increased inequality and social fragmentation, which can negatively affect economic growth and development. Bahrini & Qaffas (2019) found a negative relationship between internet penetration and economic growth. Based on the literature review, we propose the hypothesis that:

H₂: Internet penetration significantly affects the Human Development and Gross national income per capita in Czech and Slovakia

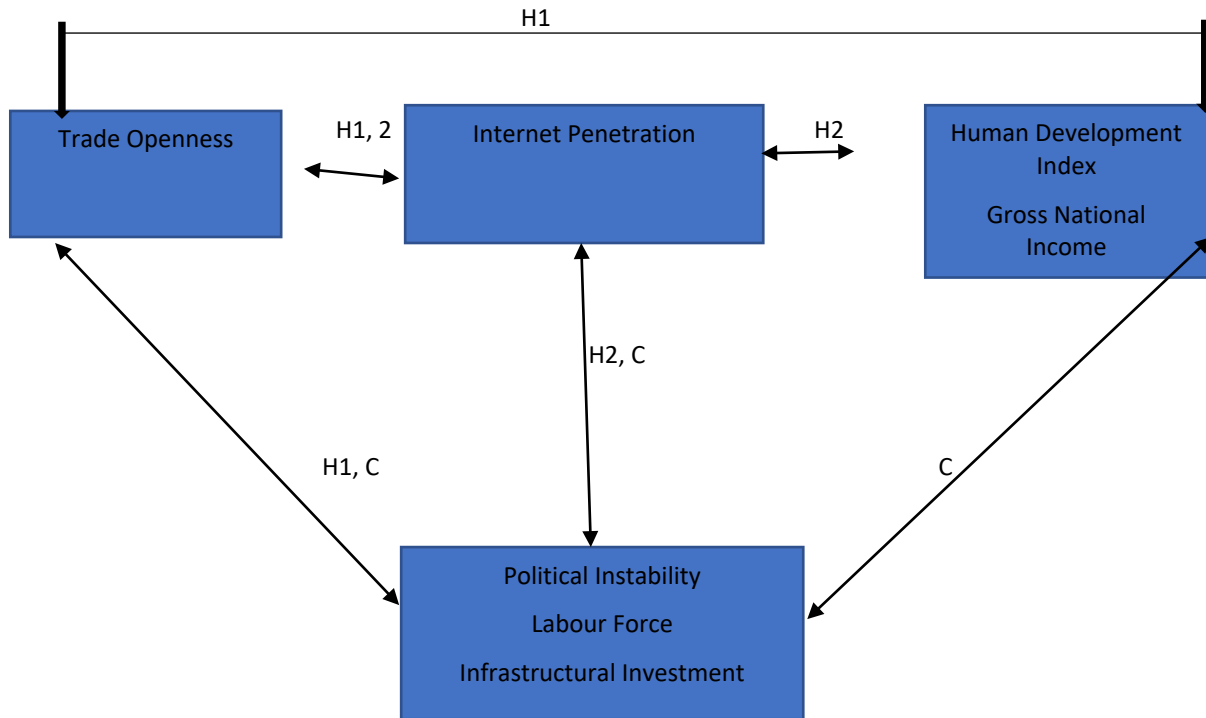


Figure 1: Conceptual Framework

The above figure 1 shows the depicted conceptual framework of the analysis on possible patterns of the causal relationship between globalization and Internet penetration contributions to improving economic growth within Czech and Slovakia. Based on the reviewed literature, the following hypotheses have been formulated.

H₁: Trade openness significantly affects the Human development and Gross national income per capita in Czech and Slovakia

H₂: Internet penetration significantly affects the Human Development and Gross national income per capita in Czech and Slovakia

3. Data and Methodology

3.1 Research Design

The main objective of this research is to ascertain whether knowledge of globalization and internet penetration contribute to economic development in the Czech Republic and Slovakia. We relied on quantitative research design in conducting this research using the panel regression modelling (Martinez-Vázquez, Lago-Peñas and Sacchi, 2017) in accordance with Montgomery et al. (2012), the panel regression analysis is adopted to have accurate and robust results when dealing with both dependent and independent data that are linear in nature.

3.2 Data Collection and Description

Empirical analysis is based on a panel dataset from the United nation’s development program, World bank and the organization for economic cooperation and development. The research uses UNDP website for data

collection purpose on Human development index. OECD data on Gross national income per capita, trade openness, internet penetration, infrastructural investment, and labour force participation rate. World bank data on the political instability index was resorted to (Tang et al., 2019). We adopted the data and methodology initiated by Czernich et al. (2011). We used pooled data sets spanning twenty-two calendar years, specifically 2000 to 2022, and a sample of two countries as is the case of (Krishnan and Lymm, 2016). The sample used for the empirical model specification consisted of the Czech Republic and Slovakia. the reason being that these economies are in transition to the open capitalist market system, and with their historical connections, as well as poor recent performance score from the globalization ranking. The analysis realized twenty numbers of observations. The table below shows the variables used for the empirical, analysis.

Table 1: Descriptive Statistics of Variables

Variables	Description	Sources
Human Development Index (HDI) (Dependent)	The HDI is a composite measure that takes into account factors such as income, education, and health, to provide a comprehensive assessment of human well-being.	UNDP, 2022
Gross National Income per capita (Dependent)	GNI per capita is the average income per person in a country and is used as an indicator of standard of living	OECD (2023)
Explanatory variables		
Trade openness	It is defined as the sum of exports and imports divided by the GDP at current prices.	OECD (2023), Feenstra, et al. (2015)
Internet penetration rate	This measures the percentage of the population that has access to the internet	OECD (2023)
control		
Infrastructure investment	This indicator is measured as a share of GDP for total inland investment and in euros for the road, rail, air, inland waterways and sea components.	OECD (2023)
Political Instability	Measures Perceptions of the likelihood of political stability/ political motivated violence, including terrorism.	world bank. (2023); Tang et al., (2019).
Labor force participation rate	measure of the proportion of a country's working-age population employed or actively seeking employment	OECD (2023)

Source: Author’s own adaptation

Mathematically, the Panel regression model is defined as:

$$y = \beta_0 + \beta_i x + \epsilon_i \tag{1}$$

Where:

‘Y’ = dependent variable, i.e., control of corruption and corruption perception index

‘β₀’= dependent variable value, that is, the y intercept

‘β_i’= slope coefficient of each of the explanatory variables.

‘x’ = represents the value of the independent variable or the input variable

‘ε_i’= represents the error term.

We use the pooled panel data in a panel regression model to examine variations in economic development contributions based on changes in predictor variables. The model assumes that the dependent variables are a function of the independent variables, and the error term is not normally distributed and is indicated by (ε_i). Hence, a nonlinear relation and function of these associations are mathematically given as follows for each of the models:

$$HDI_t = \beta_0 HDI + \beta_1 GNI.C + \beta_2 internetpent + infr. investment .invest + pol.inst + labour force + \epsilon_i \tag{2}$$

$$GNI.Cy = \beta_0 GNI.C + \beta_2 internetpenetration + \beta_3 investment.invest + \beta_4 pol.institution + \beta_5 labour force + \epsilon_i \tag{3}$$

3.3 Model Fit

We measured model fitness using collinearity analysis. We used the Variance Inflation Factor (VIF) for this purpose. The model showed the highest value of 5 which indicates no multicollinearity issues among the variables, with all variables showing less than value ten as opined by (Hair et al., 2017). Our analysis also shows that about 72% and 83% of the variance is explained in both models based on the R-squared figure.

4. Results and Findings

As stated above, the predictive accuracies power of our analysis shown in Table 2 are 72% and 83%, respectively using the Cohen’s R-squared, for the models. These accuracies in our model explained can be said to be substantial and robust (Cohen, 2013). This study investigates how knowledge of globalization contributes to increasing economic development of the Czech Republic and Slovakia. We first analyze empirically the impact of globalization thus trade openness and internet penetration against HDI and GNI per capita to ascertain the nature of the relationship and the effect it has on economic development within the Czech Republic and Slovakia.

The results of the impact of each of the measures of globalization on economic development are shown and presented in Table 2. We evaluate the hypothesis 1 that *Trade openness significantly affects the Human development and Gross national income per capita in Czech and Slovakia*. The statistical results suggest that there is a significant relationship between trade openness and both Human Development Index (HDI) and Gross National Income (GNI) per capita as measures of economic development in Czech Republic and Slovakia. Specifically, the results show that trade openness has a positive and significant effect on both HDI and GNI per capita in both countries at a 99% and 95% confidence interval. In Czech Republic, the coefficient is high at 0.12, indicating that the relationship between trade openness and economic development is strong. In Slovakia, the coefficient is also significant at 95% and 99%, with a coefficient of 2 and 4 respectively, suggesting that the impact of trade openness on economic development is substantial in this country as well. Overall, these results support the hypothesis that trade openness significantly affects economic development in both Czech Republic and Slovakia.

Subsequently, we also tested for hypothesis 2, by testing the preposition that *Internet penetration significantly affects the Human Development and Gross national income per capita*.our study found that there is a significant positive relationship between internet penetration and both HDI and GNI per capita in the Czech Republic. This relationship is significant at a 99% confidence interval, indicating a high level of confidence in the results. The coefficient of 5 for HDI and 3 for GNI per capita in the Czech Republic suggests that for every unit increase in internet penetration, there is a corresponding increase in HDI and GNI per capita. In Slovakia, the study found that internet penetration is significantly related to HDI at a 90% confidence interval with a coefficient of 2. This suggests that for every unit increase in internet penetration, there is a corresponding increase in HDI. However, the study did not find a significant relationship between internet penetration and GNI per capita in Slovakia. Overall, the results support the hypothesis that internet penetration significantly affects human development and gross national income per capita, but the relationship may vary across countries.

Table 2: Regression Analysis Results for Czech and Slovakia Republic

Dependent Variables →	Czech Republic		Slovakia Republic		VIF	
	HDI	GNI	HDI	GNI		
Independent Variable/ Control	Coefficient	Coefficient	Coefficient	Coefficient		
Constants	31.33***	40.42***	31.33***	32.10***	Czech	Slovak
Trade openness	0.1297 ** (0.0230)	0.962*** (0.1248)	2.805** (0.018)	3.586*** (2.713)	5.361	2.029
Internet penetration	5.2150*** (0.0045)	3.347*** (0.0247)	2.261* (0.0102)	1.832 (0.087)	3.099	2.854

Dependent	Czech Republic		Slovakia Republic		VIF	
Political Instability -C	-2.4620** (0.0270)	- 2.274** (0.1466)	-1.467 (0.018)	-2.002* (0.156)	1.518	3.378
Labour force participation -C	3.2580*** (0.0199)	12.86*** (0.1079)	-1.777 (0.0702)	2.634**	4.012	3.015
Infrastructure -C	2.2070* (0.0038)	5.261*** (0.0206)	1.496 (0.006)	2.496** (0.599)	2.751	2.075
No. of Obs.	20	20	20	20		
R-squared	0.752040	0.7154	0.8540	0.8440		
Adjusted R-squared	0.715410	0.7080	0.8330	0.8130		
F-statistics	82.56703	68.4650	70.490	70.490		
Prob(F-statistics)	0.000000	0.0000	0.0000	0.0000		
(Homoscedasticit	4.57108	3.5964	4.0123	4.1123		
Akaike criterion	2471.179	2144.567	2040.400	2370.155		

***p<0.001, **p<0.01, *p<0.1. Note: *** Parameter significant at 99 % level, ** significant at 95 % level, * significant at 90 % level, standard errors are in curly brackets.

To reduce the level of bias in our empirical results, we controlled for economic development using labour force participation, political instability, and infrastructure investment. In the absence of bias, our control variables showed both positive and negative coupled with high and medium significance in modules one and two. Within all models, the control variables helped to ascertain the clear effect of the explanatory variables.

5. Discussion

The results of the study suggest that both trade openness and internet penetration are significant predictors of economic development in the Czech Republic and Slovakia. The results of the study confirmed the hypothesis that trade openness significantly affects both the human development index (HDI) and gross national income per capita (GNI) in both countries. This suggests that the more open the countries are to trade, the more likely they are to experience economic growth and development (Keho, 2017). This result is grounded in the new economic geography theory as expressed by Martin & Sunley (1996) who contend that, globalization leads to increased competition and reallocation of economic activity to regions that have a competitive advantage. Our findings also compliment the trade theory, which contend that countries will tend to specialize in producing goods that use their abundant factors of production relatively intensively, while importing goods that use their scarce factors relatively intensively (Samuelson, 1948). This suggest that openness to trade may also be related to the intensity of capital and knowledge, which are both important production factors (Agénor, 2004). Our results Is again consistent with previous studies that have highlighted the importance of trade openness in promoting economic development like Munir & Ameer (2018). Hye & Lau (2015) in a study of trade openness and economic development revealed that, trade openness in a short run is found to be positively related to economic development.

This study also found that internet penetration is a significant predictor of economic development in the Czech Republic and Slovakia. The results showed that internet penetration is significantly related to the HDI and GNI in the Czech Republic. Not only thus these results affirm our hypothesis two, but the significant effect also corroborates previous findings by Qiang and Rossotto (2009) whose study found a positive relationship between internet penetration and economic growth in developing countries. They argued that the internet has the potential to increase productivity and facilitate trade, all of which can contribute to economic development. Likewise, Salahuddin & Gow (2016) examined the impact of the internet on economic growth and development. The study found that internet penetration has a positive and significant effect on GNI per capita. The study argued that the internet provides access to information and enhances communication, which leads to increased productivity and competitiveness. In the case of the Czech Republic, the high coefficient for both trade openness and internet penetration indicates that these variables have a strong positive impact on economic development in the country.

In the case of Slovakia, the results are somewhat mixed. While the coefficient for trade openness is significant and relatively high, the coefficient for internet penetration is only significant with the HDI and not the GNI. This suggests that while internet access is important for promoting human development in Slovakia, it may not have as much of an impact on gross national income per capita. Even though this is not consistent with our expectations, it supports the position of Amaluddin (2020) whose research found a mixed relationship between internet penetration and economic growth. The study argued that while the internet has the potential to increase productivity and facilitate access to markets, it can also lead to increased inequality, which can negatively affect economic growth and development.

The findings of this research recommend some practical implications for policymakers and business owners in Czech and Slovakia. Governments in both the Czech Republic and Slovakia could focus on increasing trade openness through measures such as reducing trade barriers and tariffs, increasing international trade agreements, and encouraging foreign investment (Abrego, et al., 2019). This could potentially lead to higher levels of economic development as measured by HDI and GNI per capita. Both countries could focus on investing in internet infrastructure, such as expanding broadband coverage and improving internet speeds (Hambly & Rajabiun, 2021). This could help to improve internet penetration rates, which were found to be a significant predictor of economic development in the Czech Republic and to some extent in Slovakia. These practical implications could help policymakers and governments in both the Czech Republic and Slovakia to promote economic development and improve the well-being of their citizens.

This study however has some limitation, the variables and number of countries studied are limited. Hence, results cannot be generalized.

6. Conclusion

In conclusion, the results of this study highlight the importance of both trade openness and internet penetration in promoting economic development in the Czech Republic and Slovakia. The findings suggest that policies that promote trade and internet access are likely to be effective in promoting economic growth and development in these countries. However, the study also indicates that the impact of these variables may vary depending on the specific indicator used to measure economic development. While trade openness appears to have a strong impact on both the HDI and GNI in both countries, the impact of internet penetration is more closely related to the HDI in Slovakia.

Future research can expand on this study by examining the impact of other variables such as political stability, investment in education, and the effects of regional disparities on economic development in Czech and Slovakia. Additionally, studies that compare the effects of trade openness and internet penetration on economic development across multiple countries can provide insights on how to improve economic development in different regions.

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