



Branchless Banking and Inclusive Growth: Comparative Evidence from European Emerging Economies

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Abstract: The paper investigates digital and traditional finance-related inclusive growth relationships in 17 emerging European economies during the period 2005-2022. The research employs the Panels-corrected standard errors (PCSE) model and the instrumental-variable generalized method of moments (IV-GMM) approach. The study finds that a CEE region with a relatively higher number of ATMs, coupled with individuals using the internet for internet banking experiences higher levels of human development than the SEE region, which has a lower level of development of branchless banking channels. The study concludes that, while branchless banking generally benefits human development, its impact is limited. In fact, the effect branchless banking on inclusive growth is more significant in the CEE region due to the higher institutional capacity and developed digital infrastructure. Conversely, in the SEE region, underdeveloped institutions and initial stages of digital finance can only have negligible or even negative consequences. This implies the need to adopt complementary policies, with the hope that campaigning for the adoption of branchless banking will go hand in hand with the quest to reinforce institutions and digital literacy, so that any digital financial innovation is converted into sustainable and inclusive economic growth.

Keywords: branchless banking; inclusive growth; emerging European countries; PCSEs model; IV-GMM approach.

JEL classification: C23; G20; G21.

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1. INTRODUCTION

The recent technological development has also helped to solve the sustainability issues to a very great extent. An example of sustainable practices and technology is the field of financial technology (FinTech), which has become a disruptive element in the financial sector (Cruz Rambaud and López Pascual, 2023; Atayah *et al.*, 2024). Many issues exist when financial technology (FinTech) and sustainability are integrated. Information technology (IT) can play an essential role in facilitating this integration in this context. According to Anshari *et al.* (2019), the combination of FinTech and digital markets has the potential to substantially enhance sustainability.

As liquidity providers, banks enable investment in more productive assets, thereby boosting capital accumulation and economic growth. However, a 2014 World Bank survey revealed that only about 50% of adults globally have access to formal financial institutions, partly due to the limited presence of these institutions in remote rural areas (World Bank, 2015). Willis *et al.* (2001) note that ITC have enabled banks to reorganize their networks to better serve various client needs. McKay and Pickens (2010) suggest that branchless banking is a potential way to reach the "unbanked" population, primarily in rural areas.

Although governments are committed to inclusive growth, market discrimination and poverty continue to prevent millions in developing countries from accessing financial services. This is what makes inclusive finance one of the priorities of the world as mentioned by the United Nations (2015). While some earlier research has focused on the technological basis, primarily mobile phones, and their integration into banking services (Luarn and Lin, 2005) some more recent research (Gupta *et al.*, 2015; Ganić, 2025) advocates policies that support both growth and inclusion. In some other studies, for example, Asongu and Le Roux (2017) find that the expansion of digital infrastructure (broadband internet, mobile telephony) in sub-Saharan African countries can negatively affect inclusive growth, suggesting that technology alone is not a universal solution.

However, there is a lack of research addressing the effects of branchless banking on inclusive growth. As a result, a more complex understanding of its dynamics has become an important component of the agenda. Often, decades of data are needed to examine the elements that shape inclusive growth and branchless banking. The ability to evaluate its impact was limited until recently because comparable global data on branchless banking were not available. In the current literature, there is very little concrete empirical evidence regarding the effects of branchless banking; additionally, a cross-sectional approach is frequently ignored, which results in measurement errors and cross-country heterogeneity. Additionally, there is a selection bias because research on the benefits of financial inclusion primarily concentrates on countries with favourable economic conditions. This indicates the necessity of addressing the issue of selection bias and examining the potential differences in effects across countries.

The precise impact that branchless banking has on inclusive growth is still unclear. By examining how branchless banking impacts inclusive growth, this study aims to fill that gap.

Although some research has been done on the connection between traditional finance and growth in the world the connection between digital and traditional finance and inclusive growth in the European emerging economies remains under researched. Accordingly, the purpose of this paper is to compare European emerging economies with other regions and to explore how the unique European institutional, regulatory and infrastructural framework shapes the impact of digitalization finance on inclusive growth. Our work provides the major contribution in terms of

developing a comparative analytical framework, which demonstrates that the efficiency of branchless banking does not have universal features, but varies depending on the degree of regional development. By doing so, the study extends beyond the limits of single case studies and shows that policies that concentrate on digital payments alone can be ineffective or even counterproductive in the SEE countries. It is particularly suggestive in the countries where the mere access to physical and digital infrastructure remains a pivotal assumption. This very possibility to carefully determine regional policy paths is what makes our research the value addition.

As a result, the empirical evidence in the existing literature is very limited that ignore heterogeneity across countries and institutional structures, with focus on countries with better economic conditions, which creates selection bias.

Therefore, it remains unclear what the real impact of digital payments on inclusive growth is with including institutional structures. This study seeks to fill this gap and empirically examine this relationship.

In fact, it brings several novelties to the existing empirical literature. First, with the help of the UNDP Human Development Index (HDI) (2024), we examine the contribution of digital and traditional finance-related inclusive growth relationships, which does not necessarily mean only growth in the economy. Economic growth is no longer an adequate measure of societal well-being. The goal is to ensure that the benefits of growth are distributed to include the more vulnerable and poor segments of the population, which is the essence of inclusive growth (Asian Development Bank, 2011).

Second, this research contributes to the body of literature on financial development and inclusive growth as it presents a new outlook which brings these two fields of study together in one analytical framework. Although past research mostly thinks of financial development and technology as independent growth factors, this area of research presents new findings that digital infrastructure can enhance the effectiveness of financial systems in ensuring inclusive economic performance. This wide evidence in the various emerging European economies lends a regionalization to a research territory that has largely been restricted to country-based research.

Third, this research is the first to empirically examine whether branchless banking matter for sustainable inclusive growth in 17 European emerging countries divided in two subregions: Southeastern Europe – SEE region (Albania, Bosnia and Herzegovina, North Macedonia, Montenegro, Serbia, Bulgaria, Romania, Türkiye) and the Central and Eastern Europe -CEE region (Czech Republic, Croatia, Poland, Hungary, Latvia, Lithuania, Estonia, Slovakia and Slovenia) indicating that the forces of inclusive growth in the more digitally advanced CEE region differ fundamentally with those in the SEE region.

2. LITERATURE REVIEW

There is a wide consensus among economists that financial development promotes economic growth. Several empirical studies examined the role of financial systems in economic growth of developing economies (Levine and Zervos, 1998; Rajan and Zingales, 2003). Through the demand or supply channel, financial development creates favourable conditions for growth, according to numerous theories. The expansion of the financial system aids economic expansion, according to Rajan and Zingales (2003). The main factor in economic growth was the accumulation of physical capital, according to early studies of economic growth. For example, according to early macroeconomic studies conducted in the

late 1980s and early 1990s, ICT did not contribute much to economic growth and productivity (Jorgenson and Stiroh, 1999; Oliner and Sichel, 2000).

However, in recent research, the idea of capital has been broadened to include technology and knowledge, which have become essential growth factors. Many endogenous growth models have tried to explain how technology and new knowledge the primary drivers of growth in recent years can be (Romer, 1990; Grossman and Helpman, 1991; Aghion and Howitt, 1992). Presenting ICT as an endogenous growth factor, the distinction between human capital and technology as embodied or codified knowledge is one of the essential features of these models. In endogenous growth models, where long-term growth is seen because of information technology (IT) development, ICT is a critical component of R&D.

Investment in telecommunications infrastructure has a significant effect on economic growth, according to most of the early empirical literature on the effects of telecommunications technology (Röller and Waverman, 2001; Toader *et al.*, 2018; Aghaei and Rezagholizadeh, 2020). In many cases, investment in telecommunications infrastructure can boost economic growth. According to Deng *et al.* (2019), patterns of economic growth significantly shape the relationship between FinTech and sustainable development. The competitive environment in the FinTech and banking sectors has been altered by the COVID-19 pandemic, according to Yan and Jia (2022).

The relationship between growth and financial inclusion has recently become more important in research (Demirgüç-Kunt *et al.*, 2017), but little is known about the impact of branchless banking on inclusive growth. Morison and Frazer (1982) published the first article on this subject. They examined banking services and the future of American banking, including the rise of non-branch banking. According to Richardson and Marshall (1996), this term refers to the delivery of banking services by means of ICT to provide retail services outside of physical bank branches. Suhrab *et al.* (2024) studied the connection between digital finance, financial inclusion and income inequality and found that technological innovation is essential in the Sustainable Development Goals. The authors propose that digital financial infrastructure has the potential to help close financial gaps and inclusive economic growth. Also, Pushp *et al.* (2023) investigated the moderating role of digital finance with economic development in India, and the researcher discovered that internet-based financial services enhance financial inclusion and support sustainable economic growth. Several studies indicate that technological integration – such as the spread of the internet, mobile networks and digital payments – increases market efficiency, reduces transaction costs and expands the reach of financial services (Odeleye and Olusoji, 2016; Ofori *et al.*, 2024; Saeed and Klugah, 2025). For example, the benefits of mobile banking and digital payments have greatly helped the unbanked population, enabling them to join the formal economy.

Through equal access to economic markets and resources, inclusive growth promotes equal opportunities in the economy, as the World Bank (2009) noted. Inclusive growth requires equity and growth, according to Zhang and Wan (2017). Allowing all economic actors to realize their economic potential, it includes economic equality and fair chances for all (Asian Development Bank, 2011). In other words, growth must be inclusive for a sustainable development plan to reduce poverty. In fact, through inclusive growth, the poor can obtain economic opportunities and basic services.

Governments, policymakers, and international development institutions put a high priority on inclusive growth, which presupposes achieving a more balanced distribution of the fruits of economic growth (Nizam *et al.*, 2020). Its success must be supported by the policies

that would not only be focused on the overall growth but also include the marginalized groups such as women, rural populations, and low-income families (Beşe and Friday, 2022). Inclusive growth is not confined to classical indicators of economic growth (e.g. GDP per capita). It does not only explain the dynamic but also the distribution of the benefits of growth (Anand *et al.*, 2013). As much as economic growth may be a critical condition, it does not suffice when the benefits thereof are not extended to extended parts of society. To illustrate this, the Asian Development Bank (2011) defines inclusive growth as growth that allows all categories of the population to share equally in the process and reap the gains of the same. In this paper, inclusive growth is measured by the Human Development Index (HDI). Sen (1999) perceived development in terms of opportunities and freedoms where people were able to lead lives, they find worthwhile while not just in terms of level of income. The HDI encompasses three important dimensions, namely, healthy life, education, and living standards. This way, when we examine the effect of branchless banking on the HDI, we are in effect evaluating how it will positively influence these fundamental dimensions of human development. This renders the HDI as a sound and covering indicator to measure inclusive growth.

It is a known theoretical relationship that exists between financial services and economic development. Indicatively, Schumpeter (1911) is among the original thinkers who emphasized the significance of financial intermediaries in promoting growth and innovation by enhancing the efficient allocation of capital. This knowledge has also been used to entrench the current concept of financial inclusion, which states that increasing access to financial services can alleviate inequality and poverty (Demirgüç-Kunt *et al.*, 2017).

Branchless banking as a more technologically advanced form of financial services delivery can operate through several channels:

First, digital channels (ATMs, online payments, mobile banking) allow a larger group of the population, including rural and previously unreachable ones, to enter the formal financial system because they simplify the process and do not need physical barriers (Auer *et al.*, 2023; Tombini, 2024). Second, efficiency and empowerment channel where digital banking saves time and costs on transactions, making more resources available to households to invest further in health and education, which are major areas of the HDI (Mushtaq and Bruneau, 2019; Mburamatatare *et al.*, 2025). And third, human capital investment channel where availability of better finance can help overcome credit restrictions and greater investment in health and education, which directly enhances long-term inclusive growth (Sarwar *et al.*, 2021; Opoku *et al.*, 2024).

Nevertheless, theory also leaves the possibility of heterogeneous effects—technology is not sufficient. It affects it based on the conditions of institutions, rules, and digital infrastructure (Asongu and Le Roux, 2017). The strength of these channels will, however, differ among countries.

Different European countries have different access to credit markets. Sinclair (2013) examines financial inclusion in the United Kingdom in a broader European context. He points out that, for low-income clients, there were issues with accessing basic banking services and that there was a shortage of credit that was appropriate and affordable. Additionally, there is a controversy over whether British banks have taken away services from communities in need or taken away services from people with lower incomes. According to Collard (2007), the effects of being excluded from the formal financial sector are becoming more serious as the United Kingdom moves towards cashless businesses. Fonté (2012) argues that, in the United States, mobile payments can increase access to financial services at a lower price point; however, he cautions that advertising is more focused on the wealthy than on financial inclusion.

Ganić (2025) studies the relationship between digital and traditional finance-related poverty reduction relationships, including the mediating role of European Union membership in 18 countries (2004–2021) by using panel data regression models. The findings indicate that the dominant method of poverty reduction through banking institutions remain the traditional financial inclusion instruments, such as bank accounts and bank branches, while digital financial channels have not yet fully realized their poverty-fighting potential.

Alekhina and Ganelli (2023) explored the elements that might help make growth more even in ASEAN countries. Investigating the determinants of inclusive growth in 14 Latin American countries (1995–2019), Angulo-Bustinza *et al.* (2023) found that it was driven by fiscal redistribution, women's labor force participation, productivity, digitalization, savings, and foreign direct investment. While inflation, unemployment and the occurrence of crises have a negative effect on inclusive economic growth, public spending and international trade have a positive effect on it. Using a particular measure that combines income distribution and growth, Hussein *et al.* (2017) examined the current state of inclusive growth in Africa between 2000 and 2015. To achieve inclusive growth in Africa, they emphasize the importance of macroeconomic policies (fiscal and monetary), high-quality governance and institutions, and information and communication technologies (ICT). Existent research recognizes that increase in financial inclusion in developing countries are increasingly dependent on technology, such as electronic payments, mobile banking, and advances in financial technology (De Koker and Jentzsch, 2013). The significant role of ICT in the social and economic advancement of the last decade is emphasized by the increasing literature on ICT and economic development, as stated by Mushtaq and Bruneau (2019).

The complicated connection between sustainability and IT adoption has been studied in several studies. A critical assessment of the impact of information technology on sustainability and significant research findings are the centre of this discussion. Several studies stress that sustainability must be incorporated with technologies like FinTech (Callsen *et al.*, 2021; Battisti *et al.*, 2023), blockchain technology (Mercuri *et al.*, 2021) and ICT (Ahmed *et al.*, 2021; Sahoo *et al.*, 2024).

The potential of mobile banking and digital payment platforms has already been demonstrated in terms of accessing groups of the population that cannot access traditional banking facilities and making them participants in the formal economy. Although technology is not enough to eliminate all barriers, a combination with financial systems contributes considerably to the ability to reach economic inclusion and increase efficiency, particularly in the underserved areas (Saeed *et al.*, 2024; Sahoo *et al.*, 2024; Saeed and Klugah, 2025).

When it comes to the connection between inclusive growth and branchless banking, most of the evidence is found at the micro-level, at the individual level. In fact, very little research has been done on this subject at cross-regional context, despite the possibility that branchless banking can positively affect these aspects. Mohamed and Elgammal (2024) found out that the greater the use of branchless banking in 2,996 MFIs in 123 countries, the better the productivity and social reach. Equally, Bruhn and Love (2014) discover that more financial services can boost incomes of low-income earners and enhance the expansion of informal businesses in Mexico while Burgess and Pande (2005) find that the proliferation of bank branches can alleviate rural poverty in India. These results are however doubted by Panagariya (2006) and Kochar (2011).

Financial integration, income inequality, economic growth, and institutional quality are the main subjects of most of the available literature on inclusive growth and finance. In addition, so far, research has mainly concentrated on individual countries, specific economies in panel

studies, or developing countries from Asia and Africa. Nevertheless, no empirical research has examined the connection between branchless banking and inclusive growth, particularly in the context of Eastern European economies; this issue has also not been examined in any study. A noticeable gap in the literature regarding the effects of branchless banking on inclusive growth is the focus of this study because the role of branchless banking in inclusive growth remains scarce. In less developed countries, especially when it comes to the Sustainable Development Goals (SDGs), increasing economic growth is not a primary concern, according to development literature. Researchers and policymakers are more interested in growth that lowers unemployment, poverty, and income inequality [Ajide et al. \(2021\)](#).

The hypothesis development

Despite the high-profile coverage concerning the micro advantages of digital finance, macro empirical evidence regarding the role of digital finance in the inclusive growth of the emerging European economies is mixed ([Ganić, 2024](#); [Mohamed and Elgammal, 2024](#)). However, the theoretical effects may be heterogeneous. This research, in accordance with the defined theoretical mechanisms (access, efficiency, and human capital), assumes that digital finance positively affects inclusive growth. This expectation is supported by empirical findings that digital payments can enhance productivity and social outreach ([Mohamed and Elgammal, 2024](#)), serve as a tool for financial inclusion to decrease inequality and poverty ([Hussein et al., 2017](#); [Wong et al., 2023](#); [Azmeah, 2025](#); [Ganić, 2025](#); [Memon et al., 2025](#)), and ultimately lead to high inclusive growth ([Rahman et al., 2020](#); [Ganić, 2024](#)). As [Asongu and Le Roux \(2017\)](#) state, the institutional and regulatory environment mediates the effect of the presence of digital technology, and it does not necessarily lead to positive consequences. We hypothesize these channels will be stronger depending on the current institutional quality and level of digital infrastructure of a region, a factor that can be seen in the work of other researchers who discover diverging impacts between old and new EU member countries ([Ganić, 2024, 2025](#)).

Based on this, we test the following hypotheses:

H1: *Penetration of branchless banking services (ATMs, digital payments, internet banking) has a positive effect on inclusive growth (HDI) in emerging European economies.*

H2: *The positive effects are more pronounced in Central and Eastern European countries as compared to Southeastern European countries because of superior institutional frameworks and elevated digital readiness.*

3. METHODOLOGY AND DATA

3.1. Data and Variables

Inclusive growth (IG) is the dependent variable in our econometric models proxied by the UNDP's HDI index to measure three facets of human development: education, life expectancy, and standard of living. In this research, we considered two different kinds of explanatory variables. Three distinct measures of branchless banking constitute the first category: the number of ATMs per 100,000 adults, the proportion of people over the age of 15 who have made or received a digital payment, and the proportion of people who use the Internet for online banking. Set of control economic variables constitutes the second type of

variables including: inflation, unemployment rate, population growth rate, financial development and institutional quality.

Using the Panels corrected standard errors (PCSEs) model and the generalized method of moments (IV-GMM), we empirically analyse how different indicators of branchless banking affect inclusive growth, as measured by the Human Development Index (HDI). We also include selected economic control variables in our analysis to assess their impact on inclusive growth. To examine the dynamic relationships and determinants of branchless banking and inclusive growth in the CEE countries and the SEE countries panel data techniques are employed. To fulfil the research objectives, the study considers the following variables (as shown in [Table no. 1](#)). These variables are derived from the existing empirical literature.

Table no. 1 – Summary of variables used in regression model

Variable	Description	Data Source
HDI (inclusive growth proxy)	The Human Development Index (HDI) is a summary measure of average achievement in key dimensions of human development: a long and healthy life, being knowledgeable and having a decent standard of living.	UNDP (2024)
ATM	Automated teller machines (ATMs) (per 100,000 adults)	World Bank (2024)
DIGPAY	Made or received a digital payment (% age 15+)	World Bank (2024)
IIBAN	Individuals using the internet for internet banking	European Commission Eurostat (2024)
UNEMPL	Unemployment, total (% of total labor force) (modeled ILO estimate)	World Bank (2024)
INFL	Inflation, consumer prices (annual %)	World Bank (2024)
POPGR	Annual population growth rate for year t is the exponential rate of growth of midyear population from year t-1 to t, expressed as a percentage.	World Bank (2024)
FINDEV	Domestic credit to private sector (% of GDP)	World Bank (2024)
INSTQ	Institutional Quality index based on World Governance indicators	Author's calculation

Source: author's elaboration

The HDI is employed in the study as an indicator of inclusive growth because it includes living standards, life expectancy, and education [Adeleye et al. \(2023\)](#); [Parvez et al. \(2023\)](#). The world is not only worried about the growth but also the reduction of inequality and poverty among policymakers ([Osinubi and Olomola, 2020](#); [Ajide et al., 2021](#); [Adeleye et al., 2023](#)). [Klasen \(2010\)](#) stresses the role of measures that are not limited to income. Three independent variables of ATM, DIGPAY and IIBAN are employed as proxy variables for measuring the level of the branchless banking. The idea of branchless banking combines significant advances in the delivery of banking services outside of conventional branches. As a tool for financial inclusion, ICT has the potential to speed up inclusive growth, decrease inequality and poverty. The concept means the delivery of banking services in different forms, namely, ATMs, e-banking, and mobile banking. As [Stegman et al. \(2005\)](#); [Hussein et al.](#)

(2017); Rahman *et al.* (2020); Mohamed and Elgammal (2024); Ganić (2025) all argue, branchless banking can have high inclusive growth. A variable of inflation rate is used to control macroeconomic stability. High inflation exacerbates inequality by forcing the poor to cut spending. Studies by Dollar and Kraay (2003); Anand *et al.* (2013); Hussein *et al.* (2017) and Barro and Lee (2001) show that moderate inflation can promote more inclusive growth.

The link between inclusive growth and institutional quality is often overlooked. From an institutional-economic perspective, inclusive growth depends on whether institutions are inclusive and if all members of society can contribute effectively to economic life and income generation. The rule of law, political stability, and other governance indicators are linked to greater economic growth, according to some studies (Dollar and Kraay, 2002; Resnick and Regina, 2006). According to a study conducted by Doumbia (2019), only the rule of law and government efficiency contribute to inclusive growth in a sample of 112 countries from 1975 to 2012. Similarly, Parvez *et al.* (2023) find in 25 developing Asia countries that institutional quality can improve human development. Following the studies above it is expected that institutional quality has a positive effect on inclusive growth. Therefore, we expect that an increase in institutional quality leads to the growth.

We assume that unemployment rates have a negative sign in relation to inclusive growth. This can be explained by the fact that high unemployment rates contribute to poverty by limiting people's access to earning opportunities, which negatively affects inclusive growth (Cysne, 2009; Castells-Quintana and Royuela, 2012; Angulo-Bustinza *et al.*, 2023). It anticipates a direct statistically significant relationship between inclusive growth and the unemployment rate a priori while rise of employment lead to higher inclusive growth and vice versa.

We are inconclusive on the impact of population growth on inclusive growth. One strand of the literature suggests mixed results where population growth deteriorates the level of inclusive growth in Africa (Tella and Alimi, 2016; Ajayi and Oburota, 2020). On the other hand, Parvez *et al.* (2023) documented a negative association between population growth and inclusive growth. Therefore, the relationship between population growth on inclusive growth can be positive or negative, depending on whether population growth is anticipated or not.

At the modern stage of the rapid shift to the digital world and the inability to eliminate inequality across the globe, the understanding of the connection between technology and financial systems in the context of their collaboration in ensuring inclusive growth gains an even greater relevance (Kouladoun, 2023; Huang, 2024; Ofori *et al.*, 2024). Although financial development has traditionally been known to propel economic growth, the role of financial growth in making growth more equitable and sustainable is increasingly reliant on the degree of digital maturity and technology adoption at the country level. To consider financial development, we include domestic credit to the private sector (a percentage of GDP) in our analysis. It is assumed that financial development can create conditions for social mobility and reduction of unemployment. We anticipate that it will positively promote inclusive growth. According to the literature on economic growth, the effort to examine the connection between financial sector development and economic growth is represented by the selection of this measure.

The expansion of the financial system aids economic expansion, according to Rajan and Zingales (2003); Hussein *et al.* (2017) although Ganić *et al.* (2016) found mixed results in the case of Bosnia and Herzegovina. However, in some other studies (Ibrahim *et al.*, 2024; Nassani *et al.*, 2025), a U-shaped relationship has been observed between financial development and inclusive growth and is effectively based on the quality of regulation and the capacity of financial institutions to cater to vulnerable groups.

3.2. Model Specification

The literature review reveals a gap in research on the impact of branchless banking on inclusive growth in Eastern European countries (2005–2022), where inclusive growth requires certain preconditions in addition to economic growth. The macroeconomic environment, consistent inflation rates, population growth, improved quality of institutions, financial development and stable inflation levels, especially for vulnerable and excluded groups, are important determinants for improving living standards. Higher employment is a key objective of inclusive growth.

In our econometric model, these factors, including branchless banking variables, were selected to assess their effects on inclusive growth. In this research, principal component analysis (PCA) is employed to determine INSTQ index. The representation of the factors is justified by the fact that there is a significant correlation between six Worldwide governance original variables (Control of corruption, Rule of Law, Government effectiveness, Voice and Accountability, Regulatory quality, and Political Stability and Absence of Violence/Terrorism). The quality of institutions is measured by the variable INSTQ (Table no. A1 and no. A2 from Annex). The KMO index (0.8203) shows the suitability of the sample for principal component analysis (PCA), which is justified in this case. Table no. A1 and no. A2 contain details on the calculation of INSTQ.

The study hypothesis that there is a positive association between inclusive growth and branchless banking. For panel data, the following general linear regression model is taken into consideration:

$$HDI_{i,t} = \alpha + \beta_1 BB_{i,j,t} + \beta_2 CV_{i,k,t} + \mu_i + \epsilon_{i,t} \quad (1)$$

where HDI is proxy for inclusive growth, BB refers to vector of branchless banking variables which measure the $BB_{i,j,t}$, development in country i at time t for $j = 1, 2, 3$ are : ATM, IIBAN and DIGPAY, $CV_{i,k,t}$ is vector of control variables in the model of country i , at time t , for $k = 1, 2, \dots, 5$ (UNEMPL, INFL, POPGR, INSTQ, and FINDEV), $\epsilon_{i,t}$ represents general error terms and μ_i refers to the individual- specific component.

The country in the panel data and time (year) in the model is represented by (i, t) , while intercept is presented with α . Vectors that contain the coefficients from the equations related to our three main variables in branchless banking are represented by the estimated coefficients, β_1 and β_2 .

To condense the six selected Worldwide governance indicators into one index of Institutional quality, the study used the PCA technique. This method can be used to express the index of the j th factor as:

$$Index_j = W_{j1}X_1 + W_{j2}X_2 + W_{j3}X_3 + \dots + W_{jP}X_P \quad (2)$$

where $Index_j$ is the Institutional quality index; Wp is the factor weighting coefficient; X is the corresponding original value of the components; and P is the number of variables in the equation.

According to Baum *et al.* (2007), in the event that economic growth is endogenous – that is, if it is associated with error, which can result in inaccurate conclusions and biased results – instrumental variable techniques are employed within the context of the generalized

method of moments (IV- GMM). We examined several instrumental variables and performed regressions with lagged endogenous variables, where the results could be impacted by reverse causality and endogeneity. A dynamic panel model is shown in this context. When estimating a dynamic model with the equation (3), the generalized method of moments (GMM) is primarily employed in panel data econometrics as follows:

$$HDI_{it} = \rho HDI_{i,t-1} + \beta_1 BB_{i,j,t} + \beta_2 CV_{i,k,t} + \mu_i + \epsilon_{it} \tag{3}$$

4. EMPIRICAL RESULTS

Table no. 2 illustrates the relationships between the variables, showing both positive and negative partial correlations. According to this data, inclusive growth is positively correlated with ATM, IIBAN, DIGPAY, POPGR, INSTQ and FINDEV highlighting the importance of these branchless banking proxies. Conversely, inflation and unemployment are negatively correlated with inclusive growth. Other explanatory variables also show varied positive and negative correlations. No multicollinearity is detected, as all correlation coefficients are below 0.80.

The lower section of Table no. 2 provides the summary statistics of the variables. The average HDI for 17 Eastern European countries from 2005 to 2022 is 0.818. The lowest value was recorded by Albania at 0.687 in 2005, while Slovenia had the highest at 0.921 in 2020. On the index of institutional quality, the average value is 0.0346, and the standard deviation of 1.8419 indicates that the subregions are distributed around the sample mean. The minimum value is -4.203, while the maximum is 3.398. The number of ATMs (per 100,000 adults) ranged from 4.23 to 156.8, with an average value of 60.946 and a standard deviation of 24.926. The share of individuals using the Internet for online banking varied from 0.63% (Romania, 2005) to 83.36% (Estonia, 2022), while the share of those who made or received a digital payment (% over 15 years old) varied from 0.204 (Albania, 2009) to 0.98 (Estonia, 2022).

Additionally, the mean VIF is 3.10, and the 1/VIF values range from 0.132691 to 0.75901. It indicates there is no serial multicollinearity.

Table no. 2 – Pairwise Correlation matrix and Summary statistics

	HDIindex	ATM	IIBAN	DIGPAY	POPGR	UNEMPL	INFL	INSTQ	FINDEV
HDIindex	1								
ATM	0.5165***	1							
IIBAN	0.7631***	0.2143**	1						
DIGPAY	0.7615***	0.3456***	0.8704***	1					
POPGR	.1847 *	0.0151	0.0132	0.0351	1				
UNEMPL	-0.689***	-0.318***	-0.420***	-0.536***	-0.176*	1			
INFL	-0.1730 *	-0.1501	-0.1631	-0.1047	0.1115	-0.0318	1		
INSTQ	0.6928***	0.2720***	0.630***	0.7008***	0.1837*	-0.5961	-0.093***	1	
FINDEV	0.1207	0.4561***	0.1518	0.0889	0.1394	0.0772	-0.0234	0.1369	1
Summary statistics - Multicollinearity issue									
Mean	0.8180	60.946	29.864	0.6698986	-0.34621	11.82394	4.024227	0.03463	50.13778
Max	0.921	156.8	83.36	0.9865141	1.570973	37.32	72.30884	3.39849	101.388
Min	0.6872	4.23	0.63	0.2046092	-6.18725	2.015	-1.5448	-4.2033	17.95247
Standard dev.	0.0520	24.92	23.26	0.2048235	0.81766	7.152937	5.589804	1.84193	14.29938
1/VIF	-	0.616	0.132	0.18051	0.75901	0.557948	0.593894	0.27749	0.597719

Note: *, **, ***means significance of the tested variables at 10%, 5%, 1% levels.

Source: author’s calculation

The cross-country dependence test (CSD) identifies the suitable analysis methods. Due to close associations and shared attributes, panel units face a high risk of cross-dependence. Pesaran (2004) notes that this can lead to biased estimates and conclusions. Moreover, the study conducts a preliminary check of cross-sectional dependence, stationarity, and cointegration to assess the impact of branchless banking on inclusive growth. To prevent biased estimates due to high correlations between countries, the CSD statistics test is applied (Pesaran, 2004, 2015). This test is appropriate for different panel models, robust against structural breaks, parameter heterogeneity, and non-stationarity, and relies on the correlation coefficients between unit pairs.

Furthermore, following Pesaran's methodology (2004), the study applies the unit root test for heterogeneous panels with cross-dependence once it has found that there is cross-dependence. Each series is non-stationary according to the null hypothesis. To eliminate dependence across regressions and panels, the test is performed by means of the augmented Dickey-Fuller approach (CADF), which raises the cross-sectional averages of the residual levels and the first differences of the series.

Table no. 3 – Preliminary check estimates

Variables	CSD statistics	PESCADF		Kao cointegration test	
		I(0)	I(1)		
HDIindex	47.721***	-1.985	-2.385***	Modified Dickey-Fuller t	-1.6112**
ATM	30.282***	-1.991	-2.385***	Dickey-Fuller t	-2.3867***
IIBAN	37.624***	-1.143	-1.656*	Augmented Dickey-Fuller t	-1.647**
DIGPAY	35.607***	N/A	N/A	Unadjusted modified Dickey-Fuller t	-1.6566**
POPGR	3.552***	-1.164	-2.204**	Unadjusted Dickey-Fuller t	-2.4096***
UNEMPL	26.041***	-2.518***	-2.670***		
INFL	24.433***	-1.670	-2.654***		
INSTQ	1.983**	-0.861	-2.959***		
FINDEV	9.342***	-1.867	-2.233**		

Note: *, **, *** means significance of the tested variables at 10%, 5%, 1% levels.

Source: author's calculation

The results in Table no. 3 indicate cross-sectional dependence among countries, as the null hypothesis of cross-sectional independence is rejected for all variables at the 1% significance level and for the INSTQ variable at the 5% level. Additionally, panel unit root tests (PESCADF) show that after applying the first difference, the variables became stationary at significance levels of 1% (HDIindex, ATM, UNEMPL, INSTQ), 5% (POPGR, FINDEV), or 10% (IIBAN). The variables DIGPAY could not be computed due to insufficient data. The all five Kao tests for cointegration reject the null hypothesis of no cointegration, confirming that all panels in the data are cointegrated (Table no. 3).

Panel-corrected standard errors (PCSE) are used to address heteroscedasticity and autocorrelation in panel data, which improve the accuracy of estimates by correcting for spatial correlation and heteroscedasticity. Before applying PCSE, it is important to consider all types of serial correlation (Table no. 4).

Table no. 4 – Panels corrected standard errors (PCSEs) output

	Full Sample 1	CEE region 2	SEE region 3
ATM	.0003185*** (.0000356)	.0002351** (.0001158)	.0005757*** (.000112)
IIBAN	.0005854*** (.0000855)	-.000797*** (.0001658)	.0010348*** (.0001206)
DIGPAY	.0014502 (.0065166)	.01114318*** (.0197901)	-.0670715*** (.0074527)
POPGR	.0068331*** (.0020797)	-.0003127 (.0013462)	.0016336 (.0014578)
UNEMPL	-.0017898*** (.0001434)	-.0039078*** (.0002874)	-.0014568*** (.0001648)
INFL	-.0000386 (.0002883)	-.000196 (.0006005)	-.0003949 (.0003202)
INSTQ	.0093097*** (.0008283)	.022192*** (.0016171)	-.0011971*** (.0021568)
FINDEV	-.0002845*** (.0001021)	-.0004227*** (.0000717)	-.0003301* (.0001936)
Constant	.826776*** (.003074)	.8158777*** (.0071658)	.6596276*** (.0230892)
Observations	188	92	101
Number of groups	17	8	9
Wald χ^2 (8)	20506.77	1673.40	2082.96
Prob > χ^2	0.0000	0.0000	0.0000

Note: *, **, *** means significance of the tested variables at 10%, 5%, 1% levels. Standard errors are in brackets.

Source: author's calculation

Table no. 4 of the PCSE estimation model reveals that the connection between branchless banking and inclusive growth is not exclusive. Indeed, it varies within geographical clusters. The divergent experiences in the CEE region and the SEE region confirm the fact that the new European economies cannot be perceived as a homogeneous group. These variations are mainly due to the various levels of development. For example, CEE countries possess more advanced digital infrastructure, better institutions, and higher GDP per capita, which makes the adoption of digital financial services much broader and more effective. By comparison, SEE countries have weaker institutions, weak financial intermediation and greater dependence on cash and physical banking infrastructure.

The ATM coefficient (0.0003185) in the full sample is positive at the 1% significance level, which supports the view that ATM infrastructure as a central aspect of branchless banking has a positive effect on inclusive growth in emerging European nations. The effect size is regionally different. To illustrate, the coefficient of ATM is higher in the SEE region (0.0005757) at the 1% significance level, implying that a positive effect of increasing the density of ATMs on inclusive growth is greater in that area. Conversely, the coefficient of ATMs in the CEE is positive at the 5% significance level but lower (0.0002351). This implies that the ATM is an important channel of access to finance, particularly in the SEE region where it is a more significant aspect of inclusion in the formal financial system than in the more digitally advanced CEE economies. Our findings agree with previous studies for emerging markets (Stegman *et al.*, 2005; Hussein *et al.*, 2017; Rahman *et al.*, 2020; Mohamed and Elgammal, 2024; Ganić, 2025).

Moreover, for the full sample, the variable internet banking (IIBAN) is positive at the 1% significance level; thus, an increase of 1 percentage point in internet banking usage increases the

HDI by 0.0005854 on average. The effect may appear minor, but in the narrow (0–1) range of HDI, its time-based sum is not insignificant. A coefficient of IIBAN (-0.000797) is negative at the 1% significance level in the CEE region. Internet banking is already very commonplace in the digital and banking societies that are highly developed, and no additional inclusion is brought by further growth. The negative correlation can also reflect unobserved variables, such as population aging or market saturation, in which mere internet banking no longer reflects actual growth in inclusiveness. Conversely, the coefficient of IIBAN in the SEE region is positive at the 1% significance level, and in line with [Suhrah *et al.* \(2024\)](#) and [Pushp *et al.* \(2023\)](#). The growth of internet banking is a notable development of the accessibility of the financial sector, particularly to the urban population and the middle classes, whereby cash and ATM transactions are substituted with the online platform. This transition not only saves time and costs but also increases HDI dimensions directly and is a strong determinant of inclusive growth.

At the 1% significance level, the coefficient of DIGPAY for the CEE region is positive. The high use of digital payments in developed digital economies leads to the efficiency and formalization of transactions and e-commerce. These findings align with previous research conducted in developing and emerging economies ([Hussein *et al.*, 2017](#); [Rahman *et al.*, 2020](#); [Mohamed and Elgammal, 2024](#)).

Conversely, the coefficient of the DIGPAY in the SEE region is negative at the 1% significance level (-0.0670715), and this could be a sign of a digital divide. Any initial development of digital payments in less developed countries tends to have a temporary effect of increasing inequality on certain more technologically and financially endowed groups. Provided that the returns to digitization remain concentrated in a small elite, there is a risk of adverse impacts on inclusive growth (HDI). Moreover, such forced formalization in these areas can be detrimental to such sectors that rely on cash, more so without safety nets and without digital literacy.

In the case of the institutional quality variable (INSTQ), the essential role of institutions is supported by the positive and statistically significant value of the coefficient at the 1% significance level in the full sample and the CEE region (0.0093097 and 0.022192, respectfully). Good governance, rule of law, and corruption control provide an enabling environment for the diffusion of benefits of both financial and technological innovations. The coefficient of the INSTQ in the CEE region is higher, which means that institutional changes in more developed and stable situations have higher returns. Comparatively, in the SEE region, the coefficient of INSTQ is negative/influential. This finding implies that institutional quality in the SEE region does not efficiently translate into inclusive growth, perhaps because weaker institutions, narrow interest structures, or the influence of other crucial determinants (e.g., underlying macro stability or post-conflict dynamics) are stronger than the governance dimensions represented by the INSTQ index. According to the findings, countries with high-quality institutional systems can promote inclusive growth, decrease increasing inequalities in income distribution, and lower poverty [Adeleye *et al.* \(2023\)](#); [Parvez *et al.* \(2023\)](#).

The unemployment findings acknowledge a theoretically valid, traditional negative relationship at the 1% significance level, with a greater influence in more formalized the CEE economies (-0.0039) compared to the SEE economies (-0.00145). It is in line with some previous research done by [Cysne \(2009\)](#); [Castells-Quintana and Royuela \(2012\)](#); [Angulo-Bustinza *et al.* \(2023\)](#). This implies that even in more formalized and productive CEE economies, job losses are far more damaging to inclusive growth, as social protection is more directly linked to formal employment. In SEE countries, the relative degree of dominance of

the informal economy partially mitigates the effects of unemployment, and thus the official unemployment rate does not reflect the real loss of living standards as effectively.

The results of financial development (FINDEV) on inclusive growth are very indicative. The negative value of the coefficient of all groups indicates that a current level of financial development in the countries under studied is not inclusive. This is more pronounced in the CEE region at the 1% significance level (-0.0004227), and this could be a sign of saturation of the financial system and more intense unproductive lending. The same trend can be observed in the SEE region at the 10% significance level (-0.0003301). This is an indicator of an organizational flaw in the distribution of financial resources. In other words, credit is not likely to go to the productive real sphere and poor households, but rather to concentrated groups that fail to bring about inclusive growth. It is in line with Ibrahim *et al.* (2024) and Nassani *et al.* (2025) and might be explained that financial development is useful, its effectiveness depends on the quality of regulation and the ability of financial institutions to serve vulnerable groups.

Even though the sample is quite limited (N=188), the methodologies applied are very robust to this data structure. The PCSE model is a model of large T, small N, as it removes heteroscedasticity and inter-panel correlation that typically exists in macro panels. Furthermore, endogeneity can be considered by the IV-GMM estimation (Table no. 5), and high Hansen p-values (0.4840; 0.2637; and 0.7939) justify the soundness of the instruments. The fact that the results from the PCSE and GMM specifications are consistent, despite the limited sample size, goes a long way towards making this paper's results credible.

Table no. 5 – IV-GMM output

	Full Sample 1	CEE region 2	SEE region 3
ATM	.0002965*** (.0000676)	.0002185** (.0001032)	.0005011*** (.0001717)
IIBAN	.0006595*** (.000188)	-.0007999*** (.0001222)	.0011369*** (.0002662)
DIGPAY	.0019633 (.017769)	.110691*** (.0206221)	-.0647086*** (.0170804)
POPGR	.008399*** (.0020245)	.0000514 (.0014916)	.0029439 (.0019225)
UNEMPL	-.0019139*** (.0002728)	-.0040224*** (.00029)	-.0016095*** (.000353)
INFL	-.0010435 (.000919)	-.0006951 (.0009477)	-.0012098 (.0008215)
INSTQ	.0077127*** (.0017768)	.0219904*** (.0014521)	-.0014639 (.0028626)
FINDEV	-.0002421** (.0001294)	-.0004077*** (.0000963)	-.0002566 (.0002528)
Constant	.8309856*** (.0088482)	.8190179*** (.0109138)	.8252542** (.0122288)
Observations	188	92	100
Number of groups	17	8	9
R-squared	0.8132	0.8585	0.6498
F-statistics	133.60	78.46	29.41
	Prob > F = 0.0000	Prob > F = 0.0000	Prob > F = 0.0000
Hansen p-value	1.451 (0.4840)	2.666 (0.2637)	0.461 (0.7939)

Note: *, **, *** means significance of the tested variables at 10%, 5%, 1% levels. Standard errors are in brackets

Source: author's calculation

The system IV GMM findings used to check robustness for the full sample, SEE countries, and CEE countries are presented in [Table no. 5](#). For most of the selected variables, the findings demonstrate strong consistency, as most of the regression coefficients support the robustness of the results.

5. CONCLUSION

The study examines whether new financial technologies and branchless banking can support inclusive growth across 17 emerging European economies. The main determinants of this trend are, specifically, the accessibility of ATMs and internet banking. Although these technologies have a favourable impact on human development across the board, in CEE region, the use of digital payments has a particularly large impact. The efficiency of branchless banking differs depending on the location. For example, in SEE region, digital payment usage is not as prevalent. However, the selection of proxy variables affects the growth or development of branchless banking. One of the branchless banking indicators had a negative correlation with human development, while the other had a positive correlation; three indicators together did not demonstrate a meaningful impact. These findings show the many impacts that, depending on how they are applied within the financial system, various branchless banking variables may have.

The findings support H_1 , confirming that branchless banking has a positive impact on inclusive growth in emerging European economies, although the magnitude of the effect varies by service type and region. The results also support H_2 , showing that institutional quality and digital readiness enhance the benefits of branchless banking. As a result, inclusive growth is more pronounced in the CEE region compared to the SEE region. More specifically, in regions with stronger institutions and developed digital infrastructure (CEE), the benefits of branchless banking are particularly pronounced. However, some digital finance measures (e.g. early-stage digital payments) may have negative or negligible effects in weaker institutional environments, such as the SEE region. The importance of these complementary policy findings is that the expansion of branchless banking should be accompanied by initiatives to strengthen the institutional framework and digital literacy, in order to maximize inclusive growth.

According to the results, increases in the number of ATMs and in internet banking use are significant predictors of the institution's development, even after controlling for regional and macroeconomic factors. Conversely, the impact of internet banking implies that the quality of digital access in more complex financial processes is more developmental than the presence of the internet itself. It means that the digital financial literacy policies may be more efficient than the just infrastructure expansion.

Moreover, the empirical findings show that the processes of inclusive growth vary greatly across regions. Although both regions enjoy the advantages of branchless banking, in the CEE region, the most important aspect is the development of the digital ecosystem on the premise of the digital payment (DIGPAY) whereas basic internet banking (IIBAN) has been decreasing returns lately. Conversely, in the SEE region inclusive growth is still mostly associated with the growth of physical access points (ATMs) and simple internet banking (IIBAN). This implies a circuit of financial development, in which the technological efficiency of the industrial sector evolves with the institutional and digital maturity of the area.

Furthermore, efforts to improve institutional quality must be considered to promote inclusive growth, maintain macroeconomic stability, and boost employment. The results

underscore the significance of broadening the scope of branchless banking services and enhancing institutional frameworks to promote inclusive growth within these economies. Using mobile banking, payment cards, and electronic payments more frequently can offer several benefits, including reducing cash use, which will save costs for banks and individuals alike. First, it has been shown that despite its positive effects on human development, the impact of branchless banking remains limited. Second, although the current level of financial development in emerging European economies is not conducive to improving human development, improved institutional quality can contribute significantly to human development.

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ANNEX

Table no. A1 – Correlation matrix including INSTQ and Institutional variables

	INSTQ	CCOR	GOVE	PSAV	REQ	VAAC	ROLAW
INSTQ	1.000						
CCOR	0.9128	1.000					
GOVE	0.9268	0.8554	1.000				
PSAV	0.8542	0.6442	0.7305	1.000			
REQ	0.9146	0.7932	0.8122	0.7218	1.000		
VAAC	0.9368	0.8309	0.7905	0.8483	0.8171	1.000	
ROLAW	0.4531	0.5196	0.4117	0.2889	0.3979	0.4325	1.000

Source: author's calculation

Table no. A2 – PCA and Eigenvectors

Variables	Sample
Kaiser-Meyer-Olkin measure of sampling adequacy (overall)	0.8203
The highest value of PCA eigen vectors	4.39064
Proportion explained	0.7318

Source: author's calculation