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The nexus between Financial inclusion and Income inequality: An Empirical evidence from the European Union

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ABSTRACT

This study empirically explores short run and long run causality between institutional financial inclusion and income inequality in 22 members of European Union (EU) divided in two subpanels: Old EU members and New EU Member states (NMS). A panel VECM (PVECM) approach is utilized to observe the dynamic causal relationship between financial inclusions on income inequality when control the effect of economic development on inequality. The current level of financial inclusion in the old EU members only through expansion ATMs services lead to decrease income inequality in long run while it contributes through expansion commercial bank branches in short run. On the contrary, the study finds weak and subdued effect financial inclusion on income inequality in the NMS countries in long run, while only expansion commercial bank branches lead to decrease income inequality in short run. The results show that financial inclusion measured by commercial bank branches contributes to more equal income distribution for both regions, only in the short run. In fact, deepening institutional financial inclusions by increasing availability and diversify of specialized financial products and ATM services are still needed to address impediments to financial inclusion, especially in the NMS.

ملخص

من خلال استخدام اختبار الحدود باعتماد الانحدار الذاتي ذي الفجوات الموزعة (ARDL)، تم تحديد العوامل التي تؤثر على الإنفاق العسكري الباكستاني. وتوفر مؤشرات التنمية العالمية للبنك الدولي بيانات السلاسل الزمنية من عام 1975 إلى عام 2020. وتبين النتائج التكامل المشترك طويل المدى بين المتغيرات في المعادلة التي تصف الإنفاق العسكري. النتائج في الاضطرابات تفتقر إلى

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الارتباط التسلسلي، انحدار ذاتي مشروط باختلاف التباين (ARCH)، واختلاف التباين. ويبرز اختبار الحالة الطبيعية لجاك بيرا (Jarque-Bera) أن الاضطرابات العشوائية بدورها تتبع نمطا طبيعيا في التوزيع، وهذا ما يوضح أنه يتم عرض أفضل نسخ النماذج. وبذلك يتم استيفاء الخصائص المتبقية واختبارات الثبات لنموذج تصحيح الخطأ. ونستنتج أنه يتعين على الحكومة التركيز على هذه النتائج التجريبية في تخصيصها للنفقات العسكرية في باكستان: ينبغي لحكومة باكستان التركيز على زيادة نمو الناتج المحلي الإجمالي بحيث ينبغي تلبية النفقات العسكرية وفقا للمتطلبات، لأن هناك ارتباط إيجابي بين نمو الناتج المحلي الإجمالي والنفقات العسكرية. ويمكن للاستثمار الأجنبي المباشر (FDI) أن يساهم بشكل كبير في زيادة نمو الناتج المحلي الإجمالي.

ABSTRAITE

En utilisant le test de liaison ARDL (auto regressive distributed lag), il a été déterminé quels sont les facteurs qui influencent les dépenses militaires pakistanaises. Les indicateurs du développement mondial de la Banque mondiale ont fourni les données chronologiques de 1975 à 2020. Les résultats démontrent la cointégration à long terme entre les variables de l'équation décrivant les dépenses militaires. Les résultats concernant les perturbations sont dépourvus de corrélation sérielle, d'hétéroscédasticité conditionnelle autorégressive (ARCH) et d'hétéroscédasticité. Le test de normalité de Jarque-Bera montre que les perturbations stochastiques suivent également une distribution normale, ce qui montre que les versions les plus fines des modèles sont affichées. Les caractéristiques résiduelles et les tests de stabilité du modèle à correction d'erreur sont donc satisfaits. Nous concluons que le gouvernement devrait se concentrer sur ces résultats empiriques lors de la formulation des dépenses militaires pour le Pakistan : Le gouvernement pakistanais devrait se concentrer sur l'augmentation de la croissance du PIB afin que les dépenses militaires soient satisfaites en fonction des besoins, car il existe une association positive entre la croissance du PIB et les dépenses militaires. Les IDE peuvent jouer un rôle majeur dans l'augmentation de la croissance du PIB.

Keywords: A Panel VECM Approach, financial inclusion, income inequalities, EU countries

JEL Classification: G19, J16, C01

1. Introduction

In the past, financial inclusion has not received much attention of decision makers, and researchers around the world. The past 15 years or so have seen a rise in popularity of financial inclusion leads to intensive debate about global agenda for inclusive and sustainable economic development. In fact, the topic of financial inclusion has become an indispensable component of economic research and its connection with economic growth. For instance, in developed countries, strategies on financial inclusion focus on the most vulnerable population to increase the percentage of inclusion, while in developing countries it focuses on access to finance. However, in recent years, increasing the availability of financial services to different population groups shedding new light on this relatively new topic. This study has two problem statements that the study aims to answer. The first problem statement is about the level of development of financial inclusion in selected 22 Old EU members and New EU Member states (NMS) and whether increase access to financial resources helps to reduce income inequality. The second problem statement inquires if there is any significant causality between financial inclusion and income inequality.

The most of recent empirical studies in some the world regions focused on survey households in microfinance sector to examine the level of financial exclusion rather than on financial inclusion. This study doesn't have that goal. This study aims to answer the following two distinct research questions: first, does inclusive financial system play the deterministic role in reduction of income inequality from a regional perspective? Second, if there is causality between financial inclusion and income inequality how great this effect is?

The lack of empirical studies for European post-transition countries is caused by delays in the financial inclusion process. One of the reasons that have caused delays of process financial inclusion in the region is a lack of trust in the financial system, caused by the collapse of the banking sector and the loss of savings in the early of 1990s. In fact, the New EU members (NMS) have undergone some significant transformations over the last two decades. Also, in the meantime, they experienced overall increase in living standards and incomes and joined to the EU, but still lag behind old EU members. The contribution of this study to the existing financial inclusion related literature is twofold. Firstly, it improves to identify differences in financial inclusion and income inequality by sub-group of countries, and secondly examine their causality relationship in the short run and long run.

There is no more evidence in previous researches whether effects of financial inclusions on income inequality vary significantly, especially in NMS where this issue has been neglected. For instance, in many previous related studies focusses were on microfinance sector and household finance inclusion but less on institutional financial inclusion. Secondly, the focus of this study is not on a single country or group countries but empirically compares the both EU regions (old EU members and NMS). There are some of empirical studies in the literature that investigating a link between financial inclusion, income inequality and poverty, but with focus on Asia, Africa, and Latin America but less in European post-transition countries.

This a shortage of empirical research might be explained by the fact that the literature on financial inclusion has more focused on the relationship between financial development and poverty but less on financial inclusion. Accordingly, the intention of this paper is to help us to fill the literature gap by extending examination of institutional financial inclusion in determination of income inequality by utilized a Panel VECM approach. To our knowledge there are no cross regional empirical studies to employ of institutional approach of financial inclusion and measure its effect on income inequality in short and long run.

The findings of this study provide two theoretical perspectives.

First, the study highlights the importance of financial development on inequality in a society through financial inclusion. The findings reveal that financial inclusion reduces income inequality under an assumption controlling the effect of economic development on inequality. Understanding the short run and long run causality between financial inclusion and growth of Gini disposable income contributes to this topic by providing evidence of how (un)equal access to financial services influence on changes in income distribution which holds controlling for real GDP (Gross Domestic Product) per capita.

Second, the study raises awareness of the modes through which finance affects inequality across EU countries. It can help to explain how boosting financial inclusion contributes to EU citizens participating in economic life and social mobility.

2. Literature Review

In recent years, a nexus between financial inclusion and income inequality becomes popular themes and finds its place in the economics literature. Even though there are some theoretical approaches and empirical studies about this topic, the early theoretical models focused on the link between finance and economic growth (King and Levine, 1993; Levine, 1997) while recently studies paid attention to channels that deliver financial services to clients. With the effect of globalization and especially after global financial crises financial inclusion has become a discussion topic and gained attention in the recent economics literature. One of the most influential types of research in the last decade about financial inclusion and its relationship with macroeconomic outcomes (including inequality) were studies done by Beck, et al. (2007) and Beck and Demirguc-Kunt (2008). Their studies concluded that improved access to finance is critical in promoting growth and reduction of income inequality. Initially, this led many researchers to broadly explore the link between financial inclusion, poverty alleviation, stimulating economic growth and reducing income inequality in 2000s. For instance, Beck, et al. (2007), Galor and Zeira (1993), Honohan (2007), Demirguc and Klapper (2012), Tita and Aziakpono (2017) suggest that finance enhances growth and reduce income inequality, while Greenwood and Jovanovic (1990), Merton and Bodie (1995), Jalilian and Kirkpatrick (2002) find effect of poverty alleviation at higher level of economic development.

Among the developing countries, the countries in Asia, Africa and Latin America are researched the most because income inequalities are significantly higher than in other regions. While the research on the developing countries often produces evidence that financial inclusion reduces poverty and income inequality, the examination of developed markets produces results that are difficult to generalize or mixed.

Honohan (2007) finds that improved household finance inclusion may lead to lower income inequality for some 160 countries with mixing data provided by banks, micro-finance institutions and household survey. Another study done by Neaime et al (2019) finds that financial inclusion reduces income inequality but does not have significant effect on poverty reduction in the sample of six Middle East countries (Algeria, Egypt, Jordan, Lebanon, Morocco and Tunisia).

Table 1: Review of selected empirical studies

Author(s)	**time span**	**Countries**	**Econometric method**	**Variables**
Sarma and Pais (2008)	cross-section study for 2004	49 countries	cross-sectional regressions	index of financial inclusion, logarithm of GDP per capita, percentage of literate people in total population, percentage of unemployed people in the total labor force, Gini coefficients
Mookerjee and Kalipioni (2010)	2000–2005	65 countries	IV regression, cross-sectional regressions	Gini coefficient UN-Wider data set, financial development measured by number of bank branches per 100,000 populations
Tchouassi (2011)	2003 - 2007	11 Central Africa countries	OLS random effects model	GINI index; logarithm of GDP per capita (LogGDP) and the square of the logarithm of GDP per capita (SqLogGDP), Inflation, Poverty
Park and Marado (2015)	2004 - 2012	37 countries	Cross sectional regression models	Composite financial inclusion indicator, GNI per capita (log), Rule of law (log), Education completion (log), Literacy (log)
Salazar-Cantú et al. (2015)	cross-section study for 2010	Mexican munici-palities	The OLS regression method	Gini index, Income ratio, Inclusion access rate, Inclusion usage rate, Average householders years of education, 2010 municipal income per capita, 2010 municipal public expenditure per capita
García-Herrer and Turégano (2015)	2000-2013	150 countries	The OLS regression method	GINI (disposable inc.), GDP per capita, Government Consumption, Trade Openness, Credit to Priv.Sector
Aslan et al. (2017)	2010-2013	140 countries	The OLS regression method	World Bank's Gini coefficient, inequality in financial access log of income per capita, openness to trade, Inflation, Human capital, financial development
Banerjee et.al. (2018)	2000 - 2016.	6 South Asian countries	Heterogeneous panel models	log of per capita real GDP, loan-to deposit ratio, number branches per 100,000 adult population
Neaime et. al (2019)	2002- 2018	6 MENA countries	GMM and GLS models	GINI index, ATM per 100000 adults, Banks per 100000 adults, Gross enrolment ratio, Labor force female (% of all), Population (in million), Inflation, Age dependency ratio of working age, GDP per capita growth
Le, et.al. (2019)	2005-2015	22 transition economies	2SLS model	GINI index, ATM and commercial bank branches per 100,000 adults, borrowers from commercial banks per 1,000 adults and depositors with commercial banks per 1,000 adults
Omara and Inaba (2020)	2004–2016	116 countries	Pooled regression Fixed effects, GMM estimation	Gini coefficient, composite financial inclusion index, log of per capita real GDP, rule of law, population, age dependency ratio, inflation rate
Čihák and Sahay (2020)	1980–2015	166 countries	dynamic panel GMM	Gini coefficient, financial inclusion, Inflation, trade, Population, remittance, education, rule of law.

Source: Compiled by the author

Previous studies have looked in the exploring of interaction between inadequate access to credit and growth. For instance, Honohan (2007) in more than 160 countries, Julie (2013) in Kenya, Kamboj (2014) in India, Bhattacharya and Wolde (2010) in the MENA region found some econometric evidence that inadequate access and difficulties in access to finance and credit undermines growth.

More precisely, Honohan (2004), Demirguc and Klapper (2012), Kim et al. (2018) in their studies found a strong link between financial inclusion and growth. Similarly, many other studies such as, Burgess and Pande (2005), Honohan (2007), Park and Marado (2015), Salazar-Cantú et al. (2015), García-Herrer and Turégano (2015), Mookerjee and Kalipioni (2010), Tchouassi (2011), Neaime et. al (2019), Omara and Inaba (2020), Čihák and Sahay (2020) confirmed a link between financial inclusion and access to financial services with reduction income inequality. In their study, Sarma and Pais (2008) found negative relationship between financial inclusion and income inequality measured by Gini coefficient. However, one other study conducted by Banerjee et.al. (2018) finds weak and subdue effect financial inclusion (measured by loan-to-deposit ratios and the number of financial institutions) on per capita real GDP growth in the six selected South Asian countries between 2000 and 2016.

Also, the findings some other studies are scanty and conflicting. For instance, Park and Mercado (2018), Tita and Aziakpono (2017), Zia and Prasetyo (2018) found statistically insignificant relationship between financial inclusion and income inequalities.

The emerging and transition markets on the other hand have received significantly less attention. There is limited contemporary literature investigating the significance of financial inclusion, particularly relevant for the region of Central and East Europe. One of the reasons is lack and paucity of data for measures of financial inclusion. For instance, Murgasova et al. (2015) critically review some finance developments in the Western Balkan after 15 years of transition and conclude that a rise of foreign investment in banking, an increase of bank's deposit base (retail deposits), growth of private sector credit to GDP are still an ongoing process. Additionally, it finds that the financial deepening in the Western Balkans is still beyond the corresponding average for a set of comparator countries (the new EU Member States).

Botric and Broz (2017) explored a gender dimension of financial inclusion in 19 European transition countries with 19,016 observations.

The study concludes that there are cross country variations in financial inclusion and access to financial services and age groups where financial exclusion is related with labour exclusion. More recent work by Moder and Bonifai (2017) found that limited access to finance hampers economic growth and doing business for companies in the Western Balkan region while Ganić (2021) found in his research that NMS-11 countries with relatively lower integrated international financial flows experience lower levels of income inequality. Le, et al. (2019) examined 22 transition countries from four different regions by using a two stage least squares (2SLS) model. Different time periods were studied for each of the countries depending on the availability of the data. They found a negative relationship between the financial inclusion index and the GINI coefficient. As it is demonstrated in greater detail in above studies there are some gaps for further research in some regions.

Although, the topic of financial inclusions in EU regions already received some attention and has been examined there is a value in reexamining it for several reasons. First, the relationship between financial inclusions and income inequality is very time sensitive. Any change in the financial inclusions may change the level of income inequality and thus all the implications that come with it. Second, many of the previous findings date back to before the global financial crisis that had exhibited in all countries' deterioration of income inequality where some of them never fully recover from the shock.

The results regarding the link between financial inclusions and income inequality may be quite different now, especially because new observations are generated in the post-crises period. Third, it was found that many studies under consideration employed static models (FE, OLS RE) and were not able to explore and test a long-term equilibrium relationship and causal relationship among variables. There is no clarified the impact of financial inclusion on income inequality and it depends of the context of each group of countries. Therefore, this study employs panel VECM model of stationarity test, Westerlund Cointegration Tests, and Granger causality test.

3. Data and Methodology

All panel data countries in the research are divided in two subpanels: Old EU members (Austria, Belgium, Denmark, Germany, France, Italy, Ireland, Netherland, Greece, Luxemburg, and Spain) and New EU members (countries that joined the EU after 2000: Bulgaria, Romania, Croatia, Czech Republic, Estonia, Latvia, Lithuania, Hungary, Poland, Slovakia and Slovenia). The research uses annual data on Automated teller machines (ATMs), per 100,000 adults and Commercial bank branches, per 100,000 adults, GDP per capita (constant 2010 US$) from the World Development Indicators, and Gini coefficient of equalized disposable income - EU-SILC survey (Eurostat) between 2004 and 2019.

The examination of stationarity variables and the order of integrity of each variable in the model is first step necessary to be explored. To explore this issue panel unit roots have been utilized to examine stationarity or no integrated property of each variable. The study utilizes four different types of panel unit root tests (Im, Pesaran and Shin W-stat, ADF Fisher Chi square, PP Fisher Chi square, Levin, Lin and Chu (LLC) to examine the order of integration of each variable. The most general form analysis of unit roots begins with the extended Dickey Fuller (DF) test for unit roots (known as the ADF test). The model of the following form is evaluated:

$$\Delta y_{it} = \alpha_i + \delta_i \dot{\rho} y_{i,t-1} + \sum_{l=1}^{pi} \theta_{il} \Delta y_{i,t-1} + e_{it} \text{ , i = 1,.., N, t=1,..T} \quad (1)$$

Where is: $\dot{\rho} = \rho - 1$, a $\rho = \rho_i$ which assumes that the panel structure is homogeneous.

The null hypothesis implies the existence of unit roots for all panel units ($y_{it} \sim I(1)$, whereas the alternative hypothesis assumes stationarity of all panel units ($y_{it} \sim I(0)$. Thus, LLC is a joint test, and the homogeneity of individual components is reflected in equality: $\rho_i = \rho$ for any comparative data.

The possible existence of autocorrelation in the model can be overcome by extending the model with the lagged dependent variable (eq.1), which provides the possibility of introducing a different number of lags for each time series in the panel.

In order to increase the power of unit root tests and relax homogeneity assumptions, Im, Pesaran and Shin (2003) constructed an IPS test based on averages of the individual ADF statistics for panel units. In fact, this test relies on heterogeneous coefficients with a lagged dependent variable (ρ_i), and the average ADF t -statistics:

$$\bar{t} = \frac{1}{N} = \sum_{i=1}^{N} t_{\rho i} \tag{2}$$

Where $t_{\rho i}$ is the individual t statics for testing each unit of the null hypothesis where ρ_i = 1 for each comparative data.

Therefore, the hypotheses in the IPS test are defined as follows:

$$H_0 = \rho_i = 1 \; versus \; H_1: \rho_i < 1. \tag{3}$$

Co integrated variables are no stationary variables where there to be a long run relationship. For instance, let the variables X_t and Y_t to be nonstationary and let Y_t be a linear function of X_t. In that case a variable of Y_t can be presented in the following form:

$$Y_t = \alpha + \beta X_t + \varepsilon_t \tag{4}$$

Based on the analysis of the integration and co integration of the variables, an appropriate VAR or VECM model can be proceeded. Furthermore, the Johansen's (1998) procedure is used to determine the number of co-integrating vectors, and then determine the rank of the matrix Π from equation (5) because it assumes that there are more than two variables.

The vector error correction model (VECM) is given by the following expression:

$$\Delta Z_t = \alpha_0 + \sum_{i=1}^{k-1} \Gamma_i \Delta Z_{t-1} + \Pi Z_{t-k} + e_t \tag{5}$$

Where Δ is the difference operators, Z_t is an (M x1) vector of the variables, α_0 is a Mx1-dimensional vector of the constant, e_t is k-dimensional vector of stochastic error term asummed to be normally distributed, Π is the long-lun matrix and Γ_i is the vectors of the short run relationship (Brooks, 2014).

The Westerlund (2007) cointegration test is employed to examine the cointegration of variables, through two group mean statistics (G_a,G_t) and two panel statistics (P_α, and P_t). It performs very well in small samples, as ours and has ability to make accurate predictions. In doing so, it examines whether there exists cointegration among regressors. If the null hypothesis of non-existence of cointegration is rejected, then cointegration is present. A necessary condition for conducting this analysis is that the variables of interest are integrated I (1).

In order to test Granger's causality, we use hypothesis H_0: ϕ1 = = ϕp = 0 and test whether the estimated coefficient $\widehat{\phi}$i is statistically significantly different from zero. In other words, if the obtained p-value is less than the given critical value, the null hypothesis is rejected and conclude that X_t Granger causes Y_t, or it should be included in the equation.

To obtain F-statistics for Granger causality testing, consider the restrictive and non-restrictive model:

$$y_t = \phi_0 + \beta_i y_{t-1} + \ldots + \beta_q y_{t-q} + \varepsilon_{1t} \quad (6)$$

and

$$y_t = \phi_0 + \phi_i X_{t-1} + \ldots + \phi_p X_{t-p} + \beta_1 y_{t-1} + \beta_q y_{t-q} + \varepsilon_{2t}. \quad (7)$$

The sum of squared residuals is calculated first:

$$RSS_r = \sum_{t=1}^{T} \hat{\varepsilon}_{1t}{}^2 \text{ and } RSS_{ur} = \sum_{t=1}^{T} \hat{\varepsilon}_{2t}{}^2 \quad (8)$$

Where

$$\hat{\varepsilon}_{1t} = y_t - \widehat{\phi_0} - \widehat{\beta_\imath}\, y_{t-1} - \ldots \widehat{\beta_q} y_{t-q} \quad (9)$$

and

$$\varepsilon_{2t} = y_t - \widehat{\phi_0} - -\widehat{\beta_\imath} y_{t-1} - \ldots \widehat{\beta_q} y_{t-q} - \widehat{\phi_\imath} X_{t-1} - \widehat{\phi_p} X_{t-p} \quad (10)$$

are the estimated errors of the restrictive and non-restrictive models, respectively.

RSS_r denotes the sum of squared residuals for restricted model whereas RSS_{ur} is the sum of squared residuals from unrestricted model.

Then, given the estimation above, the value of F - statistics for examination of Granger causality hypothesis takes the following form:

$$F = \frac{(SSS_r - SSS_{ur})/m}{SSS_{ur}/(T-k)} \quad (11)$$

Where T is the number of observations, k the number of parameters in the unrestricted model, and m is the number of restrictions.

In equation (12) is presented a set of the variables employed in our model to explore financial inclusion-income inequality nexus:

$$\text{Inequality} = f\,(\text{Financial inclusion}, \text{Economic development}) \quad (12)$$

Having in mind a dynamic nature of the dependent variables in this empirical study or the dependence of the present value of a variable on its previous value, the econometric model employs this research starts with long run relationship between market inequality, financial inclusion and economic development as follows:

$$\text{lndisp}_{i,t} = \alpha_{it} + \beta_{1i}\ln \text{FI1}_{i,t} + \beta_2 \ln \text{FI2}_{i,t} + \beta_3 \text{lnGDPC}_{i,t} + e_{i,t} \quad (13)$$

Where:

α_{it} is an intercept, lndisp is the log of market income inequality, lnFI1 is the log of financial inclusion 1, ln FI2 is the log of financial inclusion 2, lnGDPC is the log of GDP per capita, e -residuals, i (1, 2…) refers to number of countries and t number of years.

For testing of panel causality, a panel VECM model is specified as follows:

$$\Delta\text{lndisp}_{it} = \alpha_1 + \sum_{i=1}^{p} \beta_{1i}\ \Delta\text{lndisp}_{it-1} + \sum_{i=1}^{q} \beta_{1i}\, \Delta\ln \text{FI1}_{it-1} + \sum_{i=1}^{r} \beta_{1i}\, \Delta\ln \text{FI2}_{it-1} + \sum_{i=1}^{s} \beta_{1i}\, \Delta\text{lnGDPC}_{it-1} + \lambda_1 + \text{ect}_{t-1} + \mu_{1it} \quad (14)$$

$$\Delta\ln \text{FI1}_{it} = \alpha_2 + \sum_{i=1}^{p} \beta_{1i}\ \Delta\text{lndisp}_{it-1} + \sum_{i=1}^{q} \beta_{1i}\, \Delta\ln \text{FI1}_{it-1} + \sum_{i=1}^{r} \beta_{1i}\, \Delta\text{Ln FI2}_{it-1} + \sum_{i=1}^{s} \beta_{1i}\, \Delta\text{lnGDPC}_{it-1} + \lambda_2 + \text{ect}_{t-1} + \mu_{2it} \quad (15)$$

$$\Delta\ln \text{FI2}_{it} = \alpha_3 + \sum_{i=1}^{p} \beta_{1i}\ \Delta\text{lndisp}_{it-1} + \sum_{i=1}^{q} \beta_{1i}\, \Delta\ln \text{FI1}_{it-1} + \sum_{i=1}^{r} \beta_{1i}\Delta\ln \text{FI2}_{it-1} + \sum_{i=1}^{s} \beta_{1i}\, \Delta\text{lnGDPC}_{it-1} + \lambda_3 + \text{ect}_{t-1} + \mu_{3it} \quad (16)$$

$$\Delta\text{lnGDPC}_{it} = \alpha_4 + \sum_{i=1}^{p} \beta_{1i}\ \Delta\text{lndisp}_{it-1} + \sum_{i=1}^{q} \beta_{1i}\, \Delta\ln \text{FI1}_{it-1} + \sum_{i=1}^{r} \beta_{1i}\, \Delta\ln \text{FI2}_{it-1} + \sum_{i=1}^{s} \beta_{1i}\, \Delta\text{lnGDPC}_{it-1} + \lambda_4 + \text{ect}_{t-1} + \mu_{4it} \quad (17)$$

Where ECT refers is defined as follows:

$$\text{ECT}_{it} = \Delta\text{lndisp}_{it} - \beta_0 - \beta_1\, \Delta\text{lnGDPC}_{it} - \beta_2\, \Delta\ln \text{FI2}_{it} - \beta_3\, \Delta\ln \text{FI1}_{it}. \quad (18)$$

A result of relationships explained in eq.14–eq.17 is that either Δlndisp_{t},$\Delta\ln \text{FI1}_{it}$, $\Delta\ln \text{FI2}_{it}$, ΔlnGDPC_{it} or a combination of any of them must be caused by ect_{it-1}. Further, the error correction model (ECT) allows to run for Granger causality.

The variable of Gini disposable income (lndisp) is proxy for income inequality and refers to Gini coefficient as the relationship of cumulative shares of the population arranged based on the level of equivalised disposable income (Eurostat). This variable was employed in some recent studies done by Guzi et al. (2021), RAMOS and Rouyela (2014) amongst others, and might be utilized to measure the income (in) equality.

The study follows an assumption that financial inclusion leads to reduction of income inequality through expansion ATMs services and bank branches (Beck, et al. 2007). Two explanatory proxy variables: Automated teller machines (ATMs), per 100,000 adults and Commercial bank branches (per 100,000 adults) are employed to measure inequality in availability financial services because some recent studies by Sarma, (2012), Rojas et.al. (2014), Neaime et. al (2019), Le, et.al. (2019), Čihák and Sahay (2020) and others used the same variables. We expect that greater access to bank branches and more Automated teller machines (ATMs) can be associated with reductions in income inequality. It is expected that the both variables to have inverse relationship with income inequality. A variable GDP per capita is included to control the effect of economic development on inequality. Structural is proxied by GDP per capita to measure a country characteristic and control mean income and economic growth rate. In line with the studies done by Neaime et al. (2019), Tchouassi (2011) we expect that GDP per capita has an inverse relationship with income inequality. One of the reasons is that usually higher income increases inequality, but its effect declines after a certain point. However, Sarma and Pais (2008) found that higher income level lead higher financial inclusion. All variables are presented in logarithm scale to improve robustness of results.

4. Empirical Results

As an initial step in the empirical analysis, four panel tests of unit roots were performed to test the stationarity of all-time series and ensure that the selected variables in consideration are level of first difference stationarity.

Levin, Lin and Chu (2002) test examined the H_0 of common unit root, while the rest of three tests (ADF Fisher Chi square, PP Fisher Chi square and Im, Pesaran and Shin W-stat) examined the H_0 of individual unit root against cross-sections without unit root (H_1). Table 2 summarizes the results for unit root tests for first difference of the relevant variables.

Table 2. Results of panel unit root tests

Test Variable	Unit Root Tests			
	Im, Pesaran and Shin W-stat	**ADF Fisher Chi square**	**PP Fisher Chi square**	**Levin, Lin and Chu**
Panel A: E New EU members estimates (First Difference)				
lndisp	-3.72992***	52.4825***	54.7969***	-6.65089***
Ln FI1	-3.93494***	53.4449***	36.3494**	-10.2221***
Ln FI2	-6.91166***	72.7698***	53.3556***	-12.3662***
lnGDPC	-8.72618***	89.9324***	73.9555***	-16.5171***
Panel B: Old EU members (First Difference)				
lndisp	-4.84846***	64.6654***	130.832***	-4.87304***
Ln FI1	--1.16573***	32.1601***	80.9042***	-0.94082***
Ln FI2	-4.42096***	53.6222***	71.4473***	-11.3669***
lnGDPC	-3.86887***	52.6750***	73.3235***	--4.91442***

Source: The Author's Calculations
** p.05; *** p.01

The findings of panel unit root tests have shown that the time series in the panel confirmed stationary at the same level of integration I(1) at a significance level of 1 per cent and all tests rejects the panel unit root hypothesis for the first differences. Thus, there seem no restrictions for utilizing of co-integrating techniques and test the existence long run relationship between inequality and financial inclusion. After an examination of stationarity, the variables, Westerlund (2007) ECM (Error Correction Model) panel co integration tests is employed to explore individual and common co-integration tests (Table 3).

The findings obtained from the model for both type of tests suggest all four statistics making a pretty strong case for using a VECM.

Table 3: Westerlund Cointegration Tests results

Variable	Test Statistics			
	Group and Panel Statistics	**Value**	**z-value**	**Robust P-value**
Lndisp, ln FI1, ln FI2, lnGDPC	Group mean test, G_t	-2.148	-2.010	0.030
	Group mean test, G_α	-5.224	1.943	0.040
	Panel test, P_t	-8.836	-2.029	0.050
	Panel test, P_α	-4.678	0.303	0.020

Source: The Author's Calculations

The findings from Table 3 indicate that there is co-integration among the variables in our model and it can be used as evidence of co integration for the panel as a whole and/or at least for one of the countries in these panels. Then, the study continues further to explore the nature of relationship among short run and long run coefficients of the variables by utilizing VECM estimation. As shown in Table 4, the estimated coefficient of the lnGDP in Panel "A" only exerts positive and statistically significance (at 1 per cent) to income inequality in the long run.

Table 4: Long Run Cointegrating Equation

Variables	**Coefficient**	**Std. error**	**t-Statistic**
Panel A: NMS members estimates			
LNDISP (-1)	1.000000		
LNFI1(-1)	0.043335	0.10237	0.42330
LNFI2(-1)	-0.035099	0.08509	-0.41252
LN_GDPC (-1)	0.379728***	0.09222	4.11773
C	-7.102111		
Specification of long run equation: LNDISP= -7.1+0.04-0.035+0.38			
Panel B: Old EU members			
LNDISP (-1)	1.000000		
LNFI1(-1)	-0.217604**	(0.07820)	[-2.78262]
LNFI2(-1)	-0.026282	(0.03796)	[-0.69240]
LN_GDPC (-1)	0.038240	(0.06385	[0.59893]
C	-2.711559		
Specification of long run equation: LNDISP=-2.71-0.21-0.02+0.038			

Source: The Author's Calculations, ** p.05; *** p.01

According to the estimation results, in panel "A", it advocates in the long run that one percent increase in GDPPC, will cause income inequality levels increased by 0.38 per cent. Besides, the long run estimates show in Panel "B" that the only LNFI1 variable of financial inclusion exerts negative and statistically significance long run influence to income inequality at 5 per cent.

This result implies that there is one percent increase in number of Automated teller machines (ATMs) that will cause income inequality levels decreased by 0.21 per cent. These findings are in the line with the study done by García, et al. (2015), Sarma and Pais (2008), Park and Marado (2015), and Čihák and Sahay (2020).

The estimated ECT model (Table 5) confirmed the presence of co-integrating vector in the both panels, having in mind that ETC coefficient is a negative and statistically significant. This means that there is strong convergence from short dynamics towards long run equilibrium level. As shown in the results of the estimation in Table 5, ECT coefficient in the Panel "A" shows negative and statistically significant effect. It indicates that that there are 9.5 percentage points speed of adjustment annually from the previous period towards long run period with causality running from the independent variable (LNFI1, LNFI2, LNGDPC) to LNDISP. The coefficient of lag lnFI2 has a correct and expected sign. A final model indicates that employed variables explain 20.4% changes in income inequality. Interestingly, the both lags of income inequality (first order lag and second order lag) are shown as statistically significant.

Table 5: The Short Run Results (Error Correction Model)

Variables	Coefficient	Std.error	T test value
Panel A: NMS members estimates			
ECT	-0.095432***	0.034878	-2.736165
D(LNDISP (-1))	-0.222823***	0.07806	-2.85451
D(LNDISP (-2))	-0.133712*	0.07678	-1.74144
D(LNFI1(-1))	0.103180	0.07743	1.33256
D(LNFI2(-1))	-0.159445***	0.05332	-2.99055
D(LNGDPC (-1))	-0.008260	0.07605	-0.10861
R-squared 0.204760; F-statistic 3.547526; Prob(F-statistic) 0.000001; Sum sq. resids 0.213048 VEC Residual Heteroskedasticity Tests (Levels and Squares): Chi-sq: 351.2410; df. 180; Prob. 0.2113			
Panel B: Old EU members estimates			
ECT	-0.098199***	0.02817	-3.48610
D (LNDISP (-1))	-0.123442*	0.08391	-1.47111
D(LNFI1(-1))	-0.024132	0.04299	-0.56132
D(LNFI2(-1))	-0.057363**	0.02853	-2.01074
D (LNGDPC (-1))	-0.107317*	0.06878	-1.56030
R-squared 0. 1772; F-statistic 3.135307; Prob(F-statistic) 0.000001; Sum sq. resids 0.007320 VEC Residual Heteroskedasticity Tests (Levels and Squares): Chi-sq: 202.0180; df. 180; Prob. 0.1249			

Source: The Author's Calculations, ** p.05; *** p.01.

And in Panel "B," ETC coefficient is a negative and significant at 1 per cent level with speed adjustment of 9.8 per cent annually whenever there is a shock in a short run towards long run period. The coefficient of R-squared is low 0.17 and indicates that employed variables explain 17.72 per cent changes in income inequality in Panel "B."

Table 6. Panel VEC Granger causality/ Block Exogeneity Wald Tests

Panel VEC Granger causality/ Block Exogeneity Wald Tests			
Panel A: NMS members estimates			
	Coefficient	Std.error	p- value
D (lnFI1) does not Granger-cause D(lnDISP)	1.778309	2	0.4110
D(lnFI2) does not Granger -cause D(lnDISP)	0.766499	2	0.6816
D(lnGDPC) does not Granger -cause D(lnDISP)	6.722511	2	0.0347
All does not Ganger -cause D(lnDISP)	9.572550	6	0.1438
Panel B: Old EU members			
D(LNFI1) does not Granger -cause D(lnDISP)	3.722924	2	0.1554
D(lnFI2) does not Granger -cause D(lnDISP)	4.760253	2	0.0925
D(lnGDPC) does not Granger-cause D(lnDISP)	2.618560	2	0.2700
All does not Granger -cause D(lnDISP)	11.38058	6	0.0773

Source: The Author's Calculations, ** p.05; *** p.01.

As expected, two variables (first order lag of lnFI2 and LNGDPC) are shown as statistically significant and impact on income inequality while lag of lnFI1 has correct expected sign but statistically insignificant in explaining income inequality. In fact, an increase in the previous expected financial inclusions (first order lag of lnFI2) measured by number of bank branches lead to decrease income inequality about 0.05 per cent. Moreover, the findings for the NMS countries and Old EU countries indicate that financial access measured by number of Automated teller machines (ATMs) at the current level on short run were not being contribute to decrease income inequality in the both EU regions.

Further, the results displayed in Table 6 reveal that there is only causality from lnGDPC to lnDISP at 5 per cent level of significance (Panel "A") and from lnFI2 to lnDISP in Panel "B" at 10 per cent level of significance.

However, for the rest of variables there is no causality running from lnFI1 and lnGDPC to lnDISP. Moreover, post-estimates tests are conducted to check whether number of co integration equations is misspecified. As the estimated values for VECM Stability model shows (Figure 1 and Figure 2) for the both regions root tests of residual stability are less than 1. It supports our expectation that the prediction co integrating equitation is stationary. Accordingly, our VECM model has beneficial effects and meets the stability condition. Also, our four variables included in consideration according to autocorrelation test (Appendix 1) do not have autocorrelation problem.

Figure 1: Inverse Roots of AR for 11 NMS members

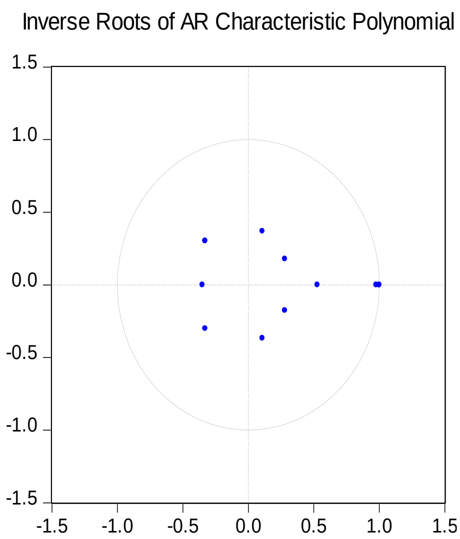
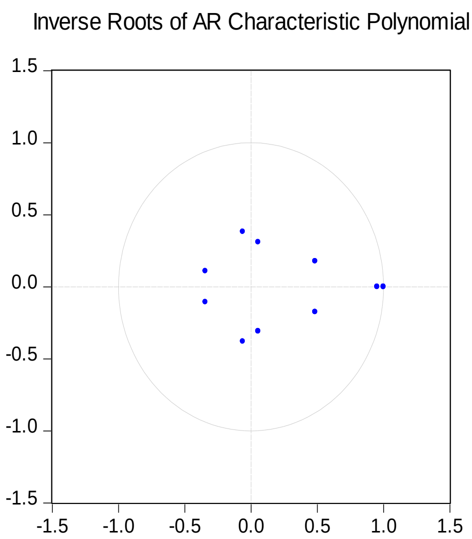


Figure 2: Inverse Roots of AR for Old EU members



Source: The Author's Calculations

4.1. Discussion

The study finds that greater financial inclusion is associated with reductions in income inequality in old EU members than in NMS. For ATM services, the study finds evidence that old EU members have more benefits from financial inclusion in equal income distribution than the NMS. It is in line with some empirical evidence done by Demirguc and Klapper (2012), Honohan (2004) and Mookerjee and Kalipioni (2010 where more developed countries have stronger link between financial access and economic development than low and middle income countries.

In addition, the results found in the NMS countries confirm earlier an examination lower levels of financial inclusion in Central Europe done by Demirguc-Kunt, Hu, and Klapper (2019) Namely, the authors found lower levels of financial inclusion in Central Europe because a substation part of adult remain unbanked with income gaps in account ownership between poor and reach. Moreover, lack of trust in banks is also one of the main barriers to account ownership (Ganić, 2021; Murgasova, et al. 2015) that can be used to explain lower levels of financial inclusion in Central Europe.

On the contrary, financial inclusion measured by commercial bank branches failed to affect income inequality in the both EU regions in the long run. For old EU countries, it might be explained by decline in the number of commercial bank branches and transition toward new modes of financial access and ATM services.

In the long run, the results indicate that a variable of GDP per capita is positive by explaining that a higher GDP per capita lead to higher level of financial inclusion. It is consistent with some previous studies such as Omar and Inaba (2020), and Sarma and Pais (2008).

Moreover, in the NMS countries expansion of ATM services does not seem to be importantly associated with income inequality neither short run nor long run. It might be explained with cross countries differences in financial inclusion where population in old EU members has greater access to financial services than in the NMS that are more financially excluded. Similar empirical evidences found Honohan (2007) in his research about cross-country variation in household access to financial services and Neaime et. al (2019) for the MENA region.

5. Conclusion

In old EU members, the study finds that financial inclusion through ATM services contributes to more equal income distribution in long run while it contributes through expansion commercial bank branches in short run. On the contrary, the study finds weak and subdue effect financial inclusion on income inequality in the NMS countries.

Regrettably, for the both region the current level of increase in bank branches and ATMs services is necessary but not sufficient condition for promoting financial inclusivity. Generally, the results show that financial inclusion measured by bank branches contributes to more equal income distribution for the both regions, only in the short run.

However, for the proxy variable of financial inclusion measured by ATMs services the results are mixed. For instance, in the NMS countries the study finds a weak link between institutional financial inclusion and income inequality in the long run. Also, the empirical results for the Old EU members, in short run provided robust evidence that economies with higher level of institutional financial inclusion reduce income inequality only for a proxy variable of number of bank branches but not for ATMs services. The final implications of this study are that policies of financial inclusions can lead and support reduction of inequality in the long run, particularly in the Old EU countries. The study offers some policy implications as follows.

First, in the long run financial inclusion will not always lead to reduce the income inequality. For example, in the long run developed old EU members will broaden financial access and inclusion, while less developed NMS will have lower range of sophisticated financial services and financial inclusion. Accordingly, deepening institutional financial inclusions by increasing availability and diversify of specialized financial products and ATM services are still needed to address impediments to financial inclusion, especially in the NMS. While income inequality tends to reduce partly as access to financial services increase, in the NMS institutional financial inclusion is still not able to support this process. Second, in short run financial inclusion through expansion of commercial bank branches has a reducing effect on income inequality in old EU members and the NMS. It suggests that higher number of commercial bank branches in the both EU regions facilitates the access to financial services for poor and reduce income inequality while governments policy for the both regions should further enhance greater promotion of financial literacy, and create new modes of financial inclusion as through ATM services in the future.

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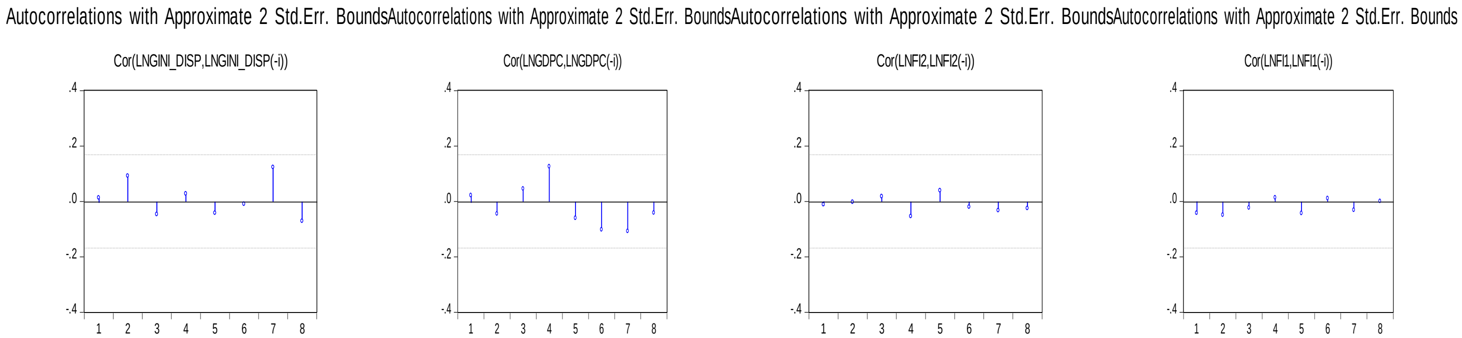
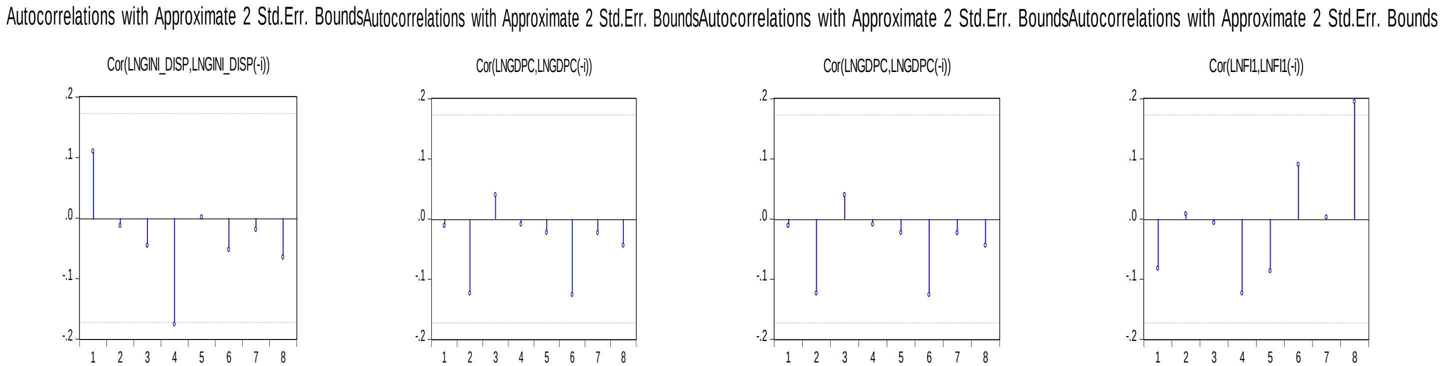
Appendix 1: VECM autocorrelation diagram



VECM autocorrelation diagram for Old EU members



VECM autocorrelation diagram for 11 NMS members

Source: The Author’s Calculations.