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Financial Development, Economic Growth and Income Inequality in Central Eastern European Transition Economies: Evidence from the Toda-Yamamoto Panel Causality Test

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Abstract. This study rigorously examines the causality between banking development, economic growth, and income inequality using annual panel data for 13 Central Eastern European transition economies from 2000 to 2020. The Granger non-causality test of heterogeneous panels based on the Toda and Yamamoto approach is employed for the empirical analysis. The main findings establish a trivariate causal relationship between financial development, economic growth, and inequality. In particular, the banking development measured by private credit provided by the financial sector and liquid liabilities Granger causes economic growth, and economic growth Granger causes income inequality. Based on the results, policy implications in European transition economies should focus primarily on expansion and banking system reforms so that to improve financial services, leading to enhanced economic growth. The boosted economic activity could ameliorate income inequality and improve social welfare.
Keywords: economic growth, financial development, inequality, trivariate panel causality, CEE countries.

Introduction

The relationship between financial development, economic growth, and income inequality is complex and multifaceted, as evidenced by various studies. The findings indicate that financial development can spur economic growth but may also exacerbate income inequality (Aghion et al., 2021). Financial development contributes to economic growth through capital accumulation and efficiency of economic activity (Levine, 2005). Income inequality can benefit or harm economic growth through various channels, such as savings, the political economy channel that includes fiscal policy, and market imperfections (Mdingi and Ho, 2021). A sound financial system is essential to boosting economic growth by providing financial opportunities for all the segments of society to participate in economic

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activities. Unequal access to credit can impede the investment opportunities and upward mobility of low segments of the population, thus contributing to the widening income inequality gap (Kim et al., 2021).

Many studies have explored financial development, economic growth nexus, and income inequality growth nexus separately. The causal relationships between financial development and economic growth have been extensively analyzed by employing different econometric methods, and they remain controversial among academics and policymakers. Likewise, empirical studies investigating the causality between inequality and economic growth produce mixed results, and a few studies have examined the direction of causality between financial development and income inequality. Most studies focus on a causal relationship in a bivariate framework without considering the consequence of the third variable in the examined nexus. However, less attention has been devoted to the trivariate causality relationships for financial development, income inequality, and economic growth, and this area has yet to be vastly investigated. Hence, this study attempts to simultaneously confirm the direction of causality between financial development, economic growth, and income inequality. The central hypothesis of this study is whether financial development causes economic growth, and if economic growth causes income inequality.

The Central and Eastern European transition economies include countries that are in the process of transformation from planned economies to market-oriented economies. This transformation, characterized by significant changes such as privatization of State-owned enterprises and reforms in economic policies, often leads to rapid economic growth but also to rising income inequalities (Brzezinski, 2018). The financial system in the Central European transition economies was relatively underdeveloped and dealt with challenges in the effective allocation of funds due to the weak regulatory frameworks and the lack of credit access for specific segments of society. The restrictions to capital access can hinder entrepreneurship and investment, affect economic activity, and exasperate income inequality. Furthermore, rent-seeking behavior can widen the inequality gap since the banking sector can allocate lending funds to large corporations and upper-income segments while denying access to the more vulnerable income segments (Manta et al., 2023).

This paper adds to the existing literature by investigating the causality between financial development, economic growth, and income inequality in a trivariate setting while using a novel Granger causality test. This test constitutes an extension of the bivariate non-causality test for heterogeneous panels developed by Dumitrescu and Hurlin (2012), which is based on the Toda and Yamamoto (1995) approach.

The main objective of this study is to determine the direction of causality between financial development, economic growth, and income inequality by using annual panel data for 13 Central Eastern European transition economies from 2000 to 2020. This study offers several contributions to the literature about the causality links between financial development, economic growth, and income inequality. First, by using the trivariate panel, the causality test provides a sufficient understanding of the relationship between financial development, economic growth, and income inequality that will have empirical and policy significance. Secondly, to the best of our knowledge, this is the first comprehensive study

that focuses solely on the Central Eastern European transition economies, thereby providing a unique perspective on the region's economic development. The findings of this study are valuable and have the potential to inform policymakers to design the appropriate strategies for Central Eastern European transition economies about the development of the financial sector that can stimulate economic growth and mitigate income inequalities. Furthermore, the findings could provide insights and offer practical guidance for policymakers and researchers in similar financial development, growth, and inequality issues.

The remainder of this study is structured as follows: Section 2 presents the literature review; Section 3 provides the materials and describes the empirical methodology; Section 4 presents and discusses the results; and Section 5 summarizes the main conclusions of this research work.

2. Literature Review

Financial development, economic growth, and income inequality have been mainly investigated in a bivariate nexus. The relationship between financial development and economic growth has been extensively studied, revealing a complex interplay and the causality direction, which can be summarized in four hypotheses. The supply-leading hypothesis means that the development of the financial system leads to economic growth (Schumpeter, 1912; Christopoulos and Tsionas, 2004). The development of the financial sector leads to the growth of the real economy through diversification of risk, physical capital accumulation, financial resource mobilization, increased productivity, and improved technology. In contrast, the demand-following hypothesis suggests that economic growth causes financial development since better living standards increase demand for financial services (Robinson, 1952). The feedback causality hypothesis supports two-way causality between financial development and economic growth. A well-developed financial sector can stimulate economic growth through technological innovations, which lead to an increased demand for financial services. This financial system expansion can cause higher economic growth (Levine, 2005). Finally, the neutrality hypothesis implies the absence of causality between financial growth and economic growth, and the role of the financial sector in economic growth is overvalued (Lucas, 1988). Several empirical studies have explored the direction of causality between financial development and economic growth.

Caporale et al. (2015) delved into the relationship between financial development and economic growth in ten new European Union members during 1994–2007, uncovering that, despite underdeveloped stock markets and banking sectors, financial development still led to economic growth. Matei (2020) examined the relationship between financial development and economic growth for 11 Emerging European Countries during the period of 1995–2016 by using dynamic panel models and found that financial development has a linear and positive effect on growth in the short-run, thus proving the supply-leading hypothesis. Song et al. (2021) explored the causality between financial development, economic growth, and corruption by using panel error correction models from 2002 to 2016 for 142 countries in the long run, approving unidirectional causality from economic

growth to financial development in developing countries. They established that there is no such causality in developed countries. Mtar and Belazreg (2020) examined the three-way relationship between innovation, financial development, and economic growth by using the panel VAR models for 27 OECD countries over the period of 2001–2016 and showed a unidirectional causality from economic growth to financial development. Ekanayake and Thaver (2021) examined the relationship between financial development and economic growth in 138 developing countries categorized into six geographical regions during the period of 1980–2018 and found a bidirectional causality in Europe and Central Asia, South Asia, and the total sample, a one-way causality from growth to financial development in the East Asia, the Pacific region, Latin America, and the Caribbean region, and no causality between financial development and economic growth in the Middle East and North Africa, and Sub-Saharan Africa. Abbas et al. (2022) investigated the relationships between financial development and economic growth by using data for middle-income countries and employing the Granger causality test based on *Vector Error Correction* (VEC) for the period of 1995–2018 and showed two-way Granger causality between financial development and economic growth. Nguyen et al. (2022) used panel data on 22 emerging markets over the period of 1980–2020, by employing the Dumitrescu and Hurlin (2012) panel Granger causality test, and found a bidirectional causality between financial development and economic growth.

The relationship between income inequality and economic growth is complex and multifaceted, with evidence suggesting that while economic growth can lead to increased income inequality, high levels of inequality can also hinder growth by limiting access to the essential services and human capital development. Kuznets (1955), in his seminal work, studied the links between growth and inequality and noted that income inequality increases at the early stage of economic growth, decelerates during industrial development, and is reduced during the maturity of the economic sector. This hypothesis has been a cornerstone for many subsequent studies that have focused on the reverse direction of causality from inequality to growth. Several authors have empirically investigated the reverse causality between inequality and economic growth. Vo et al. (2019) found bidirectional causality between economic growth and income inequality by using two samples, an unbalanced panel data of 158 countries and a sample including middle-income countries, during the period of 1960–2014 while employing the Granger causality test by Dumitrescu and Hurlin (2012). Koh et al. (2019) investigated the causality between income inequality, growth, and financial depth in China for the period of 1980–2013 by using a vector error-correction model and found a bidirectional causality between financial depth and economic growth while also establishing unidirectional causality from inequality to economic growth. Obiero and Topuz (2023) explored the direction of causality between income inequality, growth, and debt in a bivariate setting for 11 selected countries in the Sub-Saharan African region by using a panel bootstrap causality approach for the period of 1980–2018 and concluded on a one-way causal relationship from inequality to growth in Botswana, Lesotho, Nigeria, and South Africa, while also noting that the relations can differ due to the characteristics of each country.

In contrast, Wolde et al. (2022) examined the long-run relationship between income inequality and economic growth in Ethiopia over the period of 1980–2017 by using Granger causality tests and found a unidirectional causality from economic growth to income inequality. Aremo and Abiodun (2020) examined the causality between fiscal policy, economic growth, and income inequality for twenty-six Sub-Saharan African countries classified as low, lower-middle, and upper-middle-income countries over the period of 1995–2016 and found no causality in low-income countries and lower-middle-income countries; meanwhile, they established unidirectional causality from economic growth to income inequality in upper-middle-income countries. Bentzen and Tung (2020) investigated the causality between income and inequality during the period of 2006–2018 for 61 provinces in Vietnam, by applying the Granger causality test based on out-of-sample forecast errors; they concluded by finding an absence of causality. Soava et al. (2019) analyzed the relationships between income inequality, economic growth, and risk of poverty by using panel data from 28 European Union countries during the period of 2005−2016. They confirmed the Kuznets hypothesis and found a positive link between inequality and growth for emerging EU countries but a negative relationship for highly developed European Union countries. The results also showed no causal relationships between inequality and economic growth.

The relationship between financial development and income inequality is a rich and diverse topic in the literature. Some studies argue that financial development enhances income inequality by facilitating more effective resource allocation to underprivileged populations, thereby boosting human and physical capital investments (Aghion and Bolton, 1997). Whereas, Jauch and Watzka (2016) discovered a positive impact of financial development on income inequality in 138 developing and developed countries from 1960 to 2008, by employing static and dynamic panel data techniques. However, other studies propose that increased financial development can reduce income inequality, as seen in the works of Banerjee and Newman (1993) and Galor and Zeira (1993). In this regard, Weychert (2020), by using data from 59 countries over the period of 2004–2014, demonstrated that financial access reduces income inequality. Furthermore, Manta et al. (2023) found a negative correlation between financial development and income inequality during the period of 2004–2019 in Central and Eastern European Countries. The third strand of the literature suggests that financial development has an inverted U-shaped non-linear relationship with income inequality (Greenwood and Jovanovic, 1990). Nguyen et al. (2019) confirmed an inverted U-curve relationship between financial development and income inequality for 21 emerging countries from 1961 to 2017. Chakroun (2020) found an inverted U-shaped relationship between the banking sector development and inequality, but established that there is no evidence of an inverted U-shaped relationship between the stock market development and inequality. Okafor et al. (2023) investigated the impact of each financial development dimension on income inequality and found that financial access, stability, and efficiency harm income inequality, while an increase in financial depth worsens income inequality in 48 African countries for the period of 1996–2018.

Research on the direction of causality between financial development and income inequality is notably scarce, thereby underscoring the novelty and importance of this study. Most existing studies suggest a one-way causality from financial development to income inequality. For instance, Gimet and Lagoarde-Segot (2011) found that financial development triggered income inequality in 49 countries from 1994 to 2002, with the banking sector having a more significant impact on inequality. Cetin et al. (2021) explored the relationship between technological innovation and income inequality in Turkey within the context of the financial Kuznets curve hypothesis from 1987 to 2018. Their findings revealed a bidirectional causality between financial development and income inequality, with economic growth leading to income inequality. Juuti (2021) investigated the role of financial development in the inequality-growth nexus for a total sample of 69 countries, including 35 OECD member countries, from 1980 to 2017. They found a positive relationship between inequality and growth in more developed financial markets, but there was no such relationship in the less developed financial markets or in the OECD countries. Younsi et al. (2022) studied the reduction of income inequality through financial development with economic growth for 11 Asian and 4 North African countries during the period of 1996–2019. Their findings revealed an inverted U-shaped relationship between economic growth and income inequality, as well as financial development and income inequality. The results of the Granger causality tests showed a one-way causality from financial development to income inequality and a one-way causality from income inequality to economic growth. Verma and Giri (2024) found a unidirectional causality from financial inclusion and depth to income inequality in 22 Asian economies during the period of 2005–2020.

Based on the above outlined context, the literature indicates that while some studies find no significant causal relationship, others reveal unidirectional or bidirectional causality depending on the region and economic conditions. This diversity of findings underscores the pressing necessity for further research. Most empirical studies have focused on a causal relationship in a bivariate framework without considering the outcome of the third variable in the examined nexus. To the best of our knowledge, the most advanced research in this segment is Sotiropoulou et al. (2023), which found a trivariate causality running from economic growth to financial development, and economic growth leads to income inequality for 23 European Union countries from 1987 to 2017. This research gap underscores the novelty and uniqueness of this study, which aims to determine the direction of causality between financial development, economic growth, and income inequality in a trivariate framework by using data for Central Eastern European Union countries.

The central hypothesis of this study is the following:

H1: Financial development Granger causes economic growth, and economic growth Granger causes income inequality.

3. Empirical Analysis

3.1. Data and Variables

This study uses annual panel data of 13 Central Eastern European transition economies, namely, Albania, Bulgaria, Croatia, Czechia, Estonia, Hungary, Latvia, Lithuania, North Macedonia, Poland, Romania, the Slovak Republic, and Slovenia, covering the period of 2000–2020. Financial development indicators focus on banking deepening since the reform of the financial sector in transition economies started from the banking sector, and the stock markets are undeveloped. Therefore, financial development is expressed by private credit by deposit money banks and other financial institutions to GDP (%) and liquid liabilities to GDP (%). The GDP per capita (based on constant 2015 US$) measures economic growth, and the Gini index, as the estimate of disposable income after tax and after transfers, measures income inequality. The data on financial development, economic growth, and income inequality indicators were collected by the *Global Financial Development Database*, the *World Development Indicators* of the World Bank, and the *Standardized World Income Inequality Database* derived by Solt (2019), respectively.

3.2. Methodology

This study investigates the direction of causality between financial development, economic growth, and income inequality in a trivariate setting. Three approaches have been mainly employed to examine the direction of causality in the panel data. The first approach uses the *generalized method of moment* (GMM) estimator (Holtz-Eakin et al., 1988) to estimate a panel VAR model. The GMM approach could not be appropriate when T is large due to the immense number of instruments, which often renders a highly inaccurate inference (Bun and Sarafidis, 2015). Furthermore, the GMM estimators ignore the cross-sectional dependence and can produce inconsistent and misleading parameters unless the slope coefficients are, in fact, homogeneous (Pesaran et al., 1999). The second approach, proposed by Kónya (2006), is based on the SUR estimation which allows taking into account cross-sectional dependence across the members of the panel. However, the direction of causality is tested separately based on the Wald tests for each country and does not require a joint hypothesis for all the members of the panel. Although the method of Kónya (2006) does not involve any pretesting for stationary and cointegration except for cross-sectional dependence and slope heterogeneity, this technique can be expanded to a trivariate setting, but the SUR equations include the third variable as an auxiliary variable. The third approach, developed by Dumitrescu and Hurlin (2012), suggests a Granger non-causality test in heterogeneous panel data between two stationary variables, allowing all coefficients to differ across cross-sections.

In a trivariate setting, this study employs a panel causality test to determine the causality direction between financial development, economic growth, and income inequality. Andriansyah and Messinis (2019) developed an extension of the bivariate Granger non-causality test of heterogeneous panels proposed by Dumitrescu and Hurlin (2012).

The traditional panel Granger causality test is invalid when the variables are non-stationary, or when they are integrated in a different order since the Wald test statistic does not follow the asymptotic chi-square distribution. Andriansyah and Messinis (2019) defeated the stationary assumption based on the procedure of Toda and Yamamoto (1995), adding extra *m* lags, which are the maximum order of integration of the time series variables, to the k-order VAR model to ascertain the validation of the Wald test statistic that is asymptotically distributed. This method can treat the third variable as an additional explanatory variable since all three variables are endogenous with the maximum order of integration *m*.

Supposing the trivariate VAR (K+m) linear models with general form given as follows:

$$GDP_{i,t} = \alpha_{1i} + \sum_{p=1}^{K+m} \beta_{1i,p}\, GDP_{i,t-p} + \sum_{p=1}^{K+m} \gamma_{1i,p}\, FINDEV_{i,t-p} + \sum_{p=1}^{K+m} \delta_{1i,p}\, GINI_{i,t-p} + \varepsilon_{1i,t} \quad (1)$$

$$GINI_{i,t} = \alpha_{2i} + \sum_{p=1}^{K+m} \beta_{2i,p}\, GDP_{i,t-p} + \sum_{p=1}^{K+m} \gamma_{2i,p}\, FINDEV_{i,t-p} + \sum_{p=1}^{K+m} \delta_{2i,p}\, GINI_{i,t-p} + \varepsilon_{2i,t} \quad (2)$$

$$FINDEV_{i,t} = \alpha_{3i} + \sum_{p=1}^{K+m} \beta_{3i,p}\, GDP_{i,t-p} + \sum_{p=1}^{K+m} \gamma_{3i,p}\, FINDEV_{i,t-p} + \sum_{p=1}^{K+m} \delta_{3i,p}\, GINI_{i,t-p} + \varepsilon_{3i,t} \quad (3)$$

where GDP is the logarithm of GDP per capita, FINDEV represents the logarithm of proxies of financial development, more precisely, *private credit* (PRV) and *liquid liabilities* (LLY), and GINI denotes the logarithm of the *Gini index* for each country *i (i = 1,..., N)* at time period *t (t = 1,..., T).* In addition, *m* denotes the additional lags as the maximum order of integration of variables, and *K* represents the optimal lag length taken from the information criteria. The coefficients α_{1i}, α_{2i}, and α_{3i} are fixed across time, while the coefficients of variables $\beta_{i,p}$, $\gamma_{i,p}$ and $\delta_{i,p}$ may vary between and across the equations. The errors $\varepsilon_{1i,t}$, $\varepsilon_{2i,t}$ and $\varepsilon_{3i,t}$ are independent and normally distributed.

In a trivariate framework, the null hypothesis of the panel causality test assumes that *FINDEV* Granger does not cause *GDP*, while the variable *GINI* is constant.

The modified Wald statistics is given as follows:

$$W_{i,T}^{*} = \frac{\hat{\theta}_i^{*\prime} R^{*\prime} [R^{*} (Z_i^{*\prime} Z_i^{*})^{-1} R^{*\prime}]^{-1} R^{*} \hat{\theta}_i^{*}}{\hat{\varepsilon}_i^{*\prime} \hat{\varepsilon}_i^{*} / (T - 3Tlag - 1)} \quad (4)$$

The panel Wald test statistic is asymptotically distributed; it follows a normal distribution with mean zero, and variance equals to one as T → ∞:

$$Z_{N,T}^{Hnc*} = \sqrt{\frac{N}{2K}} \left(W_{N,T}^{Hnc*} - K \right) \quad (5)$$

For a fixed dimension of T, normal distribution holds, and the standardized and modified panel is written as follows:

$$\tilde{Z}_N^{Hnc*} = \sqrt{\frac{N \times (T - 3Tlag - 5)}{2K \times (T - 2K - 3m - 6)}} \times \left[\frac{(T - 3Tlag - 3)}{(T - 3Tlag - 1)} \times W_{N,T}^{Hnc*} - K\right] \quad (6)$$

The maximum lag length in a standard VAR model can be varied and depends on the information criteria used, i.e., the Akaike information criterion, the Schwarz Bayesian information criterion, and the Hannan and Quinn information criterion.

4. Results

This study aims to determine the causal relationship between financial development, economic growth, and income inequality in Central Eastern European transition economies over the period of 2000–2020. To achieve this, we employ a trivariate panel causality test. The results of the panel causality test are reported in the following steps. First, we check for slope heterogeneity and cross-sectional dependence to select the appropriate panel unit root test; second, we test for the order of integration of the variables; third, we find out the optimum lag structure by using the *Schwarz-Bayesian Information Criterion* (BIC). Lastly, we conduct the Toda-Yamamoto panel causality test to determine the direction of causality between financial development, economic growth, and income inequality in a trivariate framework.

Table 1. Results of slope heterogeneity and cross-sectional dependence tests

	PRV, GDP, GINI		**LLY, GDP, GINI**	
Cross-sectional dependence tests				
	Statistic	p-value	Statistic	p-value
LM	299.8	0.000***	232	0.000***
LM adj*	40.34	0.000***	27.75	0.000***
LM CD*	12.52	0.000***	10.07	0.000***
Slope heterogeneity tests				
Delta	14.966	0.000***	13.160	0.000***
Delta adj.	16.633	0.000***	14.627	0.000***

Note. ***is the 1% significance level.
Source: author's calculation

Table 1 contains details of the results of slope heterogeneity and cross-sectional dependency tests.

The slope heterogeneity tests proposed by Pesaran and Yamagata (2008) are used. The null hypothesis that slope coefficients are homogenous is rejected at a 1% significance level, implying that the slope coefficients are heterogeneous across cross-sectional units of the panel. This study employs the Breusch and Pagan (1980) LM test, the Pesaran (2004) CD test, and the Pesaran et al. (2008) bias-adjusted LM test to detect cross-sectional dependence. The null hypothesis of cross-sectional independence is rejected for all estimated models since p-values are lower than the 1% significance level. The cross-section

dependence test reveals dynamics between the individuals of the panel, and demonstrates how a shock can transmit and affect from one country to another.

The order of integration of the variables is initially determined by using the CIPS test proposed by Pesaran (2007). The obtained results are given in Table 2. The results demonstrate that private credit and liquid liabilities are stationary at levels or integrated zero-order I(0), as the null hypothesis of a unit root is rejected for the level series at a 1% significance level. The variables GDP and GINI have unit roots at first differences, whereas both variables are stationary at second differences or integrated second-order I(2), as the null hypothesis of a unit root is rejected for the second differences series at a 1% significance level. Accordingly, the maximum order of integration in the VAR system is defined as dmax=2.

Table 2. Results of panel unit root test

	Levels		First-differences		Second-differences		Order of integration
	Constant[a]	Constant and trend[b]	Constant[a]	Constant and trend[b]	Constant[a]	Constant and trend[b]	
PRV	-2.534***	-3.443***	-3.734***	-3.772***	-4.844***	-4.887***	I(0)
LLY	-3.027***	-2.887**	-5.256***	-5.435***	-5.977***	-6.148***	I(0)
GDP	-2.509***	-1.812	-2.711**	-2.750*	-4.108***	-4.120***	I(2)
GIN	-1.338	-1.269	-1.789	-1.723	-3.569***	-3.811***	I(2)

Notes.
a: critical values are -2.47, -2.26, and -2.14 for significance levels of 1%, 5% and 10%, respectively.
b: critical values are -3.01, -2.78 and -2.67 for significance levels of 1%, 5% and 10%, respectively.
***, ** and * denotes significant levels at 1%, 5%, and 10%, respectively.
Source: author's calculation

Additionally, the maximum lag length specification in a standard VAR model is essential for completing the trivariate panel causality test. Table 3 illustrates the results of the lag length using diverse information criteria. Since the results for the order of the optimal panel lag length vary between 1 or 2, the BIC criterion is typically used in preference to the other criteria because it tends to define more parsimonious requirements. Hence, the optimum lag length (k) chosen by BIC is found to be 1.

Table 3. Panel VAR Lag Order Selection

Model	lags	BIC	AIC	HQIC
PRV, GDP, GINI	1	-134.6507*	-27.9883	-71.33079*
	2	-111.7234	-31.72661*	-64.23348
	3	-80.51218	-27.18098	-48.85222
LLY, GDP, GINI	1	-145.5872*	-38.92482*	-82.26732*
	2	-116.9915	-36.99472	-69.50159
	3	-84.79475	-31.46355	-53.1348

Notes. BIC: Schwarz Bayesian information criterion; AIC: Akaike information criterion; HQIC: Hannan and Quinn information criterion.
Source: author's calculation

Given that the order of integration is 2 and the optimal lag length is 1, VAR (3) model is estimated to establish the direction of causality between financial development, economic growth, and income inequality when employing the Toda-Yamamoto panel non-causality test.

Table 4 shows the results of the panel causality test. The first null hypothesis that "private credit (PRV) does not Granger cause economic growth (GDP), while income inequality (GINI) is constant" is rejected at a 1% significance level since the Z-bar statistic is greater than the bootstrap critical value. The null hypothesis that "private credit (PRV) does not Granger cause income inequality (GINI), while economic growth (GDP) is constant" is rejected at a 1% significance level since the Z-bar statistic is greater than the bootstrap critical value. The null hypothesis that "economic growth (GDP) does not Granger cause private credit (PRV), while income inequality (GINI) is constant" is rejected at a 1% significance level since the Z-bar statistic is greater than the bootstrap critical value. The null hypothesis that "economic growth (GDP) does not Granger cause income inequality (GINI), while private credit (PRV) is constant" is rejected at a 1% significance level since the Z-bar statistic is greater than the bootstrap critical value. The null hypothesis that "income inequality (GINI) does not Granger cause private credit (PRV), while economic growth (GDP) is constant" is rejected at a 1% significance level since the Z-bar statistic is greater than the bootstrap critical value. The null hypothesis that "income inequality (GINI) does not Granger cause economic growth (GDP), while private credit (PRV) is constant" fails to be rejected at a 1% significance level since the Z-bar statistic is lower than the bootstrap critical value. Hence, private credit Granger causes both economic growth and income inequality, and economic growth Granger causes income inequality. Furthermore, economic growth Granger causes private credit, and income inequality Granger causes private credit.

The null hypothesis that "liquid liabilities (LLY) do not Granger cause economic growth (GDP), while income inequality (GINI) is constant" is rejected at a 1% significance level since the Z-bar statistic is greater than the bootstrap critical value. The null hypothesis that "liquid liabilities (LLY) do not Granger cause income inequality (GINI), while economic growth (GDP) is constant" is rejected at a 1% significance level since the Z-bar statistic is greater than the bootstrap critical value. The null hypothesis that "economic growth (GDP) does not Granger cause liquid liabilities (LLY), while income inequality (GINI) is constant" fails to be rejected at a 1% significance level since the Z-bar statistic is lower than the bootstrap critical value. The null hypothesis that "economic growth (GDP) does not Granger cause income inequality (GINI), while liquid liabilities (LLY) are constant" is rejected at a 1% significance level since the Z-bar statistic is greater than the bootstrap critical value. The null hypothesis that "income inequality (GINI) does not Granger cause liquid liabilities (LLY), while economic growth (GDP) is constant" is rejected at a 1% significance level since the Z-bar statistic is greater than the bootstrap critical value. The null hypothesis that "income inequality (GINI) does not Granger cause economic growth (GDP), while liquid liabilities (LLY) are constant" fails to be rejected at a 1% significance level since the Z-bar statistic is lower than the bootstrap critical value. In other words,

liquid liabilities Granger cause economic growth and income inequality, economic growth Granger causes income inequality, and income inequality Granger causes liquid liabilities.

According to the results of the empirical analysis, a unidirectional causality runs from financial development to economic growth, and a reverse causality is proven between private credit and economic growth. These results are consistent with previous studies by Ekanayake and Thaver (2021), Abbas et al. (2022), and Nguyen et al. (2022), thereby validating the feedback hypothesis between financial development and economic growth, which combines the supply-leading and demand-following hypotheses.

Likewise, the results expose that economic growth leads to income inequality with no evidence of reverse causality. This finding also complements the previous results of Aremo and Abiodun (2020) and Wolde et al. (2022), who found a unidirectional causality from economic growth to inequality. However, the finding opposes the inference of Koh et al. (2019) and Obiero and Topuz (2023), who exhibit a unidirectional causality from inequality to economic growth, and there is no evidence for a bidirectional causality (Vo et al., 2019).

Furthermore, the results validate a bidirectional causality between financial development and income inequality, aligning with the findings of Cetin et al. (2021), who found a bidirectional relationship along with the unidirectional causality from economic growth to income inequality. This finding challenges the previous assertions of Juuti (2021), Younsi et al. (2022), and Verma and Giri (2024), who suggested that financial development leads to income inequality.

The trivariate causality test discloses causal relationships with the direction from financial development to economic growth and from economic growth to income inequality. The results imply that, in Central Eastern European Union countries, a well-developed banking system can facilitate access to financial services by expanding banks, encouraging the overall activity of economic sectors, and administering individuals and businesses to improve economic and social welfare. This finding contradicts Sotiropoulou et al. (2023), who found that other economic factors can lead to economic growth in European Union countries, economic improvements can lead to more financial services, and the development of the financial system can lead to income inequality. The findings from the trivariate causality test emphasize the importance of financial development for stimulating economic growth and ameliorating income inequality. These findings are valuable for policymakers in designing strategies to boost economic growth and address inequality dissimilarities by focusing on developing the banking sector.

Table 4. Trivariate Toda-Yamamoto approach for Granger non-causality test

Causality hypothesis	Asymptotic Wald statistic		Bootstrap critical values		
			1%	5%	10%
PRV → GDP | GINI	$Z_{N,T}^{Hnc}$	6.7440***	1.5045	1.4778	1.4666
	$\tilde{Z}_{N}^{Hnc}$	5.0543***	0.7674	0.7455	0.7364
PRV→ GINI | GDP	$Z_{N,T}^{Hnc}$	6.2269***	0.0215	0.0044	-0.0040
	$\tilde{Z}_{N}^{Hnc}$	4.6312***	-0.4460	-0.4599	-0.4668
GDP → PRV | GINI	$Z_{N,T}^{Hnc}$	3.7954***	3.2445	3.0368	2.9182
	$\tilde{Z}_{N}^{Hnc}$	2.6418***	2.1911	2.0211	1.9241
GDP → GINI | PRV	$Z_{N,T}^{Hnc}$	9.7492***	1.2372	1.1749	1.1485
	$\tilde{Z}_{N}^{Hnc}$	7.5131***	0.5487	0.4977	0.4761
GINI → PRV | GDP	$Z_{N,T}^{Hnc}$	5.8086***	4.1421	3.5722	3.3464
	$\tilde{Z}_{N}^{Hnc}$	4.2890***	2.9255	2.4591	2.2744
GINI → GDP | PRV	$Z_{N,T}^{Hnc}$	4.5425	9.8068	9.6732	9.5892
	$\tilde{Z}_{N}^{Hnc}$	3.2530	7.5602	7.4509	7.3822
LLY→ GDP | GINI	$Z_{N,T}^{Hnc}$	4.0328***	-0.2530	-0.2690	-0.2770
	$\tilde{Z}_{N}^{Hnc}$	2.8360***	-0.6706	-0.6836	0.6901
LLY→ GINI | GDP	$Z_{N,T}^{Hnc}$	3.0357***	-0.9922	-1.0013	-1.0060
	$\tilde{Z}_{N}^{Hnc}$	2.0202***	-1.2753	-1.2828	1.2866
GDP → LLY| GINI	$Z_{N,T}^{Hnc}$	0.0668	3.3821	2.9257	2.7231
	$\tilde{Z}_{N}^{Hnc}$	-0.4089	0.7181	0.8550	0.9468
GDP → GINI | LLY	$Z_{N,T}^{Hnc}$	5.4689***	5.4052	5.3659	5.3436
	$\tilde{Z}_{N}^{Hnc}$	4.0110***	3.9589	3.9267	3.9084
GINI → LLY| GDP	$Z_{N,T}^{Hnc}$	3.7547***	3.3601	3.1186	3.0252
	$\tilde{Z}_{N}^{Hnc}$	2.6085***	2.2856	2.0880	2.0116
GINI → GDP | LLY	$Z_{N,T}^{Hnc}$	1.7133	5.3308	5.2309	5.1823
	$\tilde{Z}_{N}^{Hnc}$	0.9382	3.8980	3.8163	3.7766

Notes.

Symbol (→) means that the first variable Granger causes the second variable, while symbol (|) means that the third variable holds constant.

Iterations for bootstrapped critical values are 10,000 times.

***, ** and * denote the significance level at 1%, 5%, and 10%, respectively.

Source: author's calculation

5. Conclusions

This study has attempted to analyze the causal relationships between financial development, economic growth, and income inequality for 13 Central Eastern European transition economies from 2000 to 2020 by using a Granger non-causality test of heterogeneous panels in a trivariate setting, adopting the approach of Toda and Yamamoto (1995). The main objective is to evaluate whether financial development Granger causes economic growth empirically, and if economic growth Granger causes income inequality. Two different indicators are used to capture the development of the financial sector.

The results of the study reveal that private credit causes economic growth, liquid liabilities cause economic growth, and economic growth causes income inequality. These relationships exhibit a trivariate causality with the direction from financial development to economic growth and from economic growth to income inequality. This finding highlights the compulsory role of a more extensive and involved banking sector in Central Eastern European transition economies that can lead to economic growth. Thus, financial development can mobilize capital resources and increase the supply of liquid liabilities to boost economic growth. The flourishment of economic activity can create more prospects for all segments of society, reshaping income distribution patterns.

From a policy perspective, it is vital to explore the causal relationship between financial development, real economy, and social cohesion. Bank credit policies could catalyze economic growth and resolve the conceivable inequality concerns. The principal policy recommendation is to improve the banking sector through the rising money supply and development of banking institutions to foster economic growth, eventually alleviating the issue of unequal incomes. Future research should address the trivariate causality relationships between financial development, economic growth, and income inequality in miscellaneous samples covering distinct periods and country groups so that to deliver more accurate empirical results.

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