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Examining the hidden link: How public debt impacts income inequality in OECD member states*[1]

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Abstract

The theory of redistribution, which argues that individuals from higher-income groups are the primary holders of public debt, serves as the theoretical foundation for our research. The impact of redistribution based on the realization of receipts from interest on the public debt, cannot be entirely offset by the insufficient progressiveness of the tax system. Given that it significantly affects how income is distributed, the paper also considers the financial structure aspect, which is measured by the ratio of bank-based to market-based financing. The purpose of this paper is twofold. First, examine whether public debt increases inequality in income distribution, and second, test if the relative increase in market financing compared to bank financing increases inequality in income distribution. Thus, the paper investigates whether, in countries where public debt ownership is not distributed equally, public debt has a non-negligible effect on income transfer between different socioeconomic groups. The empirical part of this work was conducted using a dynamic panel model on a sample of 27 OECD member countries, for the period from 2004 to 2021. Precisely, we employ the Vector Error

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Correction Model (VECM). Research findings indicate that an increase in state borrowing results in a long-term redistribution of income from lower-income groups to higher-income groups. Conversely, an increase in the financial system's emphasis on bank financing results in a short-term decrease in income inequality. So, while high levels of public debt are certainly a cause for concern, it is crucial to also consider the distribution of this debt within the economic policy-making process, and when evaluating its potential impact on economic inequality.

Keywords: *income inequality, financial structure, redistribution theory, panel VECM*

JEL classification: *D63, H60, C33*

1. Introduction

The issue of inequality has existed throughout history, and its level depends on how successfully social elites find ways to justify it (Piketty, 2020). Thus, greater interest in inequality may result from unjustified factors contributing to it. It is important to note that inequality has increased in most developed countries over the past thirty years and persistent and widening gap in the distribution of wealth and income has various implications. Therefore, it becomes increasingly important to understand the factors that contribute to its emergence and persistence. In doing so, it is necessary to consider both the role of the market and the role of the state, as these two concepts cannot be viewed separately. One of the areas that requires careful examination and is directly related to governance, is the role of public debt in the distribution of income, as it has become a key tool for managing economic stability and stimulating growth. However, its political and economic repercussions receive minor consideration in the literature.

This paper aims to investigate the relationship between public debt and income inequality in OECD members while considering the financial system, which is closely related to both inequality and government borrowing. Given that this effect depends on the characteristics of the financial system, it is necessary to investigate the implications of the financial structure on income distribution patterns. The first research question (RQ1) deals with the growth of internal public debt, i.e. whether it increases inequality in income distribution. The theory behind the mentioned is called the theory of redistribution, and it is explained in the theoretical part of the paper. The second research question (RQ2) refers to financial development and financial structure, and we test if the relative increase in market financing compared to bank financing increases inequality in income distribution.

The conducted econometric analysis enables a conclusion on the impact of public debt growth on income inequality, as well as the impact of different financial structures on income inequality. It contributes to the literature on the interactions between public debt, financial systems, and income inequality in the context of OECD member states. The findings of this paper will provide policy insight into the problem of growing inequality.

The paper is structured into five sections. Following the introduction, the second section establishes a theoretical foundation for the connection between public debt, financial structure, and income inequality. Section 3 outlines the methodology. The fourth section presents the empirical findings and their implications. Finally, section 5 provides a conclusion.

2. Literature review

Regarding RQ1, the positive effect of public debt on inequality in income distribution is explained by the redistribution theory, which was first described by Henry Carter Adams in his work from 1887. He claimed that while the tax base bears the initial burden of debt repayment, owners of government bonds and other securities are at the top of the income distribution (Hager, 2016). The above implies that during the debt repayment process, although the rich also pay taxes, they also receive interest from government bonds, treasury bills and other instruments. This process reinforces the existing pattern of inequality in wealth and income and strengthens the so-called debt state. More precisely, if the public debt is widely distributed among all income groups, as it should be in democracies, the interest of the general citizenry should not be subordinated to the interest of the dominant holders of public debt.

In order for the theory of redistribution to have an impact on increasing income inequality, a number of assumptions must be met. The first is that the owners of public debt belong to higher-income groups. The second is that the burden of debt repayment falls more heavily on income groups that are not holders of government bonds and other instruments. The impact on income inequality in the case of financing expenditures by increasing public debt depends on the tax system and the way interest is repaid. Interest expenses can be covered by a further increase in the public debt or by an increase in taxes. In the case of a tax increase, taxpayers finance interest payments on government bonds, while bondholders, who also pay taxes, receive tax-financed interest payments. More important than the value of tax revenues, is the progressivity of the tax system. The more progressive the tax system, the greater the tax burden for people with a higher income, which eliminates a part of the effect on the growth of income inequality due to the realization of debt repayment. The last assumption is that interest rates on public debt (i) exceed the growth rate (g). The effect of difference between the two rates, i and g, affects not only the sustainability of the public debt, but also the inequality in income distribution. Piketty (2014) claims that in the long term, the rate of return on capital is higher than the growth rate of real GDP, which increases the gap between capital income and labor income. As a result of the aforementioned, and considering that mostly the rich own capital, income inequality and capital accumulation are growing, and consequently, wealth inequality is also growing.

Piketty (2014) uses real rates, where *r*, the real annual rate of return on capital, is considered a much broader term than the nominal interest rate.

Nominal interest rates on government bonds, which are considered a risk-free investment, are usually much lower than the average long-term rate of return on capital, so the term ($i - g$) is also smaller than the term ($r - g$). However, if the impact of public debt on income inequality is observed, as is the case in this paper, it is useful to observe the movement of the difference between the nominal interest rate and the nominal growth rate.

Although the redistribution theory originated in the 19th century, many authors claim that it is still applicable today. Even if not all of the redistribution theory's assumptions are met, public debt can nevertheless cause an income redistribution from lower to higher income groups. The degree to which the individual assumption is violated will determine how much less of a redistributive effect results in that scenario. Along with the aforementioned assumptions, there are additional factors on which the very strength of the effect of public debt on income inequality depends, and they relate to the structure of public debt regarding the residency of the creditor, the sector of the creditor and the debt instrument. An important determinant is also the objective of the state's borrowing, which is linked to public expenditures and their structure, i.e. whether they relate to a greater extent to social transfers or expenditures on health, defence expenditures, investment in infrastructure, etc. Mainly public expenditures, which can increase equality of opportunity, such as spending on health and education, have a greater effect on inequality in market incomes than social benefits.

The results of the empirical analysis are somewhat inconsistent. In some studies, public debt increases income inequality, in others, it reduces it, while in some cases, its impact is insignificant. These discrepancies in empirical models are not surprising, given the use of different methodologies, time periods, control variables, and samples or groups of countries. Studies also differ in terms of the dependent variable, depending on whether they use (i) external public debt (Prechel, 1985; Akram, 2013; Salti, 2015; Karlin, 2018), (ii) internal public debt (Salti, 2015; Karlin, 2018; Obiero and Topuz, 2021; Sayed, 2020; Akram and Hamid, 2016), (iii) total public debt (Lee, 2005; Tung, 2020; Malla and Pathranarakul, 2021; Arslan, 2019; Sakkas and Varthalitis, 2021), or (iv) interaction variables (Mehmood et al., 2019; Van Bon, 2019). Since the redistribution theory can only be credibly demonstrated using internal public debt as the dependent variable, there are no universally consistent empirical results. However, it can be concluded that a larger number of studies find a positive relationship between internal public debt and income inequality, which is also consistent with the existing economic models (Azzimoti et al., 2014). The inconsistent findings may also be due to different levels of debt, as varying debt-to-GDP ratios can affect both economic growth and income redistribution in different ways (Fetai, B. et al., 2020).

The RQ2 underlying premise is that financial structures based on the market or banks are not mutually exclusive but appear in combination, where one of the two structures is generally more dominant. The literature explaining and comparing bank-based and market-based financial systems varies in approach. Some authors classify a country's financial structure as bank-based or market-based depending on whether bank financing of the non-financial private sector exceeds financing from market sources, and vice versa (Allard and Blavy, 2011). The classification of the financial system as bank-centric or market-centric is inappropriate, given that the individual structure is based on several indicators, such as the size of assets, the number of institutions, the number of clients, and the type of services provided. To correct the shortcomings of such an approach, indicators are used that enable the assessment of the relative importance of banks and markets in financing the economy, without a strict division into a bank-oriented or market-oriented financial system (Gambacorta et al., 2014; Langfield and Pagano, 2016; Iyigun and Owen, 2004). Examples of relative financial structure indicators are presented below. According to Langfield and Pagan (2016), the bank-to-market ratio is calculated using two different methods:

$$\frac{\textit{Domestic credit to private sector}}{\textit{Total market capitalization of stocks and private bonds}} \tag{1}$$

$$\frac{\textit{Total assets of banks}}{\textit{Total market capitalization of stocks and private bonds}} \tag{2}$$

We chose the first method considering that some activities such as investment banking should be identified as market activities (Berlin, 2012). Therefore, it seems reasonable to use bank credit to the private sector, as recommended by Čihák et al. (2012). To measure capital market size, this paper follows the traditional literature and uses the total market capitalization of stocks and private bonds. Moreover, the success of the development of a particular financial structure is analysed from the aspect of its impact on inequality in income distribution. In market-based financial systems, stock markets are larger and offer greater choice and higher returns, with high-income earners holding larger shares of stocks in their portfolios. Consequently, inequality in the distribution of income increases to a greater extent in market-based financial systems than in bank-based financial systems (Maldonado, 2017).

3. Research methods

The empirical analysis was conducted on a sample of 27 OECD member states, in the time period from 2004 to 2021. The period was chosen based on data availability, given that some key variables are not available before 2004. OECD members for which data are not available for some of the variables are Costa Rica,

Estonia, Latvia, Lithuania, Slovakia, Denmark, Luxembourg, Turkey, Finland, Israel, Sweden. The main reason for choosing OECD member countries in the model is their heterogeneity in income inequality. Descriptive statistics is presented in Table 1.

Table 1: Descriptive statistics

	GINI	DD	BM	EXP	TAX	DIF
Mean	49.57	41.25	1.91	41.23	7.19	3.34
Median	46.78	31.01	1.47	42.64	7.36	3.23
Maximum	76.17	225.12	9.98	66.82	14.28	22.64
Minimum	37.45	1.90	0.01	18.63	0.95	-0.55
Std.dev.	9.36	35.68	1.42	9.57	3.23	2.61
Skewness	1.44	3.15	1.88	-0.43	-0.14	1.77
Kurtosis	4.29	14.34	7.99	2.64	2.03	10.79
Jarque-Bera	200.90	3376.47	652.83	17.60	3457.43	1369.38
Probability	0.00	0.00	0.00	0.00	0.00	0.00
Sum	24093.32	19880.41	769.5860	19916.36	5021.67	1501.57
Sum sq. Dev.	42503.72	612446.10	809.14	44129.36	4936.84	3042.28
Observations	468	468	468	468	468	468

Source: Authors' calculation

The estimated model includes the dependent variable GINI, the independent variables of interest DD and BM, and the control variables EXP, TAX and DIF. The basis for the selection of variables is the theory of the determinants of income inequality and public debt, and the inclusion of these variables in the model is based on Huntington-Klein (2022). The control variables included in the model were selected based on a thorough review of the literature, identifying variables that influence both public debt and income inequality. Given that taxes and government spending can seemingly amplify or mitigate the effect of public debt on income inequality, it is essential to include them as control variables in the econometric model.

Additionally, based on Piketty's findings, incorporating the interest rate-growth differential is crucial, as research highlights this variable as one of the key drivers of inequality in the modern world. Moreover, it is directly linked to the level of internal public debt, further justifying its inclusion in the analysis. The variables, their description and expected sign are presented in Table 2.

Table 2: Variables description

Dependent Variable	Definition	
GINI	The Gini coefficient before taxes and transfers; based on equal-split series, bounded in the range from 0 to 100	
Independent variables	Definition	Expected sign
DD	Internal public debt in GDP represents the public debt owned by the residents of the state	Positive
BM	The ratio of bank loans to the private sector and the total market capitalization of stocks and private bonds; an approximation of the relative importance of bank financing in relation to capital market financing	Negative
EXP	Government expenditures as a percentage of GDP; including government spending, investments and transfers; the variable refers to consolidated gross debt of general government	Positive/ negative
TAX	Income tax revenues as a percentage of GDP; levied on net income (gross income minus tax credits) and capital gains of individuals; the indicator refers to the consolidated tax revenues of general government	Positive/ negative
DIF	The interest rate-growth differential is the difference between the nominal interest rate on government bonds with a maturity of 10 years and the nominal GDP growth rate	Positive

Source: Authors' compilation

Since the value of the Gini coefficient from the previous year (t – 1) affects its value in this year (t) and since independent variables can affect the dependent variable with different time lags, dynamic panel model is used, more precisely the Vector Error Correction Model (VECM) (Jakšić et al., 2020). VECM is used to model multidimensional time series and is a generalization of the univariate Error Correction Model (ECM) (Suharsono et al., 2017). VECM is based on a reduced Vector Autoregression Model (VAR), suitable for describing the dynamic adjustment of variables in the process of moving towards an equilibrium state. However, for the analysis of long-term correlation, it is necessary to complete the VAR model with an error correction term (ECT), which results in a VECM. The VECM enables the examination of short-term and long-term dynamics between variables and assumes the existence of a cointegration relationship between them. In other words, the cointegration of two or more variables indicates the existence of a long-term equilibrium relationship between them, which allows only short deviations from equilibrium, before readjustment. The stated long-term relationships and the "speed" of error correction are estimated using Johansen's approach. If the variables are cointegrated and connected in the long term, this does

not necessarily imply the connection of the variables in the short term (Jakšić et al., 2020). Therefore, within the VEC model, the Granger causality test can be used to assess the short-term association and direction of causality between variables. Also, the model assumes that all variables are endogenous, which facilitates implementation (Andrei and Andrei, 2015).

Panel VECM considers the cross-sectional (i) and temporal (t) dimensions of panel data and assumes homogeneous long-run coefficients and adjustment parameters (Groen and Kleibergen, 2003). Its specification is as follows:

$$\Delta y_{i,t} = \Pi_i y_{i,t-1} + \sum_{h=1}^{l_i} \Gamma_{i,h} \Delta y_{i,t-h} + \Phi_i d_{i,t} + \varepsilon_{i,t},\ i=1,\ldots N, t=1,\ldots T \qquad (3)$$

where $n \cdot n$ matrix $\Pi = \alpha\beta'$, and α and β are $n \cdot r$ matrices of full rank. If the variables are cointegrated, then there is a linear combination of variables that is stationary, and in that case the matrix Π can be decomposed into $\Pi = \alpha\beta'$ (Jakšić et al., 2020: 325–329). The matrix α is the matrix of the "speed" of error correction, and the matrix β is called the cointegration matrix and contains the parameters of the cointegration equations (Jakšić et al., 2020). The expression $\Pi_i y_{i,t-1}$ represents the error correction factor of the model, $d_{i,t}$ represents the deterministic component, and $\varepsilon_{i,t}$ is the error vector. The number of cointegration equations is determined using the Johansen test. In the model, short-term dynamics ($\sum_{h=1}^{l_i} \Gamma_{i,h} \Delta y_{i,t-h}$) and long-term dynamics ($\Pi_i y_{i,t-1}$) are connected through the estimation of the parameters of the matrices $\Gamma_{i,h}$ and Π_i.

4. Results and discussion

Before the evaluation of the panel VECM itself, the following procedure must be carried out: (i) testing the dependence of cross-sectional units, i.e. cross-sectional dependence, (ii) examining whether the variables are stationary, (iii) checking whether the variables are cointegrated, and (iv) determining the optimal number of lags. The variables must be integrated of order one and cointegrated in order to satisfy the conditions for conducting the panel VECM. If the variables are not cointegrated, it is concluded that there is no long-term relationship between them, and the panel VAR model (PVAR) is appropriate.

Depending on the results of the cross-sectional dependence test, panel tests of unit roots of the first generation or panel tests of unit roots of the second generation are applied. Two dependence tests were performed, and the results are as follows: Breusch-Pagan test (LM=2115.951, p-value<0.001) and Pesaran test (CD=32.79027, p-value<0.001). Both tests indicate the rejection of the null hypothesis, i.e. that the variables exhibit some dynamics common to the cross-

sectional units. Considering the results of the tests, it is necessary to use unit root tests of the second generation, which allow different forms of cross-sectional dependence.

Therefore, the Pesaran CIPS test was conducted, and the test results are presented in Table 3. The results show that the variables are non-stationary in levels, with the exception of the GINI and BM variables. The null hypothesis of non-stationarity for the variables GINI and BM is rejected only at a significance level of 10%, and therefore, the variables were used in their first differences. In the first differences, all variables are stationary at the common significance levels. It is assumed that all variables are integrated of order one, and the cointegration analysis of the variables follows.

Table 3: Peseran CIPS panel unit root test

	Level		First difference	
	constant	constant and trend	constant	constant and trend
GINI	-2.170**	-2.650*	-4.532***	-4.657***
DD	-1.722	-2.033	-3.159***	-3.312***
BM	-2.010*	-2.739**	-3.772***	-3.817***
EXP	-1.520	-2.185	-3.763***	-4.103***
TAX	-1.923	-2.115	-3.517***	-3.578***
DIF	-1.613	-2.483	-3.752***	-3.559***

*Note: Statistical significance at 10%, 5% and 1% are denoted by *,**,***.*

Source: Authors' calculation

To examine cointegration, i.e. the connection of variables in the long term, the Pedroni, Kao, and Johansen cointegration tests are performed. Pedroni's and Ka's cointegration tests have a null hypothesis of no cointegration, while the alternative hypothesis assumes the existence of cointegration among the analysed variables. The results of the mentioned tests are presented in Table 4 and indicate the cointegration between the variables in both cases. Johansen's approach is based on the analysis of the rank of the matrix Π, which is equivalent to the number of cointegration equations. Johansen defines two tests for determining the rank of a matrix: The Trace test and the Maximum Eigenvalue test. Testing is carried out successively, i.e. it is stopped the first time when the null hypothesis about the existence of r cointegration vectors cannot be rejected (Jakšić et al., 2020).

Table 4: Panel cointegration tests (Pedroni and Kao)

	Pedroni		Kao
	constant	constant and trend	constant
Modified Phillips-Perron	-8.3408***	-9.1440***	
Phillips-Peron	-4.8088***	-3.5881***	
Augmented Dickey-Fuller	-4.9355***	-4.6684***	-4.7501***

*Note: Statistical significance at 10%, 5% and 1% are denoted by *,**,***.*

Source: Authors' calculation

Table 5 shows the results of the Johansen cointegration test, where the tests do not provide the same conclusion about the number of cointegration equations. The Trace test indicates the existence of one unique cointegration relation, while the Maximum Eigenvalue test confirms the existence of two unique cointegration relations. Considering that Johansen and Juselius (1990) recommend applying the Trace test in case of contradictory results of two tests, we conclude that there is one cointegration equation. In conducting the Johansen test, the optimal number of lags was used, the determination of which is described in the next paragraph. The existence of cointegration between the variables was confirmed using all three tests (Pedroni's, Ka's and Johansen's cointegration test), indicating a stable long-term relationship between the variables. Based on the aforementioned, it is confirmed that using the panel VEC model is appropriate. Estimating VECM requires choosing an appropriate lag length k. In determining the appropriate number of lags, this paper follows Schwarz's information criterion, which has the smallest value of the information criterion. To determine the optimal number of lags, the panel VAR model was first estimated, and following the SIC criterion, two lags were selected as the optimal number. When evaluating the panel VECM model, it is necessary to use $(k - 1)$ lags, i.e. one lag.

Table 5: Johansen Cointegration Test Result

Number of cointegration vectors	Trace test value	p-value	Number of cointegration vectors	Max-Eigen test value	p-value
None*	117.4516	0.007	None*	55.1201	0.0005
At most 1	62.3315	0.1709	At most 1*	42.5349	0.0036
At most 2	19.7967	0.9921	At most 2	12.3142	0.9193
At most 3	7.4825	0.9984	At most 3	5.0300	0.9955
At most 4	2.4524	0.9862	At most 4	2.2844	0.9827
At most 5	0.1680	0.6819	At most 5	0.1680	0.6819

*Note: Statistical significance at 10%, 5% and 1% are denoted by *,**,***.*

Source: Authors' calculation

Table 6 contains the results of the panel VEC model. When evaluating the model, only the constant is included as a deterministic component, which is considered a standard approach in the implementation of the Johansen procedure (Jakšić et al., 2020). Table 6 shows the coefficients of cointegration equations (upper part of the table) and short-term coefficients (lower part of the table) with the assumption of one cointegration vector. Since the goal of this research is, among others, to determine whether there is a long-term causality between the variables, the coefficients of the cointegration equation are analysed below. There are two implications of the coefficients of the cointegration vector in Table 6 – the first relates to the existence of long-term causality, and the second relates to the speed of adjustment to equilibrium. The speed of adjustment is measured by the error correction factor, which is defined based on the cointegration vector, and is included as an additional term in the VEC model. When the error correction factor is negative and significant, it can be concluded that the variables are cointegrated and converge to the long-run equilibrium, reducing the deviation from equilibrium. Although the VECM presents as many models as there are variables, and in each one uses a different variable as the dependent variable, Table 6 shows only the results of the model in which GINI is the dependent variable. Before the actual interpretation of the coefficients of the cointegration vector, the results from Table 6 were normalized by the GINI variable:

$$GINI_{i,t} = 0.2619\,DD_{i,t} + 0.7523\,BM_{i,t} - 0.8890\,EXP_{i,t} + \\ + 2.8480\,TAX_{i,t} + 9.9814\,DIF_{i,t} + 18.2983 \tag{4}$$

The interpretation of the coefficients of the cointegration vector, that is, the long-term association between variables, follows from equation (4). In the long term, at a significance level of 5%, the DD variable has a positive effect on the GINI variable, which is in accordance with the theory of redistribution, described in the theoretical part of the paper. The BM variable, i.e. the ratio of bank to market financing, indicates a positive effect on income inequality, however, it is not statistically significant in the model. All three control variables are statistically significant at the 5% level, with the EXP variable having a negative effect on the GINI variable, i.e. reducing the inequality in income distribution, while the TAX variable has a positive effect on the dependent variable, which highlights the different effects of fiscal policy on the redistribution of market income. The control variable DIF has a significant and positive effect on the GINI variable, which confirms Piketty's hypothesis regarding the growth of inequality due to the growing difference between the return on capital and the growth rate.

The error correction term (ECT) can be defined as follows:

$$Cointeq_{i,t} = GINI_{i,t} - 0.2619\,DD_{i,t} - 0.7523\,BM_{i,t} + 0.8890\,EXP_{i,t} - \\ - 2.8480\,TAX_{i,t} - 9.9814\,DIF_{i,t} - 18.2983 \tag{5}$$

For the *GINI* variable, the estimated error correction model is as follows:

$$\begin{aligned}\Delta GINI_{i,t} = & -0.1327 * \Delta GINI_{i,t-1} - 0.0006 * \Delta DD_{i,t-1} - 0.1006 * \Delta BM_{i,t-1} + \\ & + 0.0223 * \Delta EXP_{i,t-1} - 0.0686 * \Delta TAX_{i,t-1} - 0.1324 \Delta DIF_{i,t-1} - \\ & - 0.0071 * Cointeq_{i,t-1} - 0.0736\end{aligned} \quad (6)$$

The parameter estimate with the Cointeq cointegration vector is -0.0071 and is significant (p-value = 0.0010). Considering the negative sign and statistical significance, it can be concluded that there is a long-term causality from the independent variables to the dependent variable GINI. The second implication refers to the speed of adjustment to the equilibrium state and indicates that the GINI variable converges to the long-term equilibrium, reducing the difference from equilibrium by 0.71% per year. In other words, the GINI variable decreases annually by 0.0071 units to reach the equilibrium state.

Table 6: Panel VECM Estimation Output

Variables	Coefficients	SE	t-value	p-value
Estimation of cointegration vector including constant				
$GINI_{t-1}$	1.0000			
DD_{t-1}	-0.2619***	0.0833	-3.1445	0.0018
BM_{t-1}	-0.7523	2.4406	-0.3082	0.7581
EXP_{t-1}	0.8890**	0.3682	2.4147	0.0163
TAX_{t-1}	-2.8480***	1.0523	-2.7064	0.0047
DIF_{t-1}	-9.9814***	1.3136	-7.5983	0.0000
Constant	-18.2983			
Estimation of VEC model				
Cointeq	-0.0071***	0.0024	-3.3055	0.0010
$\Delta GINI_{t-1}$	-0.1327***	0.0480	-2.7632	0.0058
ΔDD_{t-1}	-0.0006	0.0116	-0.0555	0.9557
ΔBM_{t-1}	-0.1006*	0.0522	-1.9269	0.0541
ΔEXP_{t-1}	0.0223	0.0186	1.1997	0.2304
ΔTAX_{t-1}	-0.0686	0.1107	-0.6202	0.5352
ΔDIF_{t-1}	-0.1324***	0.0400	-3.3082	0.0010
Constant	-0.0736	0.0477	-1.5421	0.1232

Source: Authors' calculation

The coefficients in the second part of Table 6 examine the existence of short-term causality among the variables. Significance was tested using the Wald test, that is, one of the tests on the collective significance of all shifts of a single variable

in the model. The coefficient with the lagged dependent variable is negative and significant with a value of -0.1327. Regarding the independent variables, only the BM variable (including one lag) is significant in the short term, at a significance level of 10%, whereby the RQ2 of this paper can be confirmed, according to which the relative increase in market, in relation to bank financing, increases income inequality. However, the above is valid only in the short term. At the 5% significance level, the variable DIF (including one one) has a negative effect (-9.98) on income inequality, which confirms the assumption that the term (i-g) has negative redistributive effects only in the long term. The short-term parameters in front of the variables DD, EXP and TAX have the opposite signs compared to the parameters in the cointegration equation, however, in the short term the mentioned variables are not significant. In conclusion, the Granger causality test shows that changes in the DIF and BM variables in the Granger's sense (at a significance level of 5% for DIF and 10% for BM) cause a change in the GINI variable.

The results are consistent with key theoretical assumptions and prior empirical findings. The positive long-term association between internal public debt and income inequality reinforces the redistribution theory articulated by Hager (2016) and elaborated by Piketty (2014), particularly regarding the *(i–g)* mechanism (see Section 2). Moreover, the findings align with those of Salti (2015), Karlin (2018), and Obiero and Topuz (2021), who also demonstrate a positive link between internal public debt and inequality, confirming the asymmetric burden of debt servicing across income groups. By confirming these relationships in a panel VECM framework using OECD countries, this paper contributes by both supporting and extending the empirical literature on the redistributive impact of public debt.

The diagnostics in the panel VEC model refer to the evaluation of normality, autocorrelation and heteroscedasticity of relational errors. The normal distribution of errors is a prerequisite for interpreting the significance of the estimated coefficients. However, the larger the sample, the more trivial the assumption of normality becomes (Pallant, 2007). Altman and Bland (1995) argue that for samples containing hundreds of observations the distribution of the data can be ignored. The results of the Jarque-Bera test reject the null hypothesis of a normal distribution of relationship errors (at a significance level of 1%), however, considering the arguments of the authors Pallant (2007) and Altman and Bland (1995), the model is still considered adequate. The Lagrange multiplier (LM-test), used to test autocorrelation, is not significant up to the eighth lag (LM=50.4235, p-value>0.05), and therefore the null hypothesis of the absence of autocorrelation cannot be rejected. White's test indicated that there is a problem of heteroskedasticity in the model, however, the VEC model is robust even if the assumption of constant variance is not valid, i.e. if the variance of the relationship errors is heteroskedastic (Bašić, 2022).

In order to confirm the robustness of the model, and considering the imperfections of the Gini coefficient, other variables representing the same fundamental economic interpretations were also applied. Models that use the income share of the richest 10% (TOP10) and the income share of the poorest 50% in total income (BOTTOM50) as alternative measures of income inequality were evaluated. Both models confirm the obtained results above. Precisely, a one-unit increase in internal public debt in the long term affects the increase in the income share of the richest 10% by 4.4423 units and the decrease in the income share of the poorest 50% by 0.1917 units. The coefficients of the cointegration vectors (long-term coefficients) are statistically significant, while the short-term coefficients are not significant. The relationship between the variable BM and TOP10 is negative, which indicates a lower income earned by the richest 10% when the financial system is relatively more focused on banks. The opposite is true for the poorest 50%, whose share in income increases with the increase in the BM variable. The robustness of the model was also confirmed by the DIF variable, whose growth has a positive effect on the income of the richest 10% (49.11), and negatively on the income of the poorest 50% (-3.96), in the long term. Additionally, a model was again estimated with the dependent variable being Gini coefficient of disposable income (GINIdisp), which examines income inequality after taxes and transfers. The coefficients of the estimated model have the same signs as in the original model, and in both models the estimated coefficients of the same variables are statistically significant. The authors can provide tables with results of all three models upon request, due to limited space.

5. Conclusion

The econometric analysis, conducted on a sample of 27 OECD member countries and in period from 2004 to 2021, reveals that an increase in internal public debt (as a share in GDP) by one percentage point causes an increase in inequality in income, measured by the Gini coefficient, by 0.2619 index points in the long term. In other words, the internal public debt affects the increase of income inequality in the long term, while in the short term, its coefficient is negative and insignificant. The research results confirm the theory that public debt helps smooth the tax burden, thereby reducing income inequality in the short term. These findings align with the majority of studies conducted on developed countries (see Section 2). In the short term, people at the lower levels of the income distribution benefit from the increase in public debt, through redistributive policies and tax deferrals. The above leads to an increase in consumption by people with lower incomes, and to higher savings rates by people with higher incomes, whereby the increase in consumption causes an increase in real interest rates and returns on capital. In the medium and long term, considering that mostly the richer earn interest on government bonds, and deferred taxes affect the poorer population to a greater extent, the increase in public

debt has the opposite effect, i.e. it increases inequality in income redistribution. In the macroeconomic context, higher levels of public debt increase credit risks and premiums demanded by holders of public debt, which further strengthens the redistributive effect of public debt.

An increase in nominal interest rates on government bonds with a maturity of ten years, along with a decrease, or a relatively smaller increase in the growth rate, also leads to an increase in inequality in the long run, which further confirms the aforementioned theory. More precisely, a change in (*i*-*g*) by one percentage point causes an increase in the Gini coefficient by 9.9814 index points in the long run and decreases the Gini coefficient by 0.1324 index points in the short run. The positive relationship between the term (*i*-*g*) and the Gini coefficient of income inequality is explained by the high concentration of ownership of government bonds in the upper classes of the income distribution. As a result of the above, if (*i*-*g*) increases, the wealthier population achieves a higher return from investments in government bonds due to the increase in public debt, which consequently increases the gap in market incomes.

The obtained results bring significant policy implications, i.e. the redistributive effects that internal public debt has on income inequality can, with political will, be reduced by an increase in tax progressivity, which would enable a more equal tax burden for the purpose of paying interest on public debt. Another implication refers to the introduction or increase of capital income tax and capital gains tax, which have been reduced in most OECD countries in the last decade. In the context of economic inequality, it is not solely the size of public debt that brings the risks, but also the concentration of ownership of public debt. When ownership of public debt is concentrated in the hands of a few, this can exacerbate existing inequalities in a society. Therefore, while high levels of public debt are certainly a cause for concern, it is crucial to also consider the distribution of this debt within economic policy making process, and when evaluating its potential impact on economic inequality. The main contribution of this paper lies in its examination of the effects of rising internal public debt over both the short and long term. Additionally, most studies on the relationship between public debt and inequality fail to account for financial structure variables. This paper takes a more comprehensive approach, recognizing that in the era of financialization, overlooking the role of the financial system can bias the results and distort economic research findings.

In addition to the obtained results, it is necessary to point out some limitations of the conducted research which open future research avenues on this issue. The limitations are primarily related to the rather short time period. Although the positive effect of internal public debt on income inequality has been confirmed, a longer period of observation could strengthen the observed redistributive effect of public debt. Also, the observation period was characterized by low interest rates, which enabled governments to acquire increasing amounts of public debt. In times

of higher interest rates, this interaction would be different. The same applies to the effect of the capital market on income inequality, which was predicted in the theoretical part to be positive, i.e. to increase income inequality relatively more than a bank-based financial system. The impossibility of proving such a long-term relationship may be the consequence of the observed time period in which interest rates were at extremely low levels. In order to include such variations in the research, it is crucial to examine longer time periods. Finally, it is important to note that the research area of income inequality is interdisciplinary. Thus, in order to gain a comprehensive understanding of inequality patterns and the influence of public debt and financial structure, the next step in our research is augmenting the model with additional control variables beyond the solely economic aspects of income inequality such as political and institutional.

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Istraživanje skrivene veze: kako javni dug utječe na nejednakost dohotka u zemljama članicama OECD-a

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Sažetak

Teorija preraspodjele, koja tvrdi da su pojedinci iz viših dohodovnih skupina dominantni nositelji javnog duga, služi kao teorijska osnova za naše istraživanje. Utjecaj preraspodjele na temelju realizacije primitaka od kamata na javni dug ne može se u potpunosti nadoknaditi nedovoljnom progresivnošću poreznog sustava. S obzirom na to da značajno utječe na način raspodjele dohotka, rad također razmatra aspekt financijske strukture, koji se mjeri omjerom financiranja temeljenog na bankama prema financiranju temeljenom na tržištu. Svrha ovog rada je dvostruka. Prvo, ispitati povećava li javni dug nejednakost u raspodjeli dohotka, a drugo, testirati povećava li relativno povećanje tržišnog financiranja u odnosu na bankovno financiranje nejednakost u raspodjeli dohotka. Stoga rad istražuje ima li javni dug, u zemljama gdje vlasništvo nad javnim dugom nije jednako raspodijeljeno, značajan učinak na prijenos dohotka između različitih socioekonomskih skupina. Empirijski dio ovog rada proveden je korištenjem dinamičkog panel modela na uzorku od 27 zemalja članica OECD-a, za razdoblje od 2004. do 2021. Preciznije, koristimo model vektorske pogreške korekcije (VECM). Prema rezultatima istraživanja, povećanje državnog zaduživanja dovodi do preraspodjele dohotka od nižih prema višim dohodovnim skupinama na dugi rok, dok povećanje naglaska financijskog sustava na bankovno financiranje rezultira kratkoročnim smanjenjem nejednakosti dohotka. Dakle, dok su visoke razine javnog duga zasigurno razlog za zabrinutost, ključno je također razmotriti raspodjelu tog duga unutar procesa donošenja ekonomske politike i pri procjeni njegovog potencijalnog utjecaja na ekonomsku nejednakost.

Ključne riječi: *nejednakost dohotka, financijska struktura, teorija preraspodjele, panel VECM*

JEL klasifikacija: *D63, H60, C33*

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