The Relationship Between Economic Growth and Finance of the Social Security Sector: Evidence from EU Countries[1]

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Received: 26 March 2021; Accepted: 30 October 2024.

Summary: We explore whether the primary financial variables of the social security sector and changes in the GDP are complementary, thus allowing for better forecasts. Thus, it is crucial to create policies that promote fiscal sustainability and societal well-being. We analysed EU countries for the period 2003-2019. We found that the Granger burdens of causation were not equally distributed. Revenue redistribution plays a greater role than allocation. This is because, in countries that were members of the community before 2004, expenditures and revenues were characterised by bidirectional Granger causality. In turn, in countries that joined the community in 2004 and later, expenditure and balance were characterised by bidirectional Granger causality. Granger causality, demonstrated on the basis of GDP changes to expenditure, is of key importance here, and it is GDP changes that may result in changes in expenditure in EU countries, and not vice versa. This is particularly important for countries where the financial situation in this sector is more challenging.
Keywords: social security funds; GDP; Granger causality
JEL: E60, J18, C33.

Introduction

Given the dynamic nature of public finance, the debate on causality continues. However, literature examining the relationship between the components

[1] Acknowledgement: The research behind this publication was financed from the funds granted to the Krakow University of Economics.
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of social security sector funds and economic development using a Granger causality test is scarce. Narrowing the scope of research in this area will shed new light on this topic. In particular, the analysis is not limited to explaining the cross-sectional variability of the studied categories but extends to panel data analysis examining the time series dimension. This study contributes to this debate by identifying and providing further evidence that economic growth and the financial situation of the social security sector are complementary. Hence, an attempt was made to determine whether and which variables may constitute a preceding but also auxiliary category, in the sense that the financing of the social security sector may be the Granger cause of a certain pace of economic growth. The pace of economic growth may be determined by the social security sector's financial situation. We demonstrate that in aging societies, understanding the bidirectional relationship between these categories is crucial for creating policies that promote fiscal sustainability and societal well-being. The results should make economic forecasts more adaptive, allowing for the adjustment of changing circumstances and ensuring policy certainty.

The structure of this study is as follows: Section one – Literature Review; section two – Social Security Funds and GDP: Background; section three – Scope of Research and Methodology; section four – Empirical Results and Discussion; section five – Conclusions.

1. Literature Review

The differences observed in the scholarly research results limit the predictability of fiscal policies. The answer to this question is the causality test, which was once suggested for science by Adam Smith. Similarly, Wagner's theory, which wrongly considers a law, refers to causality (Alan Peacock and Alex Scott, 2000). Several studies on the relationship between fiscal categories and GDP can be found in the literature. However, based on empirical results, it is challenging to find prima facie evidence regarding causality in a Granger sense, particularly owing to the sensitivity of research results to the analysed period, the degree of time aggregation, the type of econometric methodology, and other interfering features, such as the fragmented nature of the research and the assumptions made. Some studies indicate that neither Wagner's law nor Keynes' hypothesis apply (Gitana Dudzevičiūtė, Agnė Šimelytė, and Aušra Liučvaitienė, 2018), while others prove a relationship between fiscal spending and economic growth, which conforms with Keynesian macroeconomic theory (Leke Pula and Alban Elshani, 2018; Gohar Samvel Sedrakyan and Laura Varela-Candamio, 2019; Ersin, Nail Sagdic, Mahmut Unsal Sasmaz, and Guner Tuncer, 2020).

Additionally, the empirical evidence regarding the assessment of the impact of public expenditure on social security on GDP is inconclusive. Cammeraat (2020) employs related methods, such as Ordinary Least Squares (OLS) and Two-Stage

Least Squares (2SLS) regression models, to analyse panel data from 22 EU member states over the period 1990–2015, indicating that public social expenditure does not have a significant relationship with GDP growth. Unemployment and active labour market policies were examined. In turn, Tasci and Tatli (2019) proved that social security expenditures positively affect human development. This effect is significant because it is directly related to the level of economic welfare. They employed the autoregressive distributed lag (ARDL) bounds test for cointegration to analyse the relationship between social security expenditures and human development in Turkey from 1990 to 2014. Connolly and Li (2016) believe that an increase in public social expenditure has a significant negative impact on economic growth. The authors used the generalised method of moments (GMM) approach for the econometric analyses. In their study, public social spending referred to educational or unemployment benefits.

However, most literature contains only fragmentary research based on Granger causality tests. Generally, studies focus on relationships related to public expenditure (Bağdigen and Çetintaş, 2003), social spending (Bellettini and Ceroni, 1999), public revenue or taxation (Blanchard and Perotti, 2002), and factors such as social security contributions and budget balances (Barro, 1989). For example, Ye and Zhang (2018) suggest a bidirectional relationship based on healthcare spending and claim that social security systems contribute to stabilisation and stimulate economic growth. Studies have confirmed that economic development promotes the gradual development of social security (Habibullah Khan and Omar K M R Bashar, 2015; Zheng Gongcheng and Wolfgang Scholz, 2019). Education and healthcare expenditures were considered for Australia and New Zealand. The literature emphasises the significance of well-designed social protection systems for economic stability and development.

Opposing conclusions were drawn by Lindert (2004), who observed a significant positive correlation between social protection (e.g. education expenditure was taken into consideration) and economic growth, considering that causality remains unclear. These conclusions would confirm the results of the research carried out by Zhang and Zhang (2004), which indicate that social security expenditure (considering unemployment benefits were taken into account) stimulate growth, while growth does not change the relationship between social security contributions or benefits and income.

Some economists note, with regard to purely redistributive policies, that there are two opposite effects and explain that while public pensions increase investment in human capital, which has a positive effect on growth, they reduce savings, which limits growth (Lambrecht Stephane, Michel Philipe, and Vidal Jean-Pierre, 2005). However, the institution of the intergenerational transfer mechanism with pension benefits indexed to salaries may provide taxpayers with the right incentives to support growth-oriented policies which, according to Bellettini and

Ceroni (1999), contribute to economic growth. Lee and Chang (2006) examined Asian countries and confirmed the existence of long-term and bidirectional causal relationships between public expenditure on social security and GDP. However, they emphasise that these relations are complicated and remain unresolved, both theoretically and empirically. According to the latest research carried out in Germany by Gechert, Paetz, and Villanueva (2021), expansive changes in social security have positive short- and medium-term effects on GDP. Their findings suggested that reductions in social security contributions have a supply side impact, leading to a small, short-lived increase in GDP. However, increases in social security benefits indicate stronger and more persistent demand-side effects with a higher fiscal multiplier.

Our study contributes to the literature by providing evidence of a causal relationship between social security sector funds and GDP. This is the first study that provides a framework that considers the primary financial elements of the social security sector. We examined inter alia the expenditures in the social security sector which is a component of social protection expenditure. However, it is a narrower category, which means expenditure controlled by public administration that does not include labour market programs. Moreover, we consider European Union countries, splitting them into sub-panels to show that the duration of being a country's community member determines different results.

2. Social security funds and GDP: Background

The social security sector is one of the three or four subsectors of the General Government (GG) sector in most EU countries. The social security sector comprises social security funds (SSF) which comprise all social security units. The financial resources available to this sector are the second largest source of income for EU countries, after taxes. In turn, the expenditure is a component of social protection expenditure. It is a narrower category, which means expenditure controlled by public administration that does not include labour market programs.

We categorised EU countries based on their date of accession to the EU. This resulted in three research groups: EU countries, the EU-old, and the EU-new. The first group included countries that were members of the European Community on 18 January 2021. The EU-old group included countries that joined before 2004. In the EU-new group, there were countries that joined the community in 2004 and later.

The revenue of the SSF sector varies among countries. Unlike EU-new, the old EU revenues of the SSF are much higher, their growth is faster, and the pace of change is stable. Revenues represent 16.1% of the GDP, as compared to 12.3% in the new EU, in the same terms (Fig. A1, Appendix). Similarly, the sector's expenditure in relation to GDP in the old EU was 15.6%, as compared to 12.1% in the new EU, on average (Fig. A2, Appendix). In the old EU, this expenditure is

much higher than in the new EU, and it grows faster, the pace of change is stable, and the response to economic change is milder.

In the old EU, the balance of the SSF is positive and much higher than that in the new EU for the same terms (Fig. A3, Appendix). In turn, GDP changes were characterised by greater variation. A relatively high pace of GDP change was characteristic of the new EU (3.4%) on average over the period, and the pace of change in the old EU was approximately 1.8% (Fig. A4, Appendix).

These observations form the basis of this research, the concepts and results of which are presented in the following sections.

3. Scope of Research and Methodology

The EU countries selected for the research were member states that were or became members of the European Community in the period 2000–2019. The exceptions were Ireland, Malta, and the United Kingdom. In these countries, the social security funds (SSF) are not separate from the GG sector. In this case, the data are not comparable. As mentioned, the EU countries were divided into sub-panels: the EU in general, UE-old, and UE-new. The first group included countries that were members of the European Community on 18 January 2021. The EU-old group includes countries that were founding members of the community and those that joined before 2004. The EU-new group includes countries that joined the community in 2004 and later.

This study investigates whether the economic growth and financial situation of the social security sector can be considered complementary. We want to prove that the inclusion of socioeconomic variables in the model predicting the values of the individual financial components of the social security sector increases the accuracy of their predictions and vice versa.

The following variables were used for the purpose of the analysis:

- SSFrevenue – total general government revenues of SSF (% GDP),
- SSFexpenditure – total general government expenditure of SSF (% GDP),
- SSFbalance – net lending (+)/net borrowing (-) of SSF (% GDP),
- GDP growth – GDP at market prices (percentage change on previous period).

The Granger causality test, based on panel data, requires checking for cross-sectional dependence. The Pesaran CD test for cross-sectional dependence in panels was used for the analysis (M. Hashem Pesaran, 2004).

Owing to the occurrence of cross-sectional dependence in the panel data, Pesaran's CIPS test for unit roots in the panels (Pesaran, 2007) was used to analyse the stationarity of variables.

The bootstrap panel Granger causality test was used to analyse the occurrence of Granger causality in panel data with cross-sectional dependence (Elena Ivona Dumitrescu and Christophe Hurlin, 2012).

For each country i $(i = 1, \dots, N)$ during period t $(t = 1, \dots, T)$, the following linear model was considered:

$$y_{i,t} = \alpha_i + \sum_{k=1}^{K} \gamma_i^{(k)} y_{i,t-k} + \sum_{k=1}^{K} \beta_i^{(k)} x_{i,t-k} + \varepsilon_{i,t} \quad (1)$$

where: $y_{i,t}$ $(x_{i,t})$ – value of stationary variable *Y* (*X*) for the *i*th object during period *t*.

The following assumptions were adopted (Dumitrescu and Hurlin, 2012):

- the individual effects α_i are supposed to be fixed in the years
- lag orders *K* are identical for all countries of the panel
- the panel is balanced
- the autoregressive parameters $\gamma_i^{(k)}$ and the slope regression coefficients $\beta_i^{(k)}$ may differ across countries

Dumitrescu and Hurlin (2012) tested the Homogeneous Non-Causality (HNC) hypothesis by considering both the heterogeneity of the regression model and the causal relationship.

The null hypothesis of HNC is defined as:

$$\mathrm{H}_0: \beta_i = 0 \quad \forall\, i = 1, \dots, N \quad (2)$$

with $\beta_i = \left(\beta_i^{(1)}, \dots, \beta_i^{(k)}\right)'$.

The alternative hypothesis of HNC is defined as:

$$\mathrm{H}_1: \beta_i = 0 \quad \forall\, i = 1, \dots, N_1 \quad \text{and} \quad \beta_i \neq 0 \quad \forall\, i = N_1 + 1, N_1 + 2, \dots, N \quad (3)$$

where $0 \leq N_1 < N$.

Dumitrescu and Hurlin (2012) propose using the average of the individual Wald statistics associated with the test of the non-causality hypothesis for the *i*th country.

The average statistic $W_{N,T}^{Hnc}$ is defined as:

$$W_{N,T}^{Hnc} = \frac{1}{N} \sum_{i=1}^{N} W_{i,T} \quad (4)$$

where $W_{i,T}$ denotes the individual Wald statistic for the *i*th country corresponding to the individual test $\mathrm{H}_0: \beta_i = 0$.

Dumitrescu and Hurlin (2012) proposed the two statistics, namely:

1) Statistic:

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

also marked $\bar{Z}$ and referred to as the "Zbar" statistic (Luciano Lopez and Sylvain Weber, 2017).

2) Statistic :

$$\tilde{Z}_{N}^{Hnc} = \sqrt{\frac{N}{2K} \cdot \frac{T-3K-5}{T-2K-3}} \cdot \left[\frac{T-3K-3}{T-3K-1} \cdot W_{N,T}^{Hnc} - K\right] \tag{6}$$

also marked $\tilde{Z}$ and referred to as the "Ztilde" statistic (Lopez and Weber, 2017).

Owing to the occurrence of cross-sectional dependence in the panel data, the bootstrap approach was used in the Granger causality test (Dumitrescu and Hurlin, 2012).

The following research procedure was adopted:

(a) A model (1) for panel data was defined.

(b) The lag orders was adopted $K = 1, 2, 3$. The following actions were performed for each *K*.

(c) Model (1) was estimated for each country and statistics (5) and (6) were calculated.

(d) A model (1) was estimated for each country, assuming that all parameters $\beta_i^{(k)}$ $(i = 1, \dots, N; k = 1, \dots, K)$ are equal to zero and a matrix of residuals of the dimensions of $(N \times T - K)$ was determined.

(e) A block bootstrapping procedure was applied to the residual matrix. Resample the residuals with replacement by considering a block of size 1 in the time series and size *N* in the panel dimensions. Based on the results of the block-bootstrap procedure, a new residual matrix was created.

(f) The theoretical values $\hat{y}_{i,t}$ $(i = 1, \dots, N; t = K+1, K+2, \dots, T)$ were calculated for each country based on the model from stage (d), considering the appropriate vector from the new residual matrix. Then, the new values $\tilde{y}_{i,t}$ of variable *Y* were calculated for each country, saving

$$\tilde{y}_{i,t} = \begin{cases} y_{i,t} & \text{for} \quad t = 1, \dots, K \\ \hat{y}_{i,t} & \text{for} \quad t = K+1, K+2, \dots, T \end{cases}.$$

(g) Based on data $\tilde{y}_{i,t}$ a model (1) was estimated for each country, and statistics (5) and (6) were calculated.

(h) Stages (e), (f), and (g) were repeated 999 times.

(i) Based on the values of statistics (5) and (6) obtained in the subsequent repetitions (stage (h)), the empirical critical values were calculated, corresponding to the quantiles (0.90, 0.95, and 0.99, respectively) of the

distribution of statistics (5) and (6) (taken in absolute value), assuming that the zero causality hypothesis is true.

(j) The statistical values obtained in stage (c) were compared with the empirical critical values calculated in stage (i).

All the calculations were performed in programme R, primarily using the 'plm' package (Yves Croissant and Giovanni Millo, 2008).

4. Empirical Results

The empirical research began by checking whether there was cross-sectional dependence in the analysed panel sets. For this purpose, we use the Pesaran CD test for cross-sectional dependence (Table 1).

Table 1 Pesaran CD test for cross-sectional dependence in the panels (p-value)

Group	Test	SSFrevenue	SSFexpenditure	SSFbalance	GDP growth
EU	CD	< 2.2e-16	< 2.2e-16	< 2.2e-16	< 2.2e-16
EU-old	CD	5.595e-12	< 2.2e-16	0.0008984	< 2.2e-16
EU-new	CD	2.758e-10	< 2.2e-16	2.89e-09	< 2.2e-16

Source: Authors' calculations.

The results of the cross-sectional dependence analysis (Table 1) indicate the occurrence of cross-sectional dependence in the analysed panel sets.

Next, we checked whether the variables were stationary. Pesaran's CIPS test was used for unit roots in the panels (Table 2).

Table 2 Pesaran's CIPS test for unit roots in the panels (p-value)

Group	CIPS test	SSFrevenue	SSFexpenditure	SSFbalance	GDP growth
EU	Levels	> 0.10	< 0.01	< 0.01	< 0.01
	Differences	< 0.01	< 0.01	< 0.01	< 0.01
EU-old	Levels	0.03001	< 0.01	< 0.01	< 0.01
	Differences	< 0.01	< 0.01	< 0.01	< 0.01
EU-new	Levels	> 0.10	0.04058	0.02659	0.06634
	Differences	0.06484	0.03328	< 0.01	< 0.01

Source: Authors' calculations

The results of the analysis of the stationarity of the variables in the panels (Table 2) indicate that at a significance level of 0.10, one may assume that variables such as SSF expenditure, SSF balance, and GDP growth are stationary in the analysed panel sets. As regards the SSFrevenue variable, it is stationary in the old EU set, while in the EU as a whole and new EU sets, the first differences of this

variable, i.e., the ΔSSFrevenue variable should be considered. Further analyses were performed considering the results of the stationarity analysis of the variables in the panels at a significance level of 0.10.

Granger causality analysis was performed using a bootstrap panel Granger causality test. The results are presented in Tables 3-5.

Table 3 The Granger causality analysis in the panels for variables SSFrevenue/ΔSSFrevenue and GDP growth

EU	Lag	Zbar	Q_0.90	Q_0.95	Q_0.99	Ztilde	Q_0.90	Q_0.95	Q_0.99
	1	2.459	3.292	4.712	9.118	1.471	2.143	3.202	6.587
ΔSSFrevenue ~ GDP growth	2	0.515	2.983	3.161	3.468	1.031	2.707	2.827	3.040
	3	2.225	4.227	4.440	4.659	2.186	3.287	3.404	3.525
	1	0.564	2.895	4.692	9.788	0.851	1.953	3.187	7.101
GDP growth ~ ΔSSFrevenue	2	**3.309**	2.986	3.143	3.478	**2.932**	2.712	2.819	3.047
	3	3.421	4.314	4.490	4.689	2.844	3.335	3.431	3.541
EU-old	**Lag**	**Zbar**	**Q_0.90**	**Q_0.95**	**Q_0.99**	**Ztilde**	**Q_0.90**	**Q_0.95**	**Q_0.99**
	1	**3.637**	2.364	3.503	6.282	**2.561**	1.756	2.456	4.631
SSFrevenue ~ GDP growth	2	2.210	2.480	2.625	2.912	1.094	2.206	2.303	2.510
	3	1.424	3.367	3.488	3.652	1.494	2.642	2.713	2.810
	1	2.045	3.465	5.192	10.151	1.886	2.427	3.778	7.660
GDP growth ~ SSFrevenue	2	**2.792**	2.387	2.599	3.009	**2.427**	2.131	2.279	2.527
	3	3.150	3.256	3.416	3.609	2.513	2.576	2.671	2.784
	1	**4.708**	3.063	4.141	8.046	**3.315**	2.052	2.880	5.880
ΔSSFrevenue ~ GDP growth	2	1.149	2.394	2.521	2.789	0.291	2.112	2.199	2.356
	3	0.604	3.264	3.405	3.654	1.026	2.489	2.566	2.703
	1	0.587	2.515	3.655	6.240	0.752	1.748	2.506	4.493
GDP growth ~ ΔSSFrevenue	2	2.402	2.431	2.554	2.840	2.125	2.137	2.227	2.420
	3	3.008	3.270	3.404	3.596	2.348	2.492	2.566	2.671
EU-new	**Lag**	**Zbar**	**Q_0.90**	**Q_0.95**	**Q_0.99**	**Ztilde**	**Q_0.90**	**Q_0.95**	**Q_0.99**
	1	1.351	2.785	4.090	7.540	1.327	1.860	2.853	5.503
ΔSSFrevenue ~ GDP growth	2	1.939	2.235	2.375	2.612	1.791	1.992	2.088	2.249
	3	2.582	3.063	3.212	3.420	2.087	2.351	2.432	2.536
	1	0.204	2.478	4.632	8.790	0.446	1.689	3.269	6.463
GDP growth ~ ΔSSFrevenue	2	2.276	2.311	2.446	2.675	2.020	2.042	2.132	2.285
	3	1.807	3.170	3.305	3.474	1.661	2.410	2.484	2.577

Notes: Zbar, Ztilde – statistics (5), (6); Q_0.90, Q_0.95, Q_0.99 – quantiles of Zbar and Ztilde statistics distributions, 0.90, 0.95 and 0.99, respectively.

Source: Authors' calculations.

Table 4 The Granger causality analysis in the panels for variables SSFexpenditure and GDP growth

EU	Lag	Zbar	Q_0.90	Q_0.95	Q_0.99	Ztilde	Q_0.90	Q_0.95	Q_0.99
	1	**6.865**	3.632	5.841	12.133	**4.977**	2.447	4.176	9.100
SSFexpenditure ~ GDP growth	2	1.559	3.579	3.777	4.064	0.458	3.158	3.296	3.486
	3	1.041	4.593	4.763	5.005	1.520	3.618	3.719	3.862
	1	1.263	4.107	5.142	9.294	0.593	2.819	3.629	6.878
GDP growth ~ SSFexpenditure	2	0.742	3.079	3.319	3.898	1.162	2.796	2.961	3.270
	3	2.580	4.351	4.534	4.757	2.429	3.475	3.583	3.715
EU-old	**Lag**	**Zbar**	**Q_0.90**	**Q_0.95**	**Q_0.99**	**Ztilde**	**Q_0.90**	**Q_0.95**	**Q_0.99**

	1	**3.538**	3.150	4.907	10.579	**2.484**	2.180	3.555	7.994
SSFexpenditure ~ GDP growth	2	0.808	2.658	2.772	3.011	1.030	2.330	2.413	2.581
	3	2.235	3.422	3.559	3.727	1.973	2.672	2.754	2.849
	1	1.273	3.499	4.591	8.967	1.282	2.453	3.308	6.733
GDP growth ~ SSFexpenditure	2	**2.780**	2.484	2.648	3.134	**2.419**	2.197	2.290	2.557
	3	3.006	3.273	3.456	3.631	2.429	2.585	2.692	2.797
EU-new	**Lag**	**Zbar**	**Q_0.90**	**Q_0.95**	**Q_0.99**	**Ztilde**	**Q_0.90**	**Q_0.95**	**Q_0.99**
	1	**6.225**	2.781	4.440	7.618	**4.598**	1.903	3.201	5.689
SSFexpenditure ~ GDP growth	2	**3.092**	2.674	2.784	2.953	1.733	2.326	2.403	2.523
	3	0.824	3.385	3.484	3.615	0.140	2.626	2.685	2.763
	1	**3.148**	3.037	4.086	6.186	**2.190**	2.103	2.924	4.567
GDP growth ~ SSFexpenditure	2	1.823	2.295	2.463	2.910	0.840	2.035	2.143	2.363
	3	0.595	3.188	3.302	3.518	0.978	2.510	2.578	2.705

Notes: See notes under Table 3.

Source: Authors' calculations.

Table 5 The Granger causality analysis in the panels for variables SSFbalance and GDP growth

EU	**Lag**	**Zbar**	**Q_0.90**	**Q_0.95**	**Q_0.99**	**Ztilde**	**Q_0.90**	**Q_0.95**	**Q_0.99**
	1	**10.498**	3.690	5.319	9.113	**7.821**	2.493	3.768	6.737
SSFbalance ~ GDP growth	2	0.343	3.241	3.417	3.712	0.398	2.920	3.037	3.253
	3	1.845	4.437	4.585	4.839	1.995	3.526	3.614	3.764
	1	**5.403**	3.404	4.488	7.054	**3.833**	2.275	3.117	5.126
GDP growth ~ SSFbalance	2	1.455	3.063	3.236	3.621	1.664	2.797	2.918	3.189
	3	2.863	4.276	4.454	4.742	2.596	3.431	3.536	3.706
EU-old		**Zbar**	**Q_0.90**	**Q_0.95**	**Q_0.99**	**Ztilde**	**Q_0.90**	**Q_0.95**	**Q_0.99**
	1	**7.082**	3.103	4.483	8.303	**5.258**	2.144	3.223	6.213
SSFbalance ~ GDP growth	2	0.375	2.500	2.660	2.964	0.725	2.193	2.299	2.478
	3	1.619	3.343	3.454	3.649	1.609	2.627	2.693	2.808
	1	2.348	3.179	4.458	7.319	1.553	2.203	3.204	5.443
GDP growth ~ SSFbalance	2	1.669	2.369	2.547	2.826	1.637	2.115	2.249	2.441
	3	1.938	3.240	3.390	3.596	1.797	2.566	2.655	2.777
EU-new		**Zbar**	**Q_0.90**	**Q_0.95**	**Q_0.99**	**Ztilde**	**Q_0.90**	**Q_0.95**	**Q_0.99**
	1	**7.781**	3.108	4.422	8.383	**5.816**	2.158	3.187	6.287
SSFbalance ~ GDP growth	2	0.885	2.479	2.633	2.872	0.180	2.175	2.287	2.414
	3	0.978	3.233	3.340	3.560	1.205	2.537	2.600	2.730
	1	**5.355**	2.743	3.674	6.639	**3.917**	1.893	2.602	4.922
GDP growth ~ SSFbalance	2	0.362	2.345	2.531	2.783	0.698	2.091	2.223	2.367
	3	2.115	3.153	3.290	3.469	1.876	2.490	2.571	2.676

Notes: See notes under Table 3.

Source: Authors' calculations.

On the basis of the results presented in Tables 3–5 one may observe that on the significance level of 0.10, a conclusion may be drawn that the Granger causality occurs between some of the analysed variables in the analysed panel sets.

4.1 Discussion

This study provides evidence of bidirectional causality, indicating a relationship between the categories examined. However, the results are not

consistent across the entire group of countries analysed. This study concludes that the strength of the social security funds sector's response to changes in the demand gap is important and determines indirect causality. Simultaneously, GDP changes can be confronted with financial conditions of the social security sector. This means that social security systems remain critical for ensuring the financial well-being of citizens, especially in aging societies, and shaping macroeconomic situations. This study confirms bidirectional Granger causality for EU countries. Moreover, GDP changes may be more important in shaping the finances of SSF than changes in the financial situation of the sector.

A synthetic approach to the demonstrated Granger causal relationships is presented in Table 6.

Table 6 The Granger test – synthetic approach

Group	SSFrevenue/ΔSSFrevenue	SSFexpenditure	SSFbalance
EU		SSFexp ← GDP growth**	SSFbalance ← GDP growth***
	ΔSSFrev → GDP growth**		SSFbalance → GDP growth**
EU-old	SSFrev ← GDP growth**	SSFexp ← GDP growth*	SSFbalance ← GDP growth**
	SSFrev → GDP growth**	SSFexp → GDP growth**	
	ΔSSFrev ← GDP growth**		
EU-new	no Granger causality between	SSFexp ← GDP growth**	SSFbalance ← GDP growth**
	ΔSSFrev and GDP growth	SSFexp → GDP growth*	SSFbalance → GDP growth**

Notes: $Y \leftarrow X$ means: X is a Granger cause of Y; $Y \rightarrow X$ means: Y is a Granger cause of X; * $\alpha = 0.10$; ** $\alpha = 0.05$; *** $\alpha = 0.01$

Source: Authors' calculations.

However, a deeper insight into the results indicates that bidirectional causality in the Granger sense is distributed differently between the two other groups: EU-old and EU-new. For the first group, the SSFrevenues and SSFexpenditures are characterised by bidirectional Granger causality. In the EU-new group, SSFexpenditure and SSFbalance are characterised by bidirectional Granger causality. This suggests that the duration of community participation can be meaningful. The same can be considered if we assume that the presence of better institutional quality promotes economic growth because it fosters trust and cooperation and encourages investment. Poor institutions translate into corruption, inefficiencies, and weak governance, which later lead to economic stagnation and discourage investment (Sidek and Mehmet Asutay, 2021).

The factors determining Granger causality can be seen, at least in the size, pace of change, and sectoral structure of the economy, but also – what we have considered as well – in the level of revenues and expenditure, the pace of their change, and the extent of allocation and redistribution of revenues in the economy. Considering the above, a GDP growth of 2.5% is the Granger cause of expenditure, but under these conditions, the expenditure of this sector is not an important growth factor in EU countries in general. However, the above thesis may not be confirmed.

If we note that in the new EU countries, the average pace of GDP change was 3.4%, as compared with 1.8% in the old EU countries, then SSF expenditure is the Granger cause of economic growth. Therefore, we assume that the pace of GDP change is irrelevant to Granger causality. It should be emphasised that the GDP indicator calculated in current prices in the new EU is ten times lower than the GDP level in the old EU countries (on average). This implies that the value of GDP does not determine Granger causality.

The revenues and expenditures of the SSF in the new EU countries represent only 7–8% of the revenues and expenditures of the old EU countries. The significantly lower values for these categories also differ in terms of GDP. Thus, the lower values of revenues and expenditures and the relatively smaller scope for allocation and redistribution in the new EU countries do not allow us to clearly indicate the reasons for the lack of Granger causality in terms of revenue – GDP and GDP – revenues in this group of countries and the occurrence of bidirectional Granger causality with respect to expenditure in this sector and GDP changes. One may assume that this may depend on the degree of flexibility of receipts from social security contributions and the benefits from economic fluctuations. It is likely that the structure of employment in the economy and the sources of financing of SSF revenues may also be indirectly relevant to the causal relationship in this respect. Moreover, the levels of unit self-financing in the social security sector vary. The scope of government subsidies depends on the systemic solution adopted. While social security contributions in the old EU countries represent 10.7% of GDP, in the new EU, they represent 9.9% (on average, over the period). However, the assessment is not easy because of the different solutions applied by different jurisdictions, which allow not to pay social security contributions after exceeding the statutory income threshold and allow for other restrictions regarding, for example, the annual social security contribution base for persons conducting economic activities.

It should be highlighted specifically that for the EU-old and the EU-new, expenditures in the social security sector are the Granger cause of GDP changes. This means that the government can employ expenditure as a factor for growth (Auerbach and Gale, 2024). Simultaneously, the GDP changes in both groups were Granger causes of SSF expenditure. Hence, the inclusion of socioeconomic variables in the model predicting the values of individual financial components of the social security sector increases the accuracy of their predictions, and vice versa. Granger causality proves that economic development and the financial situation of the social security sector can be considered complementary rather than competitive.

However, purely unidirectional Granger causality is rarely observed. It primarily characterizes EU countries in general. With the exception of one pair of variables (see SSFrevenue and GDP, EU-new) in which no relationship was found, the remaining eight out of nine analysed variable pairs were characterised by at least

unidirectional Granger causality, most often from GDP growth to individual components of the SSF. This demonstrates the stronger influence of GDP changes on the financial situation in the social security sector.

5. Conclusions

This study provides insight into how past decisions about the social security funds sector influenced the level of GDP. In general, European Union countries demonstrate varied regularities. This means that the proposed hypothesis is only partially confirmed empirically. Therefore, it is appropriate to base forecasts of the financial situation of the social security sector on GDP. This study confirms that the lagged values of the GDP change indicator might improve financial forecasts for the SSF sector. Furthermore, maintaining economic growth may contribute to the financial stability of the social security sector.

The results of this empirical study have significant applicability. They constitute important guidance for political decision-makers in that EU-old countries, to improve the quality of macroeconomic forecasts, should consider the past values of both income and expenditure of the SSF. In turn, the EU-new countries should focus on expenditures in particular. This is particularly important because the financial situation of this sector is more challenging than that of EU-old countries.

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Appendix

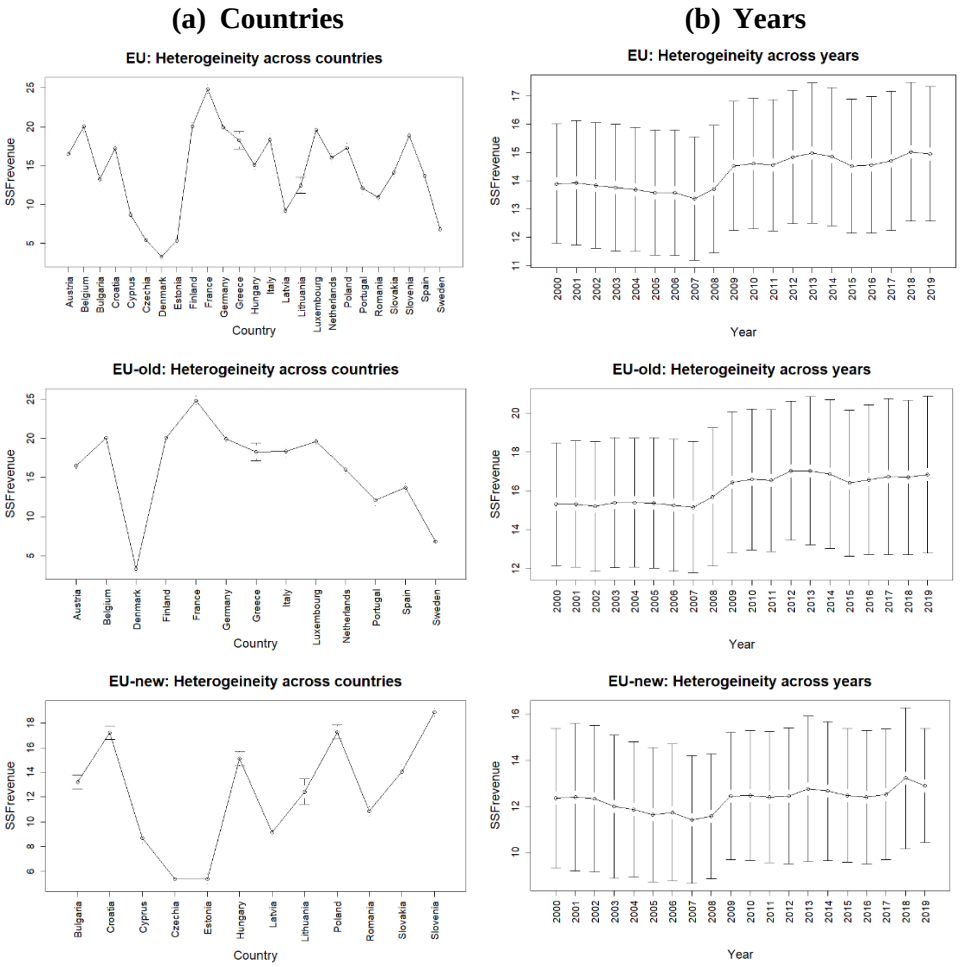

Figure A1 Revenues of the SSF in EU countries, 2000–2019 (% GDP)

Source: Authors'calculations based on Eurostat data: Government deficit/surplus, debt and associated data, https://appsso.eurostat.ec.europa.eu/nui/submitViewTableAction.do, accessed: 3.07.2020.

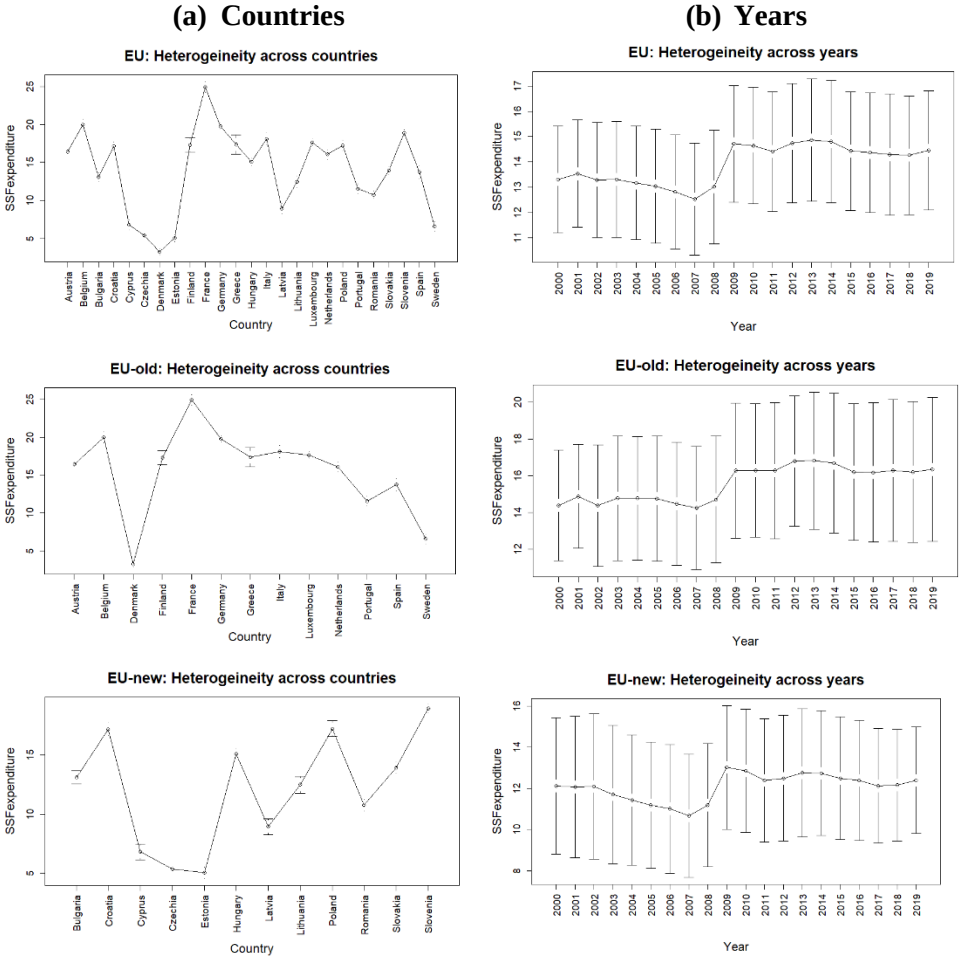

Figure A2 Expenditure of the SSF in EU countries, 2000-2019 (% GDP)

Source: Authors'calculations based on Eurostat data: Government deficit/surplus, debt and associated data, https://appsso.eurostat.ec.europa.eu/nui/submitViewTableAction.do, accessed: 3.07.2020.

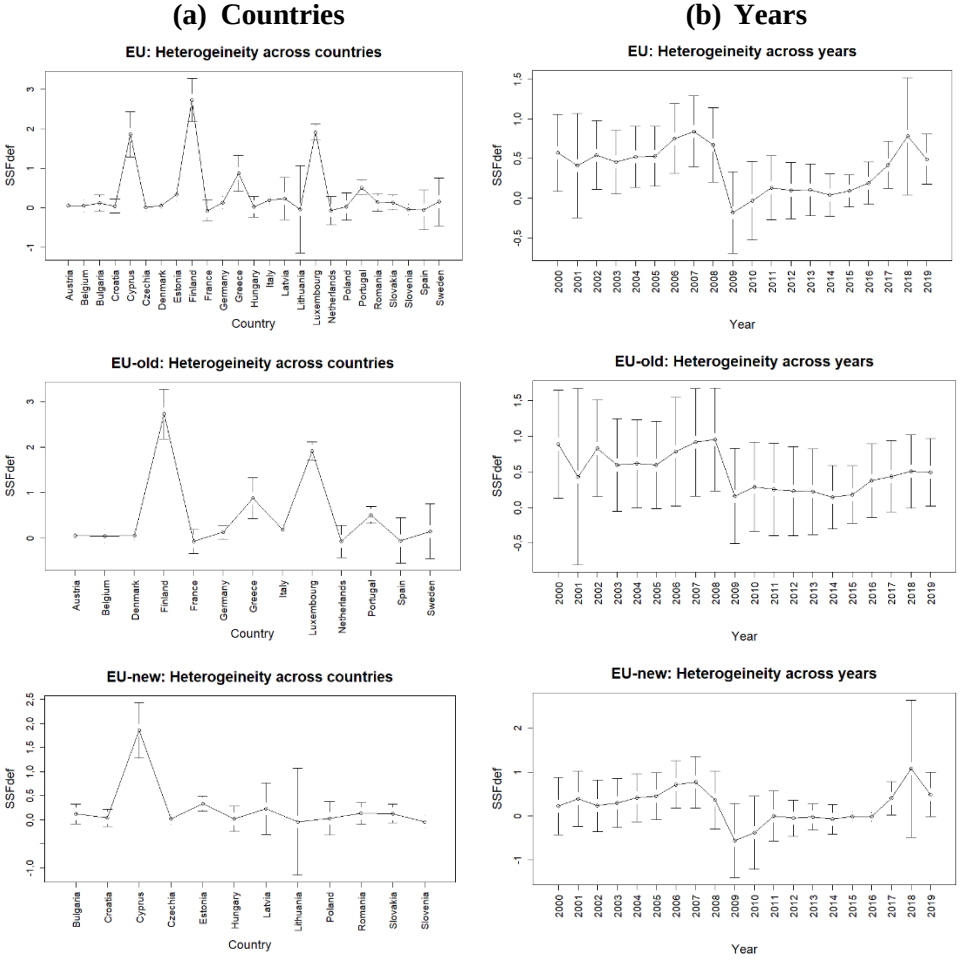

Figure A3 Balance of the SSF in EU countries, 2000–2019 (% GDP)

Source: Authors'calculations based on Eurostat data: Government deficit/surplus, debt and associated data, https://appsso.eurostat.ec.europa.eu/nui/submitViewTableAction.do, accessed: 3.07.2020.

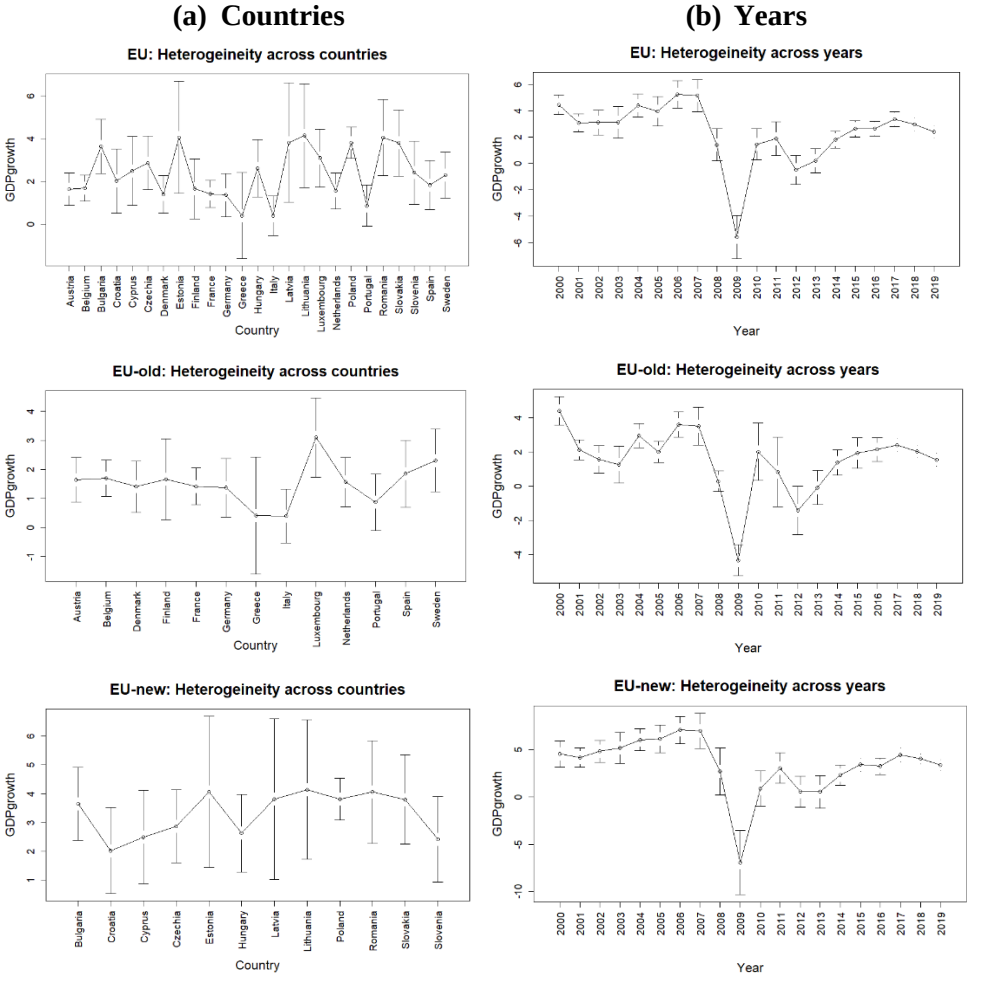

Figure A4 Real GDP in EU countries, 2000–2019 (%)

Source: Authors'calculations based on Eurostat data: GDP and main components, https://appsso.eurostat.ec.europa.eu/nui/submitViewTableAction.do, accessed: 3.07.2020