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What we know and what we do not know about social security finance and macroeconomic stabilization. Evidence from EU countries[1]

Introduction

The recent pandemic has shown that the positive trend in reducing poverty and income inequality and/or increasing economic growth can be reversed. Accurate and timely forecasts can therefore attenuate the negative impact of shocks. Decisions made on the basis of such forecasts facilitate adaptation to change and promote long-term stability. And forecasting based on causally related variables helps rationalize decision-making, enables anticipation, and supports the construction of future scenarios.

Not only have the two-way causal relationships between social security finance variables and socio-economic indicators never been verified, but few studies on social security funds (SSFs) have been conducted. Narrowing the research area to SSF finances may therefore shed new light on the results of the empirical work undertaken to date. The analysis is not limited to explaining the cross-sectional variability of the studied categories, but to panel research examining the dimension of the time series. Firstly, it is examined whether the inclusion of socio-economic variables in the model predicting the values of the individual financial components of SSFs increases the accuracy of their predictions, and vice versa. Secondly, it is examined which variables affect SSF finances and the macroeconomic situation with a view to enabling stability to be maintained under changing conditions. The main hypothesis is that socio-economic variables are a Granger cause of the SSF financial situation if the current values of the SSF financial condition can

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be predicted more accurately taking into account the past values of the socio-economic variables than by ignoring them and vice versa. The following detailed hypotheses were formulated:
H1. there is two-way Granger causality between the SSF and the Unemployment Rate;
H2. there is two-way Granger causality between the SSF and the Inflation Rate;
H3. there is two-way Granger causality between the SSF and the Age Dependency Ratio.

A bootstrap panel Granger causality test was employed. The research period was from 2000 to 2019 inclusive. Granger causality was studied by considering one variable responsible for the cause and only one variable responsible for the effect – without the simultaneous influence of the other variables. The results can be used to assess the sustainability of current social agendas and thereby assist in making socio-economic policy more effective. The results are essential for increasing the adaptability of social security systems to changing conditions and ensuring the stability of long-term benefit financing.

Section 1 is a review of the literature. Section 2 retrospectively analyses the SSF financial situation. Section 3 explains the research methodology. The research results are documented in Section 4. Section 5 contains a discussion and the conclusions.

1. Review of the literature

Macroeconomic variables and fiscal aggregates have been of scholarly interest for generations. The research conducted to date includes causality studies on expenditure and receipts (Afonso, Rault, 2009), expenditure and GDP (Dudzevičiūtė et al., 2018), the relationship between unemployment and inflation (Friedman, 1977), and the relationship between unemployment and GDP (Cuaresma, 2003). One of the reasons for the broad interest in these dependencies is that no clear conclusions can be drawn from the results of the research conducted to date. Identifying a credible cross-country cause-effect link between public finances and macroeconomic indicators is extremely problematic. Due to various distorting characteristics, this research is often fragmentary, inexhaustive, and inconclusive. It has been confirmed that, while macroeconomic indicators and demographic change indicators are generally used for research, in the case of the Granger test, they focus mainly on dependencies related to public expenditure (Bağdigen, Çetintaş, 2003), social expenses (Bellettini, Ceroni, 1999), public revenue and taxation (Blanchard, Perotti, 2002), and social security contributions and the budget balance (Barro, 1989). However, there is no information regarding empirical research on the proposed concept, which draws attention to SSF finances.

A review of the literature only allows for some general conclusions. These can be presented in a synthetic way. Therefore, while some researchers argue that budget deficits do not matter and do not affect aggregate demand (Barro, 1989), others, while agreeing with Barro's hypothesis, conclude that the impact

of the deficit on demand depends on the its structure and the level of taxes and expenditure (Kneller et al., 1999). For their part, Agell et al. (1997) argue that the impact of the public sector on changes in the economy fails to be considered obvious. And given the existence of institutional and international constraints, the government's ability to manipulate the economy through fiscal expansion is debatable (Eslava, 2011). From the perspective of social security, the results of the latest research by Gechert et al. (2021) are noteworthy. These which show that the impact of expansionary changes in social security on the economic situation is positive and has a short - and medium - term nature. But the size of the social security system is essential for macroeconomic dynamics. And the increase in public social expenditure, although it has a significant impact on the economy, is negative (Connolly, Li, 2016). Zhang and Zhang (2014) disagree, contending that social security expenditure tends to stimulate the economy. However, this stimulus does not appear to change the ratio of social security contributions or benefits to revenue. Cammeraat (2020) shows that total public social expenditure is negatively related to poverty and inequality, but not related to economic growth. It has been argued that when it comes to purely redistributive policies, there are even two opposing effects. This is because while public pensions increase investment in human capital, they also reduce savings, which limits this investment (Lambrecht et al., 2005). A Granger causal relationship can therefore be expected with respect to SSF finances and the macroeconomic variables selected for the study. This is because inflation influences the formation of fiscal variables, although the impact is complex and multi-channelled. Valorisation mechanisms and the tax base can alter the level of public revenue and expenditure. As a result, inflation also determines the balance of the public finance sector. As shown by Jabłecka and Jędrzejowicz (2015), a twelve-month deviation of inflation from expectations affects the GG sector deficit. And an unexpected change in the GG sector deficit, caused by an inflationary shock, may constitute an obstacle in achieving the adopted fiscal targets. A Granger causal relationship between SSF finances and price changes should therefore be expected. Albin and Stein (1977) showed that fluctuations in the unemployment rate evoke serious reactions from the welfare system. Therefore, it can be assumed that the increase in the unemployment rate will negatively affect SSF finances. As will the Age Dependency Ratio, as an increase means greater social security expenditure and fewer productive people to finance it while a decrease obviously implies the opposite. A low ratio therefore helps ensure the financial security of the dependent population and enables higher pensions and better health care. It should therefore be expected that, as demonstrated by Malmberg (1995), the parameters for demographic variables will have a negative sign in the economic growth equation. However, they are not expected to be significant.

2. Research background

The SSF sector is a sub-sector of the General Government (GG) sector. SSF revenue comes from social contributions and government subsidies. In turn, the expenditure of this sector is an element of social protection expenditure (OECD, 2019). The SSF budget is separate from the state budget. The revenue and expenditure of this sector exceed EUR 70 trillion and constitute around 14% of GDP on average annually. They respectively account for 40% and 37% of GG revenue and expenditure (Eurostat, 2020).

EU member states are divided into: EU-general (members as at 18 January 2021); EU-old (founding EEC [later EU] members and those that joined before 2004); and EU-new (members since 2004). Over the entire research period (2000–2019), average annual SSF revenue accounted for 16% of GDP in EU-old and 12% in EU-new. The sector has higher nominal revenue, faster growth, and a relatively stable rate of change (Fig. 1, Appendix). The expenditure situation is similar. SSF expenditure accounts for almost 16% of annual average GDP in EU-old, compared with 12% in EU-new. This expenditure is considerably higher, its growth faster, its rate of change stable, and its response to economic change less pronounced in EU-old (Fig. 2, Appendix). The SSF balance in this group is higher than in EU-new, accounting for 0.5% of average annual GDP (Fig. 3, Appendix). Unemployment grew in all the analysed subgroups during the recovery from the GFC (2007–2008). But the curve flattens at the top for EU-new. This demonstrates that this group's labour market recovery was slower. EU-old not only had lower unemployment than EU-new, but the crisis affected employment less. This made the situation on the labour market more stable (Fig. 4, Appendix). Labour market changes were accompanied by price increases. These increases were higher in EU-new than in EU-old (Fig. 5, Appendix). Pressure on the productive population simultaneously increased. The Age Dependency Ratio in EU-new grew rapidly, especially in the second decade. This stands in contrast with EU-old, where this variable exhibited steady growth throughout the entire research period. Moreover, it was typically higher in EU-old (Fig. 6, Appendix).

These observations became the basis for the research.

3. Data and methodology

a. Data

The following variables were used:

- SSFrevenue – total GG revenues of the SSF (% GDP);
- SSFexpenditure – total GG expenditure of the SSF (% GDP);
- SSFbalance – net lending (+)/net borrowing (-) of the SSF (% GDP);
- UnemplRate (%) – the unemployed as a percentage of the labour force (total number of employed and unemployed people aged 15–64);

• Inflation (%) – the annual percentage change in the cost to the average consumer of acquiring a basket of goods and services;

• AgeDepRate (%) – the ratio of dependent-people younger than 15 or older than 64 to the working-age population (15–64), expressed as a percentage.

The EU member states comprise the research group. This are divided into: EU-general, EU-old and EU-new. The research period covers 2000–2019.

b. Cross-sectional dependence in panel data

A Granger causality test on panel data requires checking for cross-sectional dependence. The Pesaran CD test was used to check for cross-sectional dependence in the panel data (Pesaran, 2004).

Hypotheses:

H_0: there is no cross-sectional dependence in the panel data;

H_1: there is cross-sectional dependence in the panel data.

The test statistic in the Pesaran CD test is as follows (Pesaran, 2004, p. 6):

$$CD = \sqrt{\frac{2T}{N(N-1)}\left(\sum_{i=1}^{N-1}\sum_{j=i+1}^{N}\hat{\rho}_{ij}\right)} \quad (1)$$

where:

N – number of country;

T – number of years;

$\hat{\rho}_{ij}$ – the estimate of the pair-wise correlation of the residuals (Pesaran, 2004, p. 5).

c. Stationarity of variables in panel data

Due to the presence of cross-sectional dependence in the panel data, the Pesaran CIPS test for unit roots in the panels was used to study the stationarity of the variables (Pesaran, 2007). This test is a cross-sectionally augmented Im, Pesaran and Shin (IPS) test for unit roots in panel models.

Hypotheses:

H_0: variable has a unit root;

H_1: variable is stationary.

The test statistic in the Pesaran CIPS test is as follows (Pesaran, 2007, p. 276):

$$CIPS(N,T) = \frac{1}{N}\sum_{i=1}^{N} t_i(N,T) \quad (2)$$

where $t_i(N,T)$ is the cross-sectionally augmented Dickey–Fuller statistic for the ith country given by the t-ratio of the coefficient of $y_{i,t-1}$ in the CADF regression.

d. Bootstrap panel Granger causality test

To study the occurrence of Granger causality in panel data with cross-sectional dependence the bootstrap panel Granger causality test was used (Dumitrescu, Hurlin, 2012).

According to the adopted research procedure, for each country i ($i = 1, ..., N$) in the period t ($t = 1, ..., T$), the following linear model was considered:

$$y_{i,t} = \alpha_i + \sum_{k=1}^{K} \gamma_i^{(k)} y_{i,t-k} + \sum_{k=1}^{K} \beta_i^{(k)} x_{i,t-k} + \varepsilon_{i,t} \quad (3)$$

where:
$y_{i,t}$ – the value of the stationary variable Y for the ith object ($i = 1, \dots, N$) in the period $t (t = 1, \dots, T)$;
$x_{i,t}$ – the value of the stationary variable X for the ith object ($i = 1, \dots, N$) in the period $t (t = 1, \dots, T)$.

The following assumptions were made (Dumitrescu, Hurlin, 2012, p. 1451):
- the individual effects α_i ($i = 1, \dots, N$) are supposed to be fixed in the years;
- lag orders K are identical for each country of the panel;
- the panel is balanced;
- the autoregressive parameters $\gamma_i^{(k)}$ and the regression coefficient slopes $\beta_i^{(k)}$ may differ across countries.

Dumitrescu and Hurlin (2012) propose to test the Homogeneous Non Causality (*HNC*) hypothesis by factoring in the heterogeneity of the regression model and the causal relation. Their test does not test the non-causality assumption against causality from X to Y for every country.

The HNC null hypothesis is defined as (Dumitrescu, Hurlin, 2012, p. 1453):

$$H_0: \beta_i = 0 \quad \forall\, i = 1, \dots, N \quad (4)$$

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

The alternative HNC hypothesis is defined as (Dumitrescu and Hurlin, 2012, p. 1453):

$$H_1: \beta_i = 0 \quad \forall\, i = 1, \dots, N_1 \text{ and } \beta_i \neq 0 \quad \forall\, i = N_1 + 1, N_1 + 2, \dots, N \quad (5)$$

where $0 \leq N_1 < N$.

Dumitrescu and Hurlin (2012) propose using the average of individual Wald statistics associated with the non-causality hypothesis test for the ith country ($i = 1, \dots, N$).

The average statistic $W_{N,T}^{Hnc}$ associated with the null Homogeneous Non Causality (HNC) hypothesis is defined as (Dumitrescu, Hurlin, 2012, p. 1453):

$$W_{N,T}^{Hnc} = \frac{1}{N} \sum_{i=1}^{N} W_{i,T} \quad (6)$$

where $W_{i,T}$ denotes the individual Wald statistics for the *i*th country corresponding to the individual test H_0: $\beta_i = 0 \quad (i = 1, \ldots, N)$.

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

1) Statistics (Dumitrescu, Hurlin, 2012, p. 1454):

$$Z_{N,T}^{Hnc} = \sqrt{\frac{N}{2K}}\left(W_{N,T}^{Hnc} - K\right) \tag{7}$$

also marked as $\bar{Z}$ and called the "Zbar" statistic (Lopez, Weber, 2017, p. 4);

2) Statistics (Dumitrescu, Hurlin, 2012, p. 1456; Lopez, Weber, 2017, p. 4):

$$\tilde{Z}_N^{Hnc} = \sqrt{\frac{N}{2K} \cdot \frac{T-3K-5}{T-2K-3}} \cdot \left[\frac{T-3K-3}{T-3K-1} \cdot W_{N,T}^{Hnc} - K\right] \tag{8}$$

also marked as $\tilde{Z}$ and called the "Ztilde" statistics (Lopez, Weber, 2017, p. 4). The above representation of statistic (8) is a modification of the original formula given in the paper (Dumitrescu, Hurlin, 2012, p. 1456). This modification was proposed by Lopez and Weber (2017, p. 4) in order to maintain the consistency of the markings. Symbol *T* is the number of all analysed periods, while $T - K$ is the number of periods considered in the given equation after accounting for the order of lags. In Dumitrescu and Hurlin's original formula, by contrast, the symbol *T* denoted the number of periods after accounting for lags.

Due to the presence of cross-sectional dependence in the panel data, a bootstrap approach was used in the Granger causality study (Dumitrescu, Hurlin, 2012).

The following research procedure was adopted:

1) The model (3) for panel data was defined;

2) The delay order was $K = 1, 2, 3$. The following operations were then performed for each *K*:

3) The model (3) for each country was estimated and statistics (7) and (8) were calculated;

4) The model (3) was estimated for each country assuming that all parameters $\beta_i^{(k)} \; (i = 1, \ldots, N; k = 1, \ldots, K)$ are equal to zero, and a matrix of residuals with dimensions $(N \times T - K)$ was determined.

5) The block bootstrap procedure was applied to the matrix of the residuals. The residuals were resampled with replacement by considering a block of size 1 in the time-series and size *N* in the panel dimension. A new residual matrix was created as a result of this procedure;

6) For each country, the theoretical values of $\hat{y}_{i,t} \; (i = 1, \ldots, N; t = K + 1, K + 2, \ldots, T)$ were calculated on the basis of the model from step 4), taking into account the appropriate vector from the new residual matrix. New $\tilde{y}_{i,t}$ values for *Y* were then calculated for each country;

7) Based on the $\tilde{y}_{i,t}$ data, the model (3) was estimated for each country and statistics (7) and (8) were calculated;

8) Steps 5), 6) and 7) were repeated 999 times;

9) Based on the values of statistics (7) and (8) obtained in successive replications (step 8), empirical critical values were calculated, corresponding to the 0.90,

0.95, and 0.99 quartiles (respectively) of the distribution of statistics (7) and (8) (taken in absolute value), assuming the null hypothesis of no causality is true;

10) The values of the statistics obtained in step 3) were compared with the empirical critical values calculated in step 9);

All calculations were performed in the R program, using mainly the 'plm' package (Croissant, Millo, 2008).

4. Results

a. Analysis of cross-sectional dependence in the panels

Empirical research began with checking whether cross-sectional dependence exists in the analysed panel collections. For this purpose, the Pesaran CD test for cross-sectional dependence in panels was used (Table 1).

Table 1

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

Variable	Group		
	EU	EU-old	EU-new
SSFrevenue	< 2.2e-16	5.595e-12	2.758e-10
SSFexpenditure	< 2.2e-16	< 2.2e-16	< 2.2e-16
SSFbalance	< 2.2e-16	0.0008984	2.89e-09
UnemplRate	< 2.2e-16	< 2.2e-16	< 2.2e-16
Inflation	< 2.2e-16	< 2.2e-16	< 2.2e-16
AgeDepRate	< 2.2e-16	< 2.2e-16	< 2.2e-16

Source: Own calculations.

The results indicate the presence of cross-sectional dependence in the analysed panel files. Further analyses therefore took the problem of cross-sectional dependence into account.

b. Analysis of the stationarity of variables in the panels

In the next step, the stationarity of the variables was checked. For this purpose, the Pesaran's CIPS test for unit roots in panels was used (Table 2).

The results of the analysis of the stationarity of variables in the panels (Table 2) indicate that it can be assumed that SSFexpenditure, SSFbalance, Inflation and AgeDepRate are stationary at the 0.10 significance level. SSFrevenue is stationary in EU-old, but the increments of this variable, i.e. the ΔSSFrevenue variable, should be considered in EU and EU-new. On the other hand, UnemplRate can be assumed to be stationary in EU and EU-new, but the increments of this variable,

i.e. the ΔUnemplRate variable, should be considered in EU-old. Further analyses that took into account the results of the analysis of the stationarity of variables in the panels at the 0.10 significance level were performed.

Table 2

Pesaran's CIPS test for unit roots in panels (*p*-value)

Variable		Group		
		EU	EU-old	EU-new
SSFrevenue	Levels	> 0.10	0.03001	> 0.10
	1st differences	< 0.01	< 0.01	0.06484
SSFexpenditure	Levels	< 0.01	< 0.01	0.04058
SSFbalance	Levels	< 0.01	< 0.01	0.02659
UnemplRate	levels	0.01966	> 0.10	0.05302
	1st differences	< 0.01	< 0.01	< 0.01
Inflation	levels	< 0.01	0.05043	< 0.01
AgeDepRate	levels	< 0.01	< 0.01	< 0.01

Source: Own calculations.

c. Granger causality analysis in the panels

The bootstrap panel Granger causality test was carried out. In the first step, calculations related to the unemployment rate were made. The tables below show the results for SSFrevenue/ΔSSFrevenue and UnemplRate/ΔUnemplRate (Table 3), SSFexpenditure and UnemplRate/ΔUnemplRate (Table 4), and SSFbalance and UnemplRate/ΔUnemplRate (Table 5).

Table 3

Results of the Granger's causality analysis in the panels for SSFrevenue/ ΔSSFrevenue and UnemplRate/ΔUnemplRate

EU	Lag	Zbar	Q_0.90	Q_0.95	Q_0.99	Ztilde	Q_0.90	Q_0.95	Q_0.99
ΔSSFrevenue ~ UnemplRate	1	**5.900**	2.828	3.660	5.424	**4.115**	1.806	2.394	3.749
	2	2.271	2.501	2.703	3.027	0.865	2.382	2.519	2.740
	3	1.366	3.861	4.025	4.327	1.713	3.086	3.176	3.342
UnemplRate ~ ΔSSFrevenue	1	**5.337**	2.361	3.090	4.157	**3.682**	1.563	2.002	2.775
	2	**3.078**	2.489	2.783	3.137	**2.775**	2.368	2.572	2.794
	3	3.689	3.793	3.995	4.341	2.991	3.048	3.160	3.349

EU-old	Lag	Zbar	Q_0.90	Q_0.95	Q_0.99	Ztilde	Q_0.90	Q_0.95	Q_0.99
SSFrevenue ~ ΔUnemplRate	1	**2.333**	1.675	2.124	3.967	**1.491**	1.430	1.652	2.746
	2	0.495	2.416	2.555	2.788	0.828	2.133	2.229	2.388
	3	1.892	3.327	3.430	3.663	1.735	2.523	2.580	2.708
ΔUnemplRate ~ SSFrevenue	1	0.982	2.853	3.975	6.465	1.055	1.913	2.752	4.665
	2	**2.076**	2.069	2.314	2.644	**1.903**	1.891	2.050	2.246
	3	3.000	3.001	3.106	3.365	2.344	2.344	2.402	2.545
ΔSSFrevenue ~ ΔUnemplRate	1	1.407	2.736	3.572	6.219	0.780	1.810	2.443	4.476
	2	0.045	2.239	2.384	2.646	0.521	2.011	2.113	2.291
	3	1.435	3.230	3.371	3.584	1.483	2.470	2.548	2.665
ΔUnemplRate ~ ΔSSFrevenue	1	0.207	2.375	2.999	4.604	0.142	1.615	2.003	3.236
	2	**2.078**	1.989	2.206	2.491	**1.905**	1.834	1.984	2.179
	3	1.978	3.137	3.268	3.466	1.782	2.419	2.491	2.600
EU-new	**Lag**	**Zbar**	**Q_0.90**	**Q_0.95**	**Q_0.99**	**Ztilde**	**Q_0.90**	**Q_0.95**	**Q_0.99**
ΔSSFrevenue ~ UnemplRate	1	**6.369**	2.575	3.566	5.526	**4.604**	1.720	2.450	3.956
	2	**2.240**	1.984	2.181	2.651	1.053	1.809	1.936	2.168
	3	0.968	2.872	3.052	3.279	1.199	2.246	2.345	2.470
UnemplRate ~ ΔSSFrevenue	1	**5.375**	2.061	2.829	4.465	**3.839**	1.440	1.890	3.140
	2	1.956	2.407	2.535	2.739	1.802	2.106	2.190	2.308
	3	2.818	3.274	3.374	3.514	2.216	2.467	2.522	2.598

Notes: Zbar, Ztilde – statistics (7), (8); Q_0.90, Q_0.95, Q_0.99 – quantiles of Zbar and Ztilde statistics distribution, respectively, 0.90, 0.95 and 0.99.

Source: Own calculations.

Table 4

Results of the Granger's causality analysis in the panels for SSFexpenditure and UnemplRate/ΔUnemplRate

EU	Lag	Zbar	Q_0.90	Q_0.95	Q_0.99	Ztilde	Q_0.90	Q_0.95	Q_0.99
SSFexpenditure ~ UnemplRate	1	**8.808**	5.014	5.808	7.195	**6.498**	3.529	4.150	5.236
	2	0.470	2.835	3.061	3.382	0.309	2.634	2.795	3.021
	3	1.284	4.244	4.367	4.580	1.663	3.412	3.485	3.611
UnemplRate ~ SSFexpenditure	1	**8.373**	5.521	6.487	9.373	**6.157**	3.926	4.682	6.940
	2	1.387	3.797	3.905	4.158	1.616	3.313	3.389	3.567
	3	3.300	4.600	4.709	4.923	2.855	3.622	3.687	3.813

EU-old	Lag	Zbar	Q_0.90	Q_0.95	Q_0.99	Ztilde	Q_0.90	Q_0.95	Q_0.99
SSFexpenditure ~ ΔUnemplRate	1	**2.533**	1.868	2.570	5.386	**1.645**	1.488	1.821	3.836
	2	0.952	2.538	2.652	2.866	0.157	2.217	2.295	2.441
	3	1.518	3.444	3.544	3.731	1.529	2.588	2.643	2.746
ΔUnemplRate ~ SSFexpenditure	1	1.283	2.858	3.794	6.454	1.287	1.894	2.613	4.657
	2	0.691	2.309	2.506	2.783	0.961	2.048	2.172	2.366
	3	2.613	3.146	3.253	3.486	2.131	2.424	2.483	2.611
EU-new	**Lag**	**Zbar**	**Q_0.90**	**Q_0.95**	**Q_0.99**	**Ztilde**	**Q_0.90**	**Q_0.95**	**Q_0.99**
SSFexpenditure ~ UnemplRate	1	**8.975**	4.195	5.229	7.508	**6.750**	3.009	3.819	5.602
	2	0.205	2.169	2.364	2.750	0.299	1.956	2.082	2.299
	3	1.644	3.163	3.295	3.489	1.598	2.495	2.574	2.688
UnemplRate ~ SSFexpenditure	1	**6.112**	3.495	4.432	6.713	**4.509**	2.461	3.195	4.980
	2	0.974	3.066	3.113	3.192	1.129	2.599	2.635	2.691
	3	2.509	3.506	3.599	3.743	2.109	2.698	2.753	2.838

Notes: Zbar, Ztilde – statistics (7), (8); Q_0.90, Q_0.95, Q_0.99 – quantiles of Zbar and Ztilde statistics distribution, respectively, 0.90, 0.95 and 0.99.

Source: Own calculations.

Table 5

Results of the Granger's causality analysis in the panels for SSFbalance and UnemplRate/ΔUnemplRate

EU	Lag	Zbar	Q_0.90	Q_0.95	Q_0.99	Ztilde	Q_0.90	Q_0.95	Q_0.99
SSFbalance ~ UnemplRate	1	1.910	3.122	3.927	5.329	1.099	2.048	2.678	3.776
	2	0.097	2.728	2.873	3.136	0.571	2.561	2.662	2.848
	3	1.927	4.071	4.227	4.499	2.043	3.310	3.402	3.563
UnemplRate ~ SSFbalance	1	**5.365**	2.904	3.637	4.936	**3.803**	1.879	2.451	3.467
	2	2.576	3.303	3.461	3.740	2.454	2.966	3.077	3.273
	3	3.792	4.309	4.429	4.696	3.145	3.451	3.521	3.679
EU-old		**Zbar**	**Q_0.90**	**Q_0.95**	**Q_0.99**	**Ztilde**	**Q_0.90**	**Q_0.95**	**Q_0.99**
SSFbalance ~ ΔUnemplRate	1	**3,325**	2,151	3,240	5,749	**2,253**	1,580	2,188	4,115
	2	0,313	2,337	2,481	2,718	0,704	2,068	2,168	2,319
	3	2,493	3,257	3,376	3,596	2,065	2,485	2,551	2,671
ΔUnemplRate ~ SSFbalance	1	0,765	2,369	3,233	6,494	0,889	1,588	2,182	4,687
	2	1,571	2,217	2,406	2,800	1,560	1,981	2,112	2,304
	3	2,708	3,050	3,191	3,523	2,183	2,371	2,446	2,628

EU-new		Zbar	Q_0.90	Q_0.95	Q_0.99	Ztilde	Q_0.90	Q_0.95	Q_0.99
SSFbalance ~ UnemplRate	1	**3.070**	2.629	3.376	5.670	**2.128**	1.784	2.368	4.164
	2	0.315	2.223	2.409	2.705	0.222	2.000	2.123	2.311
	3	1.056	3.068	3.192	3.423	1.251	2.439	2.513	2.649
UnemplRate ~ SSFbalance	1	1.533	2.462	3.238	5.132	0.926	1.668	2.260	3.743
	2	1.505	2.566	2.682	2.903	1.503	2.246	2.328	2.481
	3	2.835	3.292	3.383	3.533	2.302	2.572	2.625	2.714

Notes: Zbar, Ztilde – statistics (7), (8); Q_0.90, Q_0.95, Q_0.99 – quantiles of Zbar and Ztilde statistics distribution, respectively, 0.90, 0.95 and 0.99.

Source: Own calculations.

Next, inflation was calculated. The tables below show the results obtained for SSFrevenue/ΔSSFrevenue and Inflation (Table 6), SSFexpenditure and Inflation (Table 7), and SSFbalance and Inflation (Table 8).

Table 6

Results of the Granger's causality analysis in the panels for SSFrevenue/ ΔSSFrevenue and Inflation

EU	Lag	Zbar	Q_0.90	Q_0.95	Q_0.99	Ztilde	Q_0.90	Q_0.95	Q_0.99
ΔSSFrevenue ~ Inflation	1	**9.754**	2.996	3.949	6.383	**7.076**	1.964	2.616	4.485
	2	1.662	2.974	3.173	3.526	0.451	2.702	2.839	3.073
	3	2.019	4.250	4.404	4.698	2.073	3.300	3.384	3.546
Inflation ~ ΔSSFrevenue	1	0.014	2.319	3.315	5.085	0.407	1.624	2.138	3.488
	2	2.422	2.957	3.110	3.426	2.328	2.693	2.797	3.012
	3	3.672	4.363	4.496	4.717	2.982	3.362	3.435	3.556
EU-old	**Lag**	**Zbar**	**Q_0.90**	**Q_0.95**	**Q_0.99**	**Ztilde**	**Q_0.90**	**Q_0.95**	**Q_0.99**
SSFrevenue ~ Inflation	1	**5.521**	3.595	4.651	7.177	**4.036**	2.529	3.355	5.332
	2	0.489	2.267	2.453	2.734	0.118	2.056	2.186	2.386
	3	1.670	3.295	3.402	3.609	1.639	2.599	2.662	2.785
Inflation ~ SSFrevenue	1	**3.149**	3.076	4.261	7.345	**2.180**	2.122	3.050	5.463
	2	0.803	2.277	2.446	2.828	1.027	2.046	2.157	2.415
	3	1.257	3.177	3.315	3.584	1.395	2.529	2.611	2.770
ΔSSFrevenue ~ Inflation	1	**9.981**	2.653	3.924	6.360	**7.366**	1.774	2.713	4.584
	2	1.751	2.381	2.537	2.852	0.701	2.110	2.217	2.426
	3	1.447	3.219	3.389	3.591	1.490	2.464	2.558	2.669
	1	0.039	2.208	3.255	5.093	0.331	1.538	2.199	3.612

EU-old	Lag	Zbar	Q_0.90	Q_0.95	Q_0.99	Ztilde	Q_0.90	Q_0.95	Q_0.99
Inflation ~ ΔSSFrevenue	2	1.898	2.343	2.509	2.752	1.782	2.085	2.198	2.363
	3	2.846	3.319	3.450	3.626	2.259	2.519	2.591	2.688
EU-new	**Lag**	**Zbar**	**Q_0.90**	**Q_0.95**	**Q_0.99**	**Ztilde**	**Q_0.90**	**Q_0.95**	**Q_0.99**
ΔSSFrevenue ~ Inflation	1	**3.691**	2.503	3.433	5.510	**2.546**	1.658	2.348	3.943
	2	0.577	2.271	2.390	2.629	0.079	2.017	2.098	2.261
	3	1.408	3.023	3.173	3.485	1.441	2.327	2.410	2.580
Inflation ~ ΔSSFrevenue	1	0.061	1.957	2.622	4.617	0.243	1.486	1.746	3.257
	2	1.520	2.254	2.415	2.657	1.506	2.003	2.106	2.259
	3	2.338	3.146	3.288	3.440	1.953	2.397	2.475	2.558

Notes: Zbar, Ztilde – statistics (7), (8); Q_0.90, Q_0.95, Q_0.99 – quantiles of Zbar and Ztilde statistics distribution, respectively, 0.90, 0.95 and 0.99.

Source: Own calculations.

Table 7

Results of the Granger's causality analysis in the panels for SSFexpenditure and Inflation

EU	Lag	Zbar	Q_0.90	Q_0.95	Q_0.99	Ztilde	Q_0.90	Q_0.95	Q_0.99
SSFexpenditure ~ Inflation	1	**20.701**	4.990	6.337	9.446	**15.806**	3.510	4.564	6.997
	2	**6.674**	3.145	3.324	3.636	**4.059**	2.854	2.980	3.200
	3	2.055	4.504	4.632	4.918	0.310	3.566	3.641	3.810
Inflation ~ SSFexpenditure	1	**8.196**	3.623	4.736	7.466	**6.019**	2.445	3.311	5.448
	2	0.790	3.114	3.345	3.618	0.084	2.831	2.992	3.187
	3	1.119	4.365	4.550	4.767	1.566	3.483	3.593	3.721
EU-old	**Lag**	**Zbar**	**Q_0.90**	**Q_0.95**	**Q_0.99**	**Ztilde**	**Q_0.90**	**Q_0.95**	**Q_0.99**
SSFexpenditure ~ Inflation	1	**9.821**	3.857	5.208	7.535	**7.401**	2.733	3.791	5.612
	2	**3.856**	2.281	2.497	2.779	**2.253**	2.065	2.207	2.408
	3	0.656	3.337	3.495	3.642	0.265	2.624	2.717	2.804
Inflation ~ SSFexpenditure	1	2.390	3.284	4.619	7.295	1.586	2.285	3.330	5.424
	2	1.274	2.414	2.624	2.904	1.358	2.150	2.290	2.478
	3	1.856	3.232	3.395	3.645	1.749	2.562	2.658	2.806
EU-new	**Lag**	**Zbar**	**Q_0.90**	**Q_0.95**	**Q_0.99**	**Ztilde**	**Q_0.90**	**Q_0.95**	**Q_0.99**
SSFexpenditure ~ Inflation	1	**19.658**	4.171	5.160	8.238	**15.111**	2.990	3.764	6.174
	2	**5.620**	2.507	2.643	2.848	**3.513**	2.208	2.299	2.427
	3	2.284	3.286	3.373	3.530	0.723	2.568	2.619	2.712
	1	**9.341**	2.275	3.266	5.931	**7.037**	1.650	2.282	4.368

EU-new	Lag	Zbar	Q_0.90	Q_0.95	Q_0.99	Ztilde	Q_0.90	Q_0.95	Q_0.99
Inflation ~ SSFexpenditure	2	**2.466**	2.386	2.527	2.779	1.293	2.121	2.216	2.383
	3	0.316	3.174	3.275	3.507	0.440	2.502	2.562	2.699

Notes: Zbar, Ztilde – statistics (7), (8); Q_0.90, Q_0.95, Q_0.99 – quantiles of Zbar and Ztilde statistics distribution, respectively, 0.90, 0.95 and 0.99.

Source: Own calculations.

Table 8

Results of the Granger's causality analysis in the panels for SSFbalance and Inflation

EU	Lag	Zbar	Q_0.90	Q_0.95	Q_0.99	Ztilde	Q_0.90	Q_0.95	Q_0.99
SSFbalance ~ Inflation	1	**5.785**	3.332	4.618	6.815	**4.132**	2.239	3.219	4.938
	2	0.360	3.067	3.251	3.630	0.893	2.799	2.929	3.196
	3	2.422	4.326	4.458	4.730	2.335	3.461	3.538	3.699
Inflation ~ SSFbalance	1	**3.236**	2.693	3.606	6.127	**2.137**	1.817	2.427	4.400
	2	1.964	2.859	3.078	3.418	2.023	2.653	2.807	3.046
	3	2.798	4.223	4.370	4.638	2.558	3.400	3.486	3.645
EU-old		**Zbar**	**Q_0.90**	**Q_0.95**	**Q_0.99**	**Ztilde**	**Q_0.90**	**Q_0.95**	**Q_0.99**
SSFbalance ~ Inflation	1	**4.160**	2.729	3.833	6.226	**2.971**	1.862	2.715	4.588
	2	0.226	2.346	2.508	2.779	0.621	2.112	2.228	2.418
	3	1.789	3.235	3.346	3.577	1.710	2.564	2.629	2.766
Inflation ~ SSFbalance	1	1.289	2.615	3.456	5.386	0.724	1.782	2.419	3.930
	2	1.764	2.309	2.523	2.770	1.704	2.079	2.233	2.403
	3	2.659	3.261	3.399	3.627	2.224	2.576	2.659	2.794
EU-new		**Zbar**	**Q_0.90**	**Q_0.95**	**Q_0.99**	**Ztilde**	**Q_0.90**	**Q_0.95**	**Q_0.99**
SSFbalance ~ Inflation	1	**4.020**	3.046	4.175	6.819	**2.872**	2.110	2.993	5.063
	2	0.284	2.400	2.587	2.812	0.644	2.133	2.265	2.404
	3	1.633	3.203	3.311	3.494	1.591	2.519	2.583	2.691
Inflation ~ SSFbalance	1	**3.329**	2.034	2.731	5.187	**2.332**	1.509	1.864	3.785
	2	0.998	2.191	2.362	2.592	1.146	1.983	2.101	2.261
	3	1.271	3.041	3.178	3.399	1.377	2.423	2.504	2.635

Notes: Zbar, Ztilde – statistics (7), (8); Q_0.90, Q_0.95, Q_0.99 – quantiles of Zbar and Ztilde statistics distribution, respectively, 0.90, 0.95 and 0.99.

Source: Own calculations.

Calculations regarding the age dependence ratio were also made. The tables below show the results obtained for SSFrevenue/ΔSSFrevenue and AgeDepRate (Table 9), SSFexpenditure and AgeDepRate (Table 10), and SSFbalance and AgeDepRate (Table 11).

Table 9

Results of the Granger's causality analysis in the panels for SSFrevenue/ ΔSSFrevenue and AgeDepRate

EU	**Lag**	**Zbar**	**Q_0.90**	**Q_0.95**	**Q_0.99**	**Ztilde**	**Q_0.90**	**Q_0.95**	**Q_0.99**
ΔSSFrevenue ~ AgeDepRate	1	0.519	3.472	4.700	8.072	0.816	2.249	3.193	5.783
	2	1.585	2.317	2.586	3.093	1.759	2.236	2.419	2.657
	3	2.815	3.279	3.547	3.861	2.510	2.765	2.913	3.086
AgeDepRate ~ ΔSSFrevenue	1	0.787	3.732	5.299	9.105	0.187	2.449	3.653	6.577
	2	2.358	3.118	3.487	5.228	2.285	2.631	2.833	3.081
	3	3.447	4.134	4.302	4.566	2.858	3.236	3.328	3.473
EU-old	**Lag**	**Zbar**	**Q_0.90**	**Q_0.95**	**Q_0.99**	**Ztilde**	**Q_0.90**	**Q_0.95**	**Q_0.99**
SSFrevenue ~ AgeDepRate	1	1.070	10.163	11.727	15.189	0.552	7.668	8.893	11.603
	2	0.470	1.782	2.180	3.434	0.792	1.344	1.571	1.964
	3	2.537	2.549	2.771	3.143	2.151	2.155	2.282	2.481
AgeDepRate ~ SSFrevenue	1	**32.917**	8.277	10.065	13.924	**25.477**	6.193	7.592	10.613
	2	0.061	2.513	3.027	5.728	0.505	2.015	2.276	3.571
	3	2.335	2.780	4.216	9.114	2.032	2.053	2.291	4.733
ΔSSFrevenue ~ AgeDepRate	1	0.530	3.012	4.118	6.441	0.708	2.013	2.862	4.647
	2	1.764	1.975	2.186	2.634	1.691	1.786	1.904	2.100
	3	**2.735**	2.562	2.788	3.050	**2.198**	2.098	2.214	2.370
AgeDepRate ~ ΔSSFrevenue	1	0.777	2.216	2.972	5.211	0.296	1.560	1.987	3.702
	2	1.887	4.805	6.017	8.755	1.775	2.778	3.603	5.466
	3	2.276	2.675	2.842	3.210	1.946	2.162	2.255	2.456
EU-new	**Lag**	**Zbar**	**Q_0.90**	**Q_0.95**	**Q_0.99**	**Ztilde**	**Q_0.90**	**Q_0.95**	**Q_0.99**
ΔSSFrevenue ~ AgeDepRate	1	0.197	2.715	3.740	6.585	0.441	1.807	2.583	4.769
	2	0.452	1.890	2.112	2.548	0.779	1.698	1.836	2.144
	3	1.217	2.589	2.759	3.104	1.336	2.079	2.172	2.341
AgeDepRate ~ ΔSSFrevenue	1	0.327	4.087	6.799	12.357	0.038	2.851	4.934	9.203
	2	1.439	2.561	2.667	2.867	1.451	2.207	2.273	2.408
	3	2.606	3.436	3.497	3.619	2.100	2.556	2.590	2.657

Notes: Zbar, Ztilde – statistics (7), (8); Q_0.90, Q_0.95, Q_0.99 – quantiles of Zbar and Ztilde statistics distribution, respectively, 0.90, 0.95 and 0.99.

Source: Own calculations.

Table 10

Results of the Granger's causality analysis in the panels for SSFexpenditure and AgeDepRate

EU	Lag	Zbar	Q_0.90	Q_0.95	Q_0.99	Ztilde	Q_0.90	Q_0.95	Q_0.99
SSFexpenditure ~ AgeDepRate	1	4.219	9.808	11.860	16.750	2.907	7.281	8.887	12.714
	2	**2.562**	2.297	2.758	4.329	1.163	2.101	2.279	2.673
	3	2.039	3.496	3.744	4.356	2.109	2.960	3.093	3.290
AgeDepRate ~ SSFexpenditure	1	**36.640**	4.701	6.259	8.637	**28.280**	3.284	4.503	6.364
	2	0.401	3.814	4.012	4.256	0.923	3.326	3.464	3.636
	3	3.454	4.304	4.485	4.792	2.945	3.446	3.546	3.734
EU-old	**Lag**	**Zbar**	**Q_0.90**	**Q_0.95**	**Q_0.99**	**Ztilde**	**Q_0.90**	**Q_0.95**	**Q_0.99**
SSFexpenditure ~ AgeDepRate	1	1.178	10.958	12.761	16.554	0.637	8.291	9.702	12.671
	2	1.424	2.199	3.038	5.383	0.541	1.629	1.947	3.328
	3	2.293	2.594	2.851	5.110	2.007	2.150	2.259	2.555
AgeDepRate ~ SSFexpenditure	1	**28.033**	5.257	6.592	9.468	**21.654**	3.829	4.874	7.125
	2	0.597	2.505	2.760	3.085	0.041	2.203	2.373	2.588
	3	2.604	2.900	3.161	4.800	2.191	2.333	2.465	2.666
EU-new	**Lag**	**Zbar**	**Q_0.90**	**Q_0.95**	**Q_0.99**	**Ztilde**	**Q_0.90**	**Q_0.95**	**Q_0.99**
SSFexpenditure ~ AgeDepRate	1	**4.863**	3.909	5.221	9.733	**3.532**	2.786	3.812	7.344
	2	**2.215**	1.914	2.114	3.121	1.116	1.750	1.867	2.069
	3	0.556	2.865	3.011	3.338	0.955	2.297	2.396	2.562
AgeDepRate ~ SSFexpenditure	1	**23.708**	2.063	2.737	4.279	**18.281**	1.453	1.869	3.075
	2	1.201	3.142	3.176	3.241	1.289	2.656	2.679	2.725
	3	2.276	3.583	3.688	3.811	1.971	2.744	2.805	2.878

Notes: Zbar, Ztilde – statistics (7), (8); Q_0.90, Q_0.95, Q_0.99 – quantiles of Zbar and Ztilde statistics distribution, respectively, 0.90, 0.95 and 0.99.

Source: Own calculations.

Table 11

Results of the Granger's causality analysis in the panels for SSFbalance and AgeDepRate

EU	Lag	Zbar	Q_0.90	Q_0.95	Q_0.99	Ztilde	Q_0.90	Q_0.95	Q_0.99
SSFbalance ~ AgeDepRate	1	2.589	4.568	5.693	9.271	1.631	3.180	4.060	6.861
	2	2.152	2.367	2.596	2.910	0.875	2.307	2.468	2.689
	3	0.792	3.692	3.866	4.213	1.372	3.086	3.189	3.394
AgeDepRate ~ SSFbalance	1	**9.423**	2.338	2.882	3.928	**6.979**	1.491	1.887	2.679
	2	2.404	3.953	4.077	4.201	2.332	3.423	3.511	3.598
	3	3.762	4.911	5.002	5.143	3.127	3.806	3.860	3.943
EU-old		**Zbar**	**Q_0.90**	**Q_0.95**	**Q_0.99**	**Ztilde**	**Q_0.90**	**Q_0.95**	**Q_0.99**
SSFbalance ~ AgeDepRate	1	2.121	4.496	5.397	7.046	1.375	3.233	3.939	5.229
	2	**2.844**	1.764	1.974	2.487	1.541	1.670	1.824	2.073
	3	0.537	2.714	2.914	3.167	0.335	2.247	2.364	2.516
AgeDepRate ~ SSFbalance	1	**5.410**	3.098	3.885	5.375	**3.949**	2.140	2.755	3.921
	2	1.928	2.894	3.019	3.161	1.819	2.499	2.587	2.687
	3	3.187	3.590	3.700	3.853	2.535	2.774	2.838	2.929
EU-new		**Zbar**	**Q_0.90**	**Q_0.95**	**Q_0.99**	**Ztilde**	**Q_0.90**	**Q_0.95**	**Q_0.99**
SSFbalance ~ AgeDepRate	1	1.529	3.128	4.206	6.827	0.923	2.174	3.018	5.069
	2	0.146	2.098	2.291	2.552	0.341	1.916	2.051	2.236
	3	1.701	2.940	3.071	3.388	1.632	2.364	2.441	2.628
AgeDepRate ~ SSFbalance	1	**7.970**	1.795	2.020	3.261	**5.964**	1.570	1.730	2.278
	2	1.463	2.940	3.012	3.127	1.473	2.508	2.564	2.644
	3	2.113	3.524	3.592	3.707	1.875	2.709	2.749	2.817

Notes: Zbar, Ztilde – statistics (7), (8); Q_0.90, Q_0.95, Q_0.99 – quantiles of Zbar and Ztilde statistics distribution, respectively, 0.90, 0.95 and 0.99.

Source: Own calculations.

On the basis of the results shown in Tables 3–11, it can be concluded that there is Granger causality between some of the variables in the panel sets at the 0.10 significance level.

5. Discussion

The causality study provides insight into how past decisions about certain categories influenced the level of other categories in the past. Evidence for two-way causality suggests that there is a relationship between one category and another,

so that the hypothesis cannot be rejected that changes in one result in changes in the other, and vice versa. On the other hand, evidence of one-sided causality suggests that changes in one category result in changes in the other. Finally, evidence that there is no significant causal link means that changes in one category do not necessarily change the other. In the area studied, demonstrating Granger causality entails having to prove the relationship between SSF components and macroeconomic variables.

With regard to the detailed hypotheses, two-way Granger causality between the SSF and UnemplRate was observed in five out of nine cases. Five out of nine observations confirmed two-way Granger causality between the SSF and Inflation. And two out of nine observations confirmed two-way Granger causality between SSF and AgeDepRate. A synthetic approach to the demonstrated Granger causal relationships is shown below (Tables 12–14).

Table 12

Granger test results for SSF and Unemployment Rate components – synthetic approach

Group	**SSFrevenue**/ΔSSFrevenue	**SSFexpenditure**	**SSFbalance**
EU	ΔSSFrev ← UnemplRate***	SSFexp ← UnemplRate***	
	ΔSSFrev → UnemplRate***	SSFexp → UnemplRate**	SSFbalance → UnemplRate***
EU-old	SSFrev ← ΔUnemplRate*	SSFexp ← ΔUnemplRate*	SSFbalance ← ΔUnemplRate**
	SSFrev → ΔUnemplRate*		
	ΔSSFrev → ΔUnemplRate*		
EU-new	ΔSSFrev ← UnemplRate***	SSFexp ← UnemplRate***	SSFbalance ← UnemplRate*
	ΔSSFrev → UnemplRate***	SSFexp → UnemplRate**	

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: Own calculations.

Table 13

Granger test results for SSF and Inflation Rate components – synthetic approach

Group	**SSFrevenue**/ΔSSFrevenue	**SSFexpenditure**	**SSFbalance**
EU	ΔSSFrev ← Inflation***	SSFexp ← Inflation***	SSFbalance ← Inflation**
		SSFexp → Inflation***	SSFbalance → Inflation*
EU-old	SSFrev ← Inflation**	SSFexp ← Inflation***	SSFbalance ← Inflation**
	SSFrev → Inflation*		
	ΔSSFrev ← Inflation***		
EU-new	ΔSSFrev ← Inflation**	SSFexp ← Inflation***	SSFbalance ← Inflation*
		SSFexp → Inflation***	SSFbalance → Inflation**

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: Own calculations.

Table 14

Granger's test results for SSF and Age Dependence Rate components – synthetic approach

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

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: Own calculations.

Granger causality occurs in 25 pairs of variables studied. One-way Granger causality was proven in 13 pairs tested, and two-way Granger causality was demonstrated in 12 pairs of variables. The Granger causal relationship was not observed in two cases. Granger causality occurs under each observation, except for the SSF revenue and AgeDepRate. One-way causality (at least), from macroeconomic variables to the SSF, was observed in 19 pairs. At most, one-way causality takes place from macroeconomic variables to the SSF. This direction was observed in seven pairs (Unemployment and Inflation). At most, one-way causality from individual SSF components to macroeconomic variables was observed in the case of AgeDepRate (five pairs of variables). One-way causality from macroeconomic variables to the SSF occurred in eight/nine (Unemployment to SSF), nine/nine (Inflation to SSF) and two/nine (AgeDepRate and SSF). One-way causality from the SSF to a given macroeconomic variable occurred in six pairs under the SSF to Unemployment, five in the SSF to Inflation, and seven in the SSF to AgeDepRate.

In the EU, the two-way Granger cause-and-effect relationship has been observed most frequently between income and expenditure as well as the unemployment rate, and between expenditure and balance as well as the inflation rate. Therefore, it is significant for political decision-makers that assessing the labour market should be leading in forecasting the SSF finances, which is contrary to the case of inflation, which changes the level of public income and expenditure through valorisation mechanisms and the tax base. Forecasting the financial situation of the SSF should therefore primarily be based on past labour market figures. In turn, the demographic index and fiscal values more frequently show a one-way cause-and-effect relationship in the Granger sense from fiscal variables to the AgeDepRate index. As a result, forecasting the relationship between working-age

and non-working-age people can be based on expenditure and SSF balance data. This is noteworthy in the context of unfavourable demographic processes whose impact will strongly affect the long-term functioning of European countries.

It is also thought-provoking that in EU-old, two-way Granger causality occurs most often in the case of SSF revenue and every one of the macroeconomic variables. In EU-new, by contrast, two-way Granger causality occurs most often in the case of SSF expenditure and all macroeconomic variables. Taking all this into account makes it very difficult to provide an unambiguous answer in terms of the causes of the observed differences. This is because it is not only systemic and institutions solutions that are subject to change over time, but also the current policy, the size of the output gap, the employment structure and the scope of allocation and redistribution are at the core. Additionally, the public sector in the EU-old group plays a greater role in financing social protection and stimulating the economy than the private sector. The research results should therefore be treated with caution, as the way(s) in which automatic stabilizers are affected by system solutions can differ. In some countries, benefits form part of the basis on which insurance premiums are calculated and deducted. Assessment is further hampered by different solutions that make insurance premiums non-compulsory above a certain income threshold (specified by law) and other restrictions on e.g. the annual premium basis for business owners. Income and expenditure sensitivity to economic changes is also significant. It is higher in the case of income in EU-new countries. The greater the flexibility, the stronger the impact of automatic economic stabilizers on the condition of the economy. The discretionary policy, resulting in lower insurance rates, or the introduction of measures to reduce the tax base, may consequently affect the flexibility of specific categories. Thus, the claim that a Granger causal relationship depends on the size of the variables, which here includes the size of the social security sector, should be negated. The presented empirical data on the size of the social security sector and its financial condition thus reflect the nature of the economic policy implemented in EU member states.

The obtained results concerning the Granger cause-and-effect relationships between financial and economic categories compel the conclusion that the observed interrelationships are not incidental. That is because at the core are system solutions that are permanently inscribed in the architecture of modern economies. This, in turn, allows decision-makers to distinguish between random factors that trigger rapid changes and cyclical ones. This applies to both the EU-new and EU-old countries. Importantly, proven Granger causality is observed throughout the period covered by the research. In the changing socio-economic conditions, the current values of the financial categories that make up the balance of the social security sector enable more precise predictions, especially by taking into account past values regarding the situation on the labour market, as well as price fluctuations, and vice versa. Thus, the applicable system regulations are not limiting, and regulating the economic situation with built-in flexibility may stabilize the economy. The course chosen so far by political decision-makers is accurate, and consequently helps maintain financial stability.

Conclusions

The results of the Granger test indicate that the causation study of macroeconomic variables and the SSF has empirical justification. The research confirmed the lack of uniformity of the obtained results raised in the literature on the subject, and only partially confirms the hypotheses. Nevertheless, the inclusion of selected macroeconomic variables in the model predicting the values of the components shaping the SSF, and vice versa, increases the accuracy of the prediction. This was especially noticeable with regard to inflation and unemployment. On the other hand, the forecasting of macroeconomic indicators can be improved by taking expenditure and SSF revenue into account. This is particularly important in forecasting unemployment and applies to all the studied groups of EU member states. What is most interesting, however, is that SSF revenue should be factored into the forecasting model for EU-old, but not EU-new. The most common two-way relationships observed in this latter group related to expenditure. This means that forecasting the SSF financial situation and macroeconomic indicators in EU-new should take SSF expenditure into account.

Studies have shown that the formation of the SSF financial figures is to be attributed to the variability in the macroeconomic environment. And the inclusion of social security expenditure in EU member states in the model predicting the formation of the AgeDepRate variable is especially justified. And while the inclusion of macroeconomic variables in forecasting SSF revenue and expenditure is justified and does not raise any major doubts, research has shown that there is a relationship between macroeconomic indicators, particularly those that reflect the pressure on the productive population. It is such that financial variables relating to the SSF should be taken into account when forecasting the population structure, mostly in EU-old. In fact, the studied variables may have a stabilizing effect on each other.

References

Afonso, A., Rault, Ch. (2009). Bootstrap panel Granger-causality between government spending and revenue in the EU. *Working Paper*, 944.

Agell, J., Lindh, T., Ohlsson, H. (1997). Growth and the public sector: A critical review Essay. *European Journal of Political Economy*, *13*(1), 33–52.

Albin, P. S., Stein, B. (1977). The Impact of Unemployment on Welfare Expenditures, *ILR Review*, *31*(1), 31–44, https://www.jstor.org/stable/2522507 (accessed 20 June 2021).

Bağdigen, M., Çetintaş, H. (2003). Causality between Public Expenditure and Economic Growth: The Turkish Case. *Journal of Economic and Social Research*, *6*(1), 53–72.

Barro, R. J. (1989). The Ricardian approach to budget deficits. *Journal of Economic Perspectives*, *3*, 37–54.

Bellettini, G., Ceroni, C. B. (1999). Is Social Security Really Bad for Growth?. *Review of Economic Dynamics*, *2*(7), 96–819.

Blanchard, O., Perotti, R. (2002). An Empirical Characterization of the Dynamic Effects of Changes in Government Spending and Taxes on Output. *The Quarterly Journal of Economics*, *117*(4), 1329–1368.

Cammeraat, E. (2020). The relationship between different social expenditure schemes and poverty, inequality and economic growth. *International Social Security Review*, *73*(2), 101–123.

Connolly, M., Li, Ch. (2016). Government spending and economic growth in the OECD Countries. *Journal of Economic Policy Reform*, *19*(4), 386–395.

Croissant, Y., Millo, G. (2008). Panel Data Econometrics in R: The plm Package. *Journal of Statistical Software*, *27*(2), 1–43.

Cuaresma, J. C. (2003). Okun's Law Revisited. *Oxford Bulletin of Economics and Statistics, 65*(4).

Dudzevičiūtė, G., Šimelytė, A., Liučvaitienė, A. (2018). Government expenditure and economic growth in the European Union countries. *International Journal of Social Economics*, *45*(2), 372–386.

Dumitrescu, E. I., Hurlin, C. (2012). Testing for Granger non-causality in heterogeneous Panels. *Economic Modelling*, *29*, 1450–1460.

Eslava, M. (2011). The Political Economy of fiscal deficits: A Survey. *Journal of Economic Surveys*, *25*(4), 645–673.

Eurostat (2020). *Database*. https://ec.europa.eu/eurostat/data/database (accessed 2 December 2020).

Friedman, M. (1977). Nobel Lecture: Inflation and Unemployment. *Journal of Political Economy*, (3).

Gechert, S., Paetz, C., Villanueva, P. (2021). The macroeconomic effects of social security contributions and benefits. *Journal of Monetary Economics*, *117.*

Jabłecka, A., Jędrzejowicz, T. (2015). Wpływ zmian inflacji na finanse publiczne i politykę fiskalną w Polsce. *Materiały i Studia*, *321.* [The effect of inflation on public finances and fiscal policy in Poland. *Materials and Studies*, *321*].

Kneller, R., Bleaney, M. F., Gemmel, N. (1999). Fiscal policy and growth: evidence from OECD countries. *Journal of Public Economics*, *74*, 171–190.

Lambrecht, S., Michel, P., Vidal, J. P. (2005). Public pensions and growth. *European Economic Review*, *49*, 1261–1281.

Lopez, L., Weber, S. (2017). Testing for Granger causality in panel data. *IRENE Working Paper*, (17-03), 1–13.

Malmberg, B. (1995). Age structure effects on economic growth: Swedish evidence. *Scandinavian Economic History Review*, *42*, 279–295.

OECD (2019). *Society at a Glance 2019: OECD Social Indicators*. Paris: OECD Publishing.

Pesaran, M. H. (2004). General diagnostic tests for cross section dependence in panels. *CESifo Working Paper*, (1229), 0–40.

Pesaran, M. H. (2007). A simple panel unit root test in the presence of cross-section Dependence. *Journal of Applied Econometrics*, *22*, 265–312.

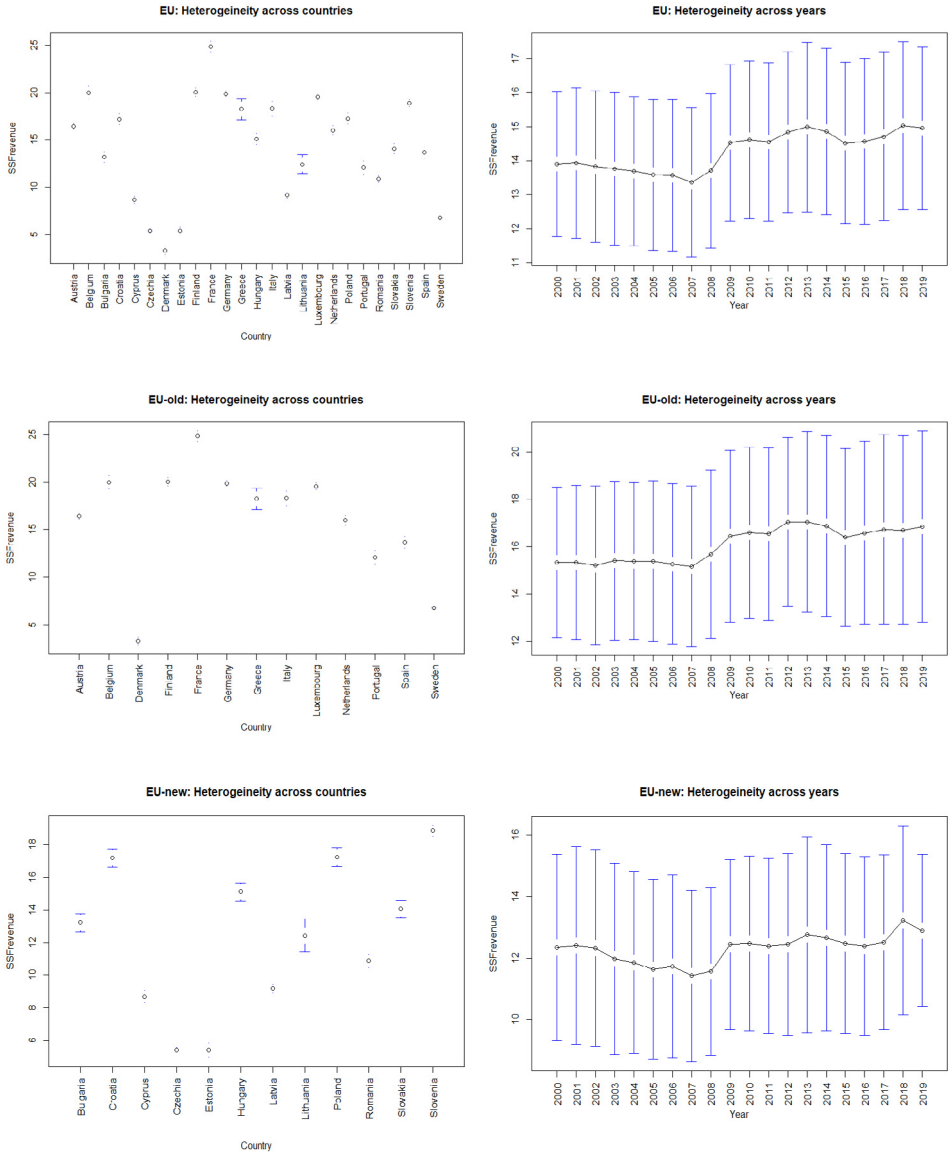
Zhang, J., Zhang, J. (2014). How Does Social Security Affect Economic Growth? Evidence from Cross-Country Data. *Journal of Population Economics*, *17*(3), 473–500.

Appendix

Fig. 1

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

Countries **Years**

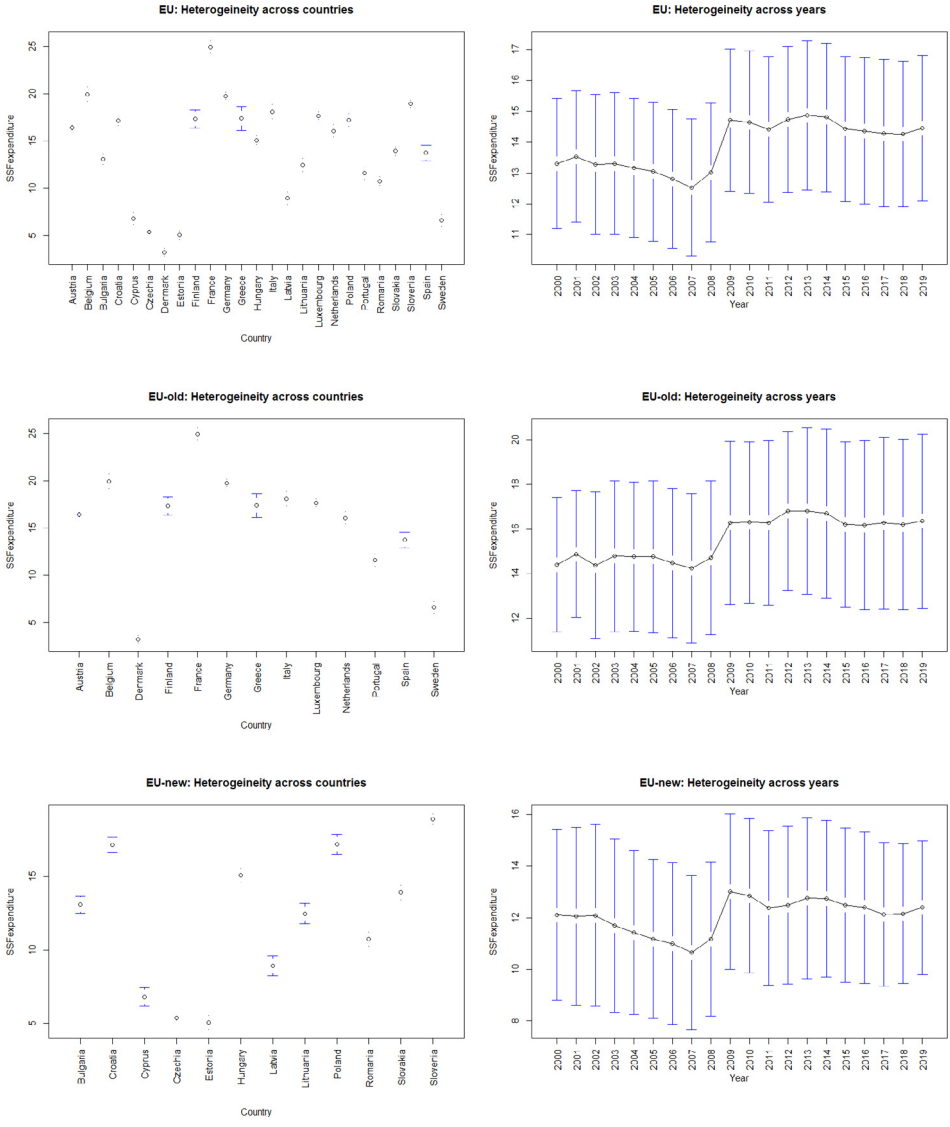


Source: Authors'calculations based on Eurostat data.

Fig. 2

Expenditure of the SSF in the EU countries, 2000–2019 (% GDP)

Countries Years

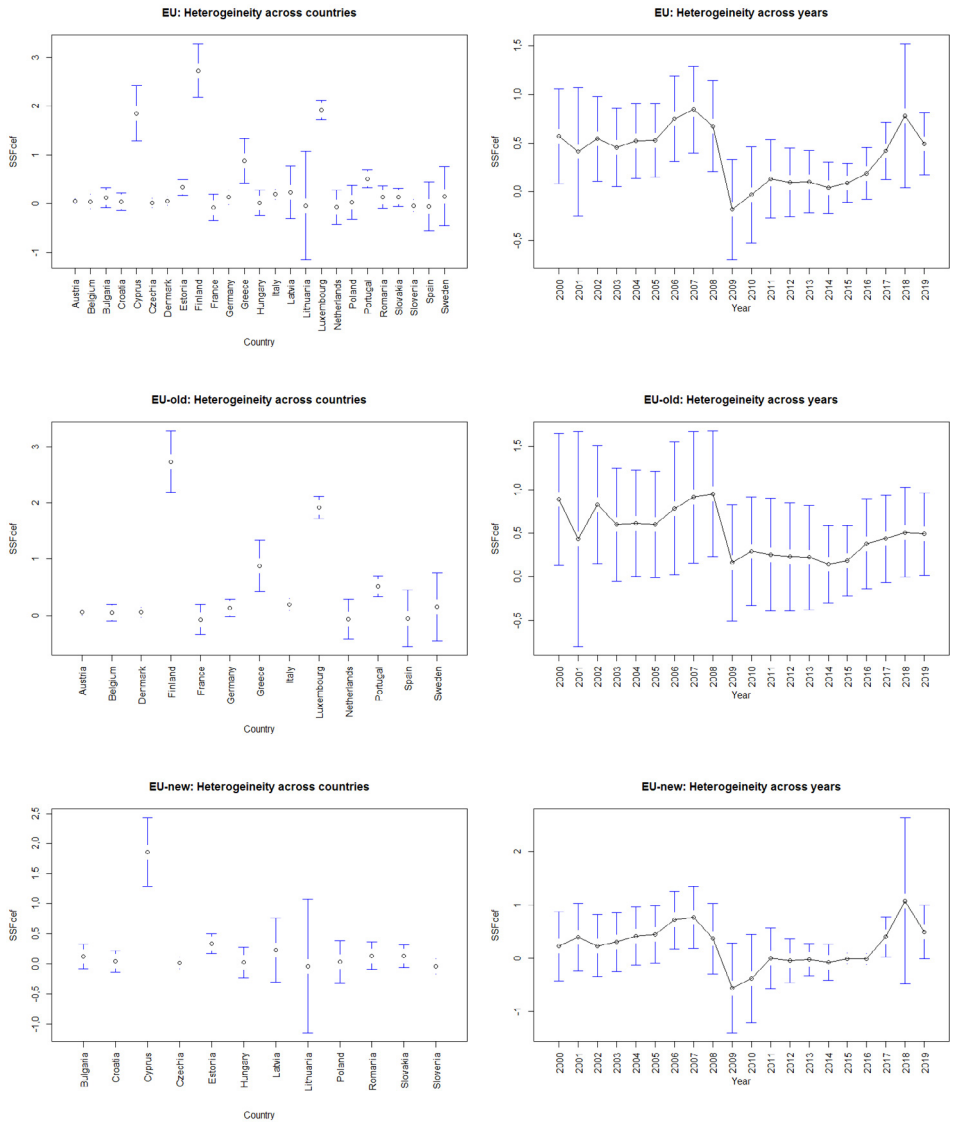


Source: Authors'calculations based on Eurostat data.

Fig. 3

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

Countries Years

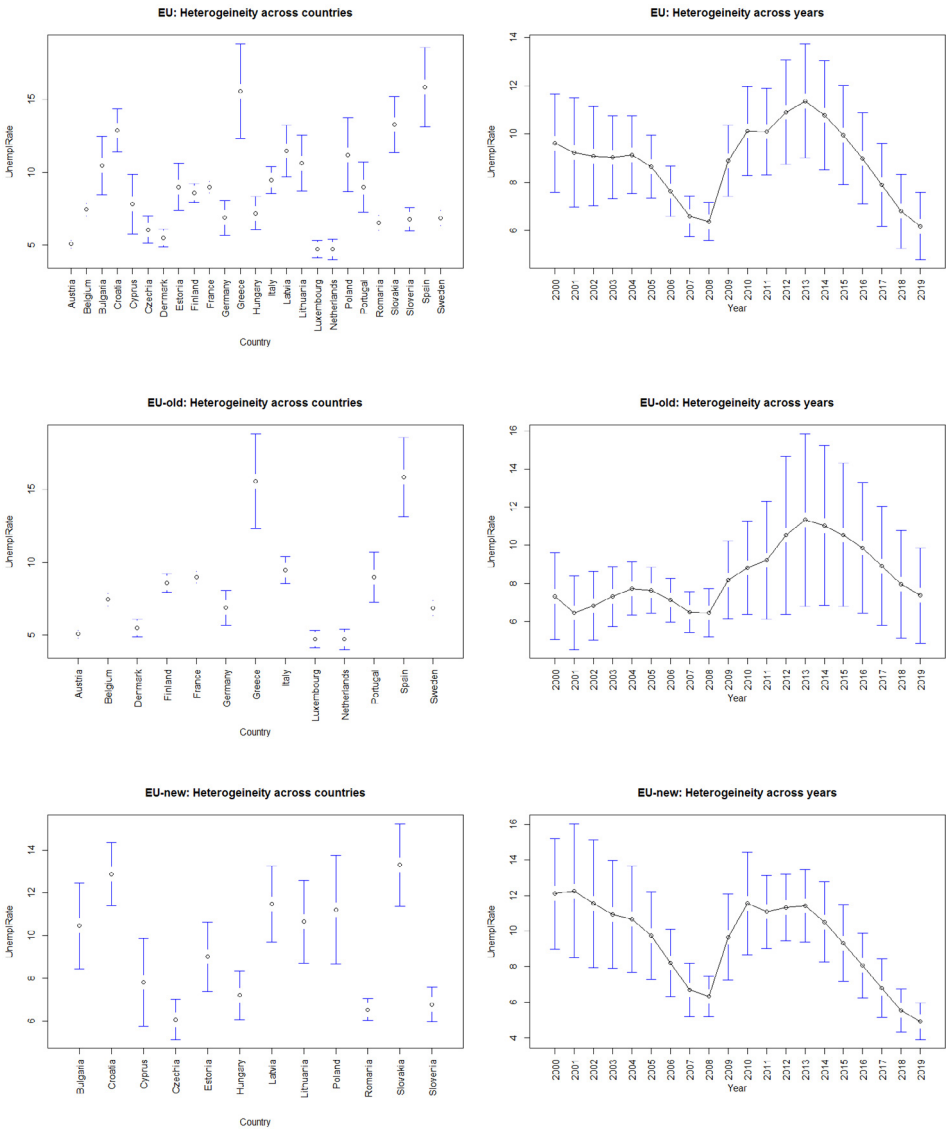


Source: Authors'calculations based on Eurostat data.

Fig. 4

Unemployment Rate in the EU countries, 2000–2019 (%)

Countries **Years**

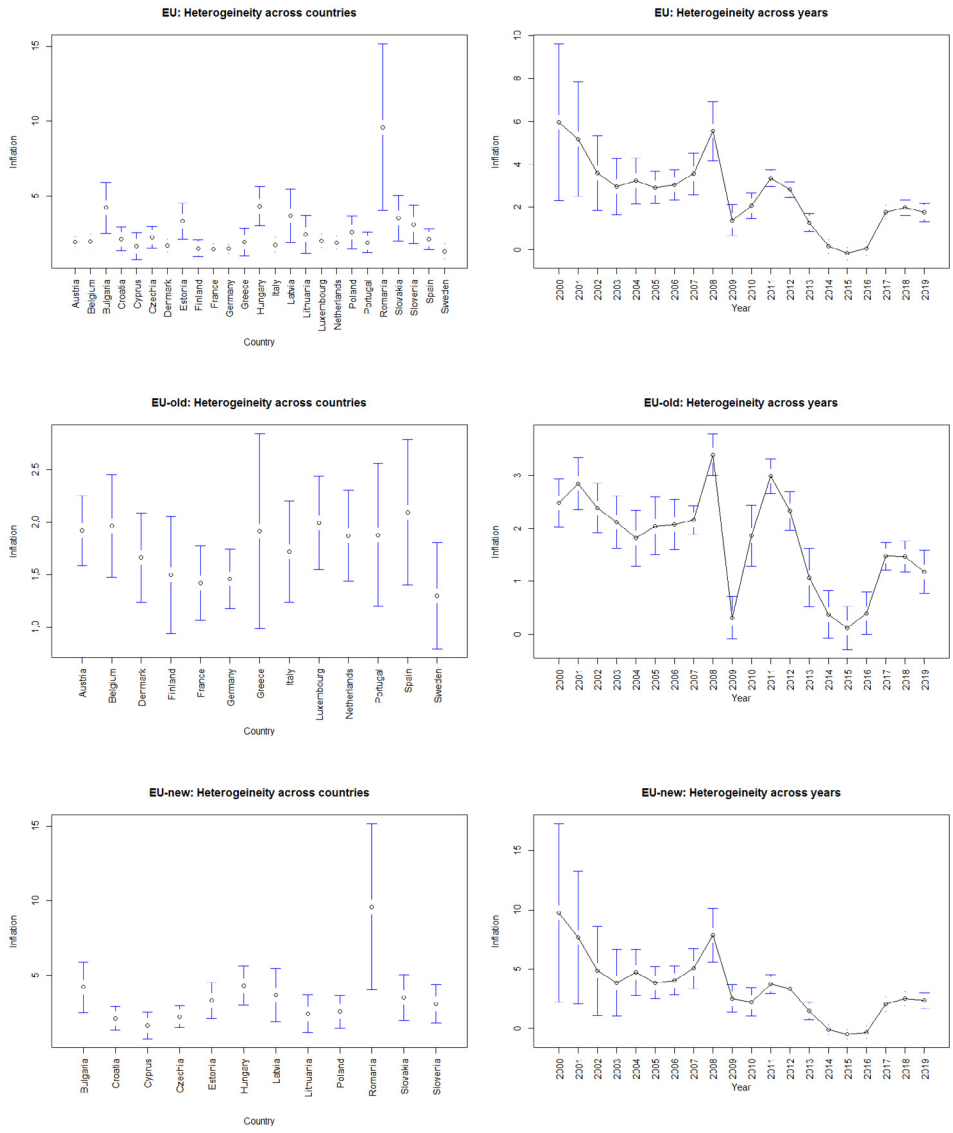


Source: Authors'calculations based on Eurostat data.

Fig. 5

Inflation Rate in the EU countries, 2000–2019 (%)

Countries **Years**

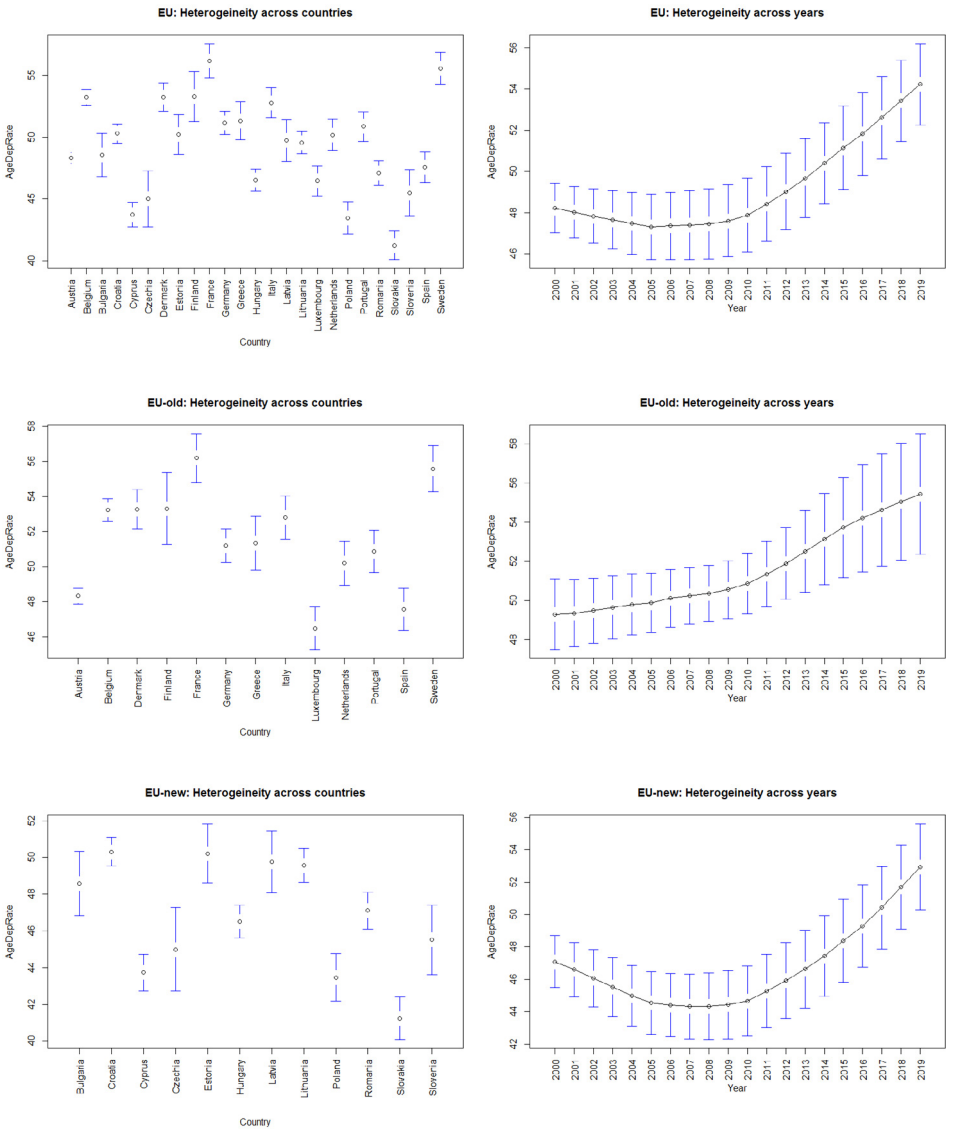


Source: Authors'calculations based on Eurostat data.

Fig. 6

Age Dependence Rate in EU countries, 2000–2019 (%)

Countries **Years**



Source: Authors'calculations based on Eurostat data.

WHAT WE KNOW AND WHAT WE DO NOT KNOW ABOUT SOCIAL SECURITY FINANCE AND MACROECONOMIC STABILIZATION. EVIDENCE FROM EU COUNTRIES

Abstract

This study examines those variables that affect social security finances and those that affect the macroeconomic situation in the EU countries with a view to enabling stability to be maintained under changing conditions. A retrospective analysis, the bootstrap panel Granger causality test, the Pesaran CD test for cross-sectional dependence in panels and Pesaran's CIPS test for unit roots in panels were employed to this end. These methodological tools were applied to panel data of EU countries. The research period was from 2000 to 2019 inclusive. The results reveal that the inclusion of selected macroeconomic variables in the model that predicts the values of the components that shape social security finances, and vice versa, increases the accuracy of the prediction. It is confirmed that the studied variables have a mutually stabilizing effect. This is essential for increasing the adaptability of social security systems to changing conditions and ensuring the long-term stability of financing benefits. This discovery is what distinguishes this study from those conducted on general government finance; two-way causal relationships in this field have never before been verified.

Keywords: fiscal policy, social funds, macroeconomic factors, Granger causality

JEL: E62, H60, C33

CO WIEMY, A CZEGO NIE WIEMY O FINANSACH UBEZPIECZEŃ SPOŁECZNYCH I STABILIZACJI MAKROEKONOMICZNEJ. DOŚWIADCZENIA PAŃSTW UE

Streszczenie

Niniejsze badania mają na celu zweryfikowanie, jakie zmienne wpływają na finanse sektora ubezpieczeń społecznych i sytuację makroekonomiczną w krajach UE w taki sposób, aby umożliwiały utrzymanie stabilności w zmieniających się warunkach. W badaniach zastosowano: metodę analizy retrospektywnej oraz bootstrapowy test przyczynowości w sensie Grangera dla danych panelowych, test Pesarana CD na występowanie zależności przekrojowej w danych panelowych i test Pesarana CIPS pierwiastka jednostkowego dla danych panelowych. Badanie opiera się na danych panelowych dotyczących krajów UE. Okres badawczy: 2000–2019. Wyniki badań wskazują, że uwzględnienie wybranych zmiennych makroekonomicznych w modelu prognozującym wartości składników kształtujących finanse sektora ubezpieczeń społecznych i odwrotnie zwiększa trafność predykcji. Potwierdzono, że badane zmienne mogą mieć na siebie wpływ stabilizujący. Jest to niezbędne dla zwiększenia adaptacyjności systemów zabezpieczenia społecznego do zmieniających się warunków oraz zapewnienia stabilności finansowania świadczeń w długim okresie. Koncepcja ta odróżnia niniejsze badanie od badań prowadzonych w obszarze finansów sektora instytucji rządowych i samorządowych, gdyż dotychczas nie weryfikowano empirycznie dwukierunkowych związków przyczynowych w tym obszarze.

Słowa kluczowe: polityka fiskalna, fundusze społeczne, czynniki makroekonomiczne, przyczynowość w sensie Grangera

JEL: E62, H60, C33