The Relationships between Social Security Funds and Macroeconomic Changes. An Empirical Analysis of the EU-CEE Countries

Zależności między funduszami zabezpieczenia społecznego a zmianami makroekonomicznymi. Analiza empiryczna dla państw Europy Środkowo- -Wschodniej należących do Unii Europejskiej

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ABSTRACT

Objective: This paper investigates whether and which of a set of macroeconomic variables may be a Granger cause for changes in the financing of the social security sector, and *vice versa*.
Research Design & Methods: Descriptive statistics, the bootstrap panel Granger causality test, and Pesaran CD test for cross-sectional dependence in panels and Pesaran's CIPS test for

unit roots in panels were applied. Panel data of the CEE countries, which are members of the European Union, was used. The research period was 2000–2019.

Findings: It was determined that lagged values of macroeconomic indicators can improve forecasting of social security sector expenditure. In turn, understanding the social security sector's expenditure may contribute to better forecasting of the macroeconomic indicators considered for the research.

Implications/Recommendations: Maintaining stable economic growth may contribute to the financial stability of the social security system.

Contribution: The research is the first to refer to the financing of the social security sector. The study provides a framework that takes full account of the main elements of social security systems and associates them with the most significant macroeconomic indicators.

Article type: original article.

Keywords: social security, growth, unemployment, inflation, Granger.

JEL Classification: H55, H60, E30, C33.

STRESZCZENIE

Cel: Ustalenie, czy i które zmienne makroekonomiczne mogą być przyczyną w sensie Grangera zmian finansów sektora ubezpieczeń społecznych i odwrotnie.

Metodyka badań: Zastosowano narzędzia statystyki opisowej, bootstrapowy test przyczyno-wości 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. Wykorzystano dane panelowe dotyczące państw Europy Środkowo-Wschodniej, które są członkami Unii Europejskiej. Badania obejmują lata 2000–2019.

Wyniki badań: Z przeprowadzonych badań wynika, że opóźnione wartości wskaźników makroekonomicznych mogą poprawić prognozę wydatków sektora ubezpieczeń społecznych, a uwzględnienie jego wydatków może przyczynić się do lepszego prognozowania rozważanych wskaźników makroekonomicznych.

Wnioski: Utrzymanie stabilnego wzrostu gospodarczego może pozytywnie wpłynąć na stabil-ność finansową sektora ubezpieczeń społecznych.

Wkład w rozwój dyscypliny: Proponowana koncepcja badań jest pierwszą, która odnosi się do finansów sektora ubezpieczeń społecznych. W badaniu uwzględniono główne elementy systemów zabezpieczenia społecznego, wiążąc je z najważniejszymi wskaźnikami makroeko-nomicznymi.

Typ artykułu: oryginalny artykuł naukowy.

Słowa kluczowe: zabezpieczenie społeczne, wzrost, bezrobocie, inflacja, przyczynowość w sensie Grangera.

1. Introduction

The research presented herein examines the public system, one of the most important pillars of social security in EU countries. Countries that since 1989 and throughout the 21st century have reformed the state social policy were chosen for the study. Alongside their increasing wealth, these countries' social and welfare functions have taken on greater significance. At the same time, they currently bear higher social security costs due to income and expenditure instability in the social security sector as well as relatively volatile changes in GDP. In the EU-CEE countries, the ratio of income to expenditure of the social security sector has been considerably diversified, with periods of building financial stability intertwined with years when expenditure exceeded income.

The research drew on a bootstrap approach in the Granger causality test. It was assumed that the recognition of Granger causality concerning social security financing and the most significant macroeconomic variables may contribute to a better understanding of the relationship and interdependence between the phenomena represented by these variables, which in turn should improve the quality of forecasts as well as foster planning and effective socio-economic policy, therefore stabilising the fiscal situation of the social security sector.

The purpose of the research is to determine whether and which of the macroeconomic variables under consideration may be a Granger cause for changes in individual components of the social security sector, and *vice versa*. Whether and which of the fiscal components of the social insurance sector may be a Granger cause for changes in macroeconomic variables.

The following hypotheses were investigated:

H1a: There is a two-way Granger causality between the income of the social security sector and real GDP.

H1b: There is a two-way Granger causality between the income of the social security sector and the unemployment rate.

H1c: There is a two-way Granger causality between the income of the social security sector and the inflation rate.

H2a: There is a two-way Granger causality between the expenditure of the social security sector and real GDP.

H2b: There is a two-way Granger causality between the expenditure of the social security sector and the unemployment rate.

H2c: There is a two-way Granger causality between the expenditure of the social security sector and the inflation rate.

H3a: There is a two-way Granger causality between the balance of the social security sector and real GDP.

H3b: There is a two-way Granger causality between the balance of the social security sector and the unemployment rate.

H3c: There is a two-way Granger causality between the balance of the social security sector and the inflation rate.

The research covers the period 2000–2019, and the method used in the research called for panel data to be used. The paper is structured as follows. The second chapter presents the framework used for the theoretical research. The third chapter characterises the research area. The fourth chapter presents the variables used in the research along with the research methodology. The test results are documented in Chapter Five and Chapter Six provides conclusions.

2. Literature Review

The subject of our research is a part of public sector economics theory, which has yet to clearly resolve the controversy over the influence of the state on the market and the market on the state. Representatives of the classical economy concentrated on this problem, as they, being supporters of liberalism, conservatism or Marxism, interpreted their mutual relations in various ways. According to Smith (1812), the source of all wealth is human productive labour, while the path to social welfare runs through maximising free market exchange. The extent of state intervention should therefore be reduced to a minimum. However, there were different voices among the proponents of this theory. Some were in favour of maintaining a minimum of political regulation, considering it beneficial for the economy, while others sought to provide no social protection at all.

Representatives of neoliberal ideology (Tanzi 2015), on the other hand, interpreted the economic role of the state in the light of the constant struggle between collectivism and individualism. They claimed that expanding the scope of power is collectivist in nature, and hence is, *a priori*, an attack on freedom. Of a similar opinion, representatives of contemporary neoliberalism maintain that state intervention that goes beyond the necessary minimum may only weaken the effects of the market mechanism and become a source of economic ineffectiveness. Disagreeing with Friedman, Keynes questioned classical economic thought, assuming that the state insists on solving social problems and, basing its response on the welfare state model, guarantees a wide range of social rights. At the same time, government expenditure increases aggregate demand, which in turn stimulates economic activity, reducing unemployment and deflation. A suitable fiscal policy can therefore ensure economic growth (Keynes 1936). Supporters of the Wagner's view, in contrast, argue that it is socio-economic development that determines increased state expenditure (Musgrave & Musgrave 1989). Meanwhile, Wagner himself concluded that a cause-and-effect relationship between economic development and government activity does not necessarily exist and explained that the existence of cointegration does not imply causality (Peacock & Scott 2000). He also disagreed that market exchange is the only and basic condition for economic effectiveness. Therefore,

neither theoretical science nor empiricism provide clear evidence of which theory is fully reflected in practice. Some studies support the belief that the relationship between government expenditure and economic growth is consistent with Keynes's or Wagner's macroeconomic theories, while others deny it. The reasons for this can be traced to empirical differences arising from, for example, the database used, the degree of time aggregation, or theoretical and methodological differences.

Influencing the economy through various channels and causing various effects through the fiscal multiplier (Mineshima, Poplawski-Ribeiro & Weber 2014), state finances bring about fiscal strengthening and economic growth. While the latter two go hand in hand, state finances themselves are sometimes treated with too much optimism. Among the factors determining, for example, the level of professional activity, economic factors play a decisive role. According to the neoclassical model of the allocation of work and free time, these factors depend on individual decisions about starting work, when one works and has free time (Cahuc & Zylberberg 2004). Auerbach, Gale and Harris (2010) argue that the effectiveness of fiscal interventions aimed at stimulating and stabilising the economy has come in for debate. Income, expenditure and balance – the basic tools of macroeconomic stabilisation – help determine the inflation rate and the level of economic activity. They affect the consumption rate, savings and investment (Mankiw & Taylor 2014). Science has proven that the complexity of the mechanisms that govern the economy, however, causes interdependencies between the most significant macroeconomic categories (Cuaresma 2003). Therefore, the policy of stimulating global demand may cause inflation to rise. In turn, the policy of inhibiting aggregate demand may lead to higher unemployment. The above categories are among the areas studies address empirically (Samudram, Nair & Vaithilingam 2009, Cloyne 2013, Gechert 2015), as well as in the context of social security insurance, which is part of the public sector.

Gechert, Paetz and Villanueva (2021) showed that expansive changes in social security have a positive short- and medium-term effect on GDP. The team concluded that the social protection system and legislative changes are, due to their sheer size, likely to be important for macroeconomic dynamics. Meanwhile, Cammeraat (2020) showed that public social expenditure do not have a significant relationship with an increase in GDP. Connolly and Li (2016) concluded that an increase in public social expenditure has a significant, but negative, impact on economic growth. Lindert (2004a, 2004b) presented contradictory conclusions: while observing a significant positive correlation between social security and economic growth, they nonetheless believe that the causality remains unclear. Similarly, Zhang and Zhang (2014) show that social security expenditure tends to stimulate growth, but growth does not seem to change the ratio of social security contributions or benefits to income. Lambrecht, Michel and Vidal (2005) note that with regard to purely redistributive policies, two opposing effects work. They explain that while

public pensions increase investment in human capital, it does reduce the saving, constraining this growth. The institution of an intergenerational transfer mechanism, however, can provide adequate incentives to support a growth-oriented policy, which in turn fosters economic growth, according to Bellettini and Ceroni (1999).

We considered it necessary to carry out research that has not previously been undertaken. There are several reasons for this. First, the finances of the social security sector are also influenced by cyclical and structural factors, and their impact is varied; second, the impact of inflation on the balance of the public finance sector is complex and multi-channeled; and, finally, unexpected changes in inflation, through their impact on the level of restrictive fiscal policy, may hinder the conduct of economic policy. The study of relationships in finances and macroeconomic indicators that would help predict changes in national income and / or *vice versa* is of general scientific interest, but it is usually limited to studies of relationships in income and expenditure (Manage & Marlow 1986); public expenditure and national income (Afonso & Rault 2009); unemployment and inflation (Bhattarai 2016); inflation and GDP (Bruno & Easterly 1998) and unemployment and GDP (Zagler 2004). This article fills a gap in the literature with new empirical evidence.

3. Research Focus

In the countries of the EU-CEE, social security is an element of the general government sector. As a subsector, social security consists of social security funds (SSF), which cover of all social security units. SSF income and expenditures belong to the income and expenditure of the GG sector. Social benefits are financed primarily from social contributions paid by employees and employers. In the period 2000–2019, the income of the SSF accounted for about 34% of GG sector income. The main purpose of the SSF is to provide social benefits, while the expenditure of the SSF is a component of the social protection expenditure. The expenditure of the SSF averaged almost 32% of the GG expenditure over the period 2000–2019 (available at https://ec.europa.eu/eurostat/web/main/data/database, accessed: 20.09.2021).

For the present research we took into account the main components of the SSF financing and macroeconomic variables, including GDP, the unemployment rate and inflation. Analysis of SSF financial data leads to several crucial observations (available at https://ec.europa.eu/eurostat/web/main/data/database, accessed: 20.09.2021):

– SSF sector income in the EU-CEE countries is relatively low – about 8% (average) in nominal terms of the income of this sector in other EU countries. It constitutes 12.6% of GDP. Income grows slowly and is subject to slight fluctuations. In 2007, it decreased slightly relative to GDP. It then increased, keeping it slightly above GDP in the years that followed. No major differentiation in income was observed relative to specific years of the period under examination;

– the expenditure of the SSF measured in relation to GDP averaged 12.5% over the entire period. That expenditure is characterised by high growth starting from 2007 and was maintained in the years that followed. The good economic situation preceding the crisis of 2009 was conducive to increased expenditure. In the EU-CEE, SSF expenditure fluctuated dramatically and in nominal terms was relatively low with a slow rate of growth;

– the balance of the SSF is relatively low and negative, ranging from –4.4% to 0.3% of GDP. In most EU-CEE countries, the balance of the SSF to GDP (on average) was positive. As a result of the crisis of 2009, the overall financial situation of the SSF in the EU-CEE countries worsened, while in nominal terms the balance decreased. In only a few countries did a slight improvement occur in the financial situation of the SSF after 2009 (Czechia, Croatia, Hungary, Poland). Bulgaria and Estonia were characterised by a good financial situation in this sector throughout the research period. In turn, Hungary and Slovakia returned the highest negative values.

The financial condition of the SSF is determined by, among other issues, cyclical changes in the economic situation, which in the EU-CEE countries during the period under analysis was characterised by major differentiation. The visible collapse that occurred in 2009 was accompanied by deterioration in financial situation of the SSF. In turn, the collapse of 2012 did not cause any significant changes in the balance of the SSF. And the gradual improvement of the economic situation after 2010, and in particular in 2017, was reflected in the improvement of the balance of the SSF. Along with the changes in the economic situation, the unemployment rate was subject to fluctuations characteristic of Okun's Law. In the period 2000–2005 high level of unemployment was accompanied by high level of inflation. And despite the increase in economic activity, inflation in the following years remained at a similar level (available at https://ec.europa.eu/eurostat/web/main/data/database, accessed: 20.09.2021). These observations became the basis of the research.

4. Data and Methodology

4.1. Data

The countries of Central and Eastern Europe that share common historical, economic and social characteristics were selected for the research. All are part of the former Eastern bloc and socialist states, and all have joined the EU in the 21st century. Characterised by a similar level of wealth, none of the countries fulfill the features of a model welfare state as expressed in the Esping-Andersen (1999) typology of the three worlds. EU-CEE countries are similar insofar as the relation of social expenditure to GDP is lower there than in the conservative or social democratic welfare regimes.

We used the following variables:

– SSFrevenue – total general government revenues of social security funds (% GDP),

– SSFexpenditure – total general government expenditures of social security funds (% GDP),

– SSFbalance – net lending (+)/net borrowing (–) of social security funds (% GDP),

– GDPgrowth – gross domestic product at market prices,

– UnemplRate – unemployed persons as a percentage of the labour force (aged 15 to 64),

– Inflation – measured by the consumer price index (reflecting the annual percentage change in the cost to the average consumer of acquiring a basket of goods and services).

The main source of time series data is the Eurostat database.

4.2. Methodology

In empirical research based on panel data, it is recommended that the presence of cross-sectional dependence be checked. In the present analysis, the Pesaran CD test for cross-sectional dependence in panels (Pesaran 2004) was used.

If cross-sectional dependence in panel data is present in the test of the variables' stationarity, the second-generation panel unit root test should be used. This study used the Pesaran's CIPS test for unit roots in panels (Pesaran 2007).

The bootstrap panel Granger causality test (Dumitrescu & Hurlin 2012) was used in Granger causality analysis in panel data with cross-sectional dependence.

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

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

where $y_{i,t}$ is the value of the stationary variable Y for the ith object ($i = 1, …, N$) in the period t ($t = 1, …, T$), and $x_{i,t}$ is the value of the stationary variable X for the ith object ($i = 1, …, N$) in the period t ($t = 1, …, T$).

Following Dumitrescu and Hurlin (2012, p. 1451), the following assumptions were made: the individual effects α_i ($i = 1, …, N$) are to be fixed in 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) propose to test the Homogeneous Non-Causality hypothesis by considering both the heterogeneity of the regression model and that of the causal relation. The null hypothesis is defined as (Dumitrescu & Hurlin 2012, p. 1453):

$$H_0: \beta_i = 0 \quad \forall \quad i = 1, …, N \qquad (2)$$

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

$$H_1: \beta_i = 0 \ \forall \ i = 1, \dots, N_1 \quad \text{and} \quad \beta_i \neq 0 \ \forall \ i = N_1 + 1, N_1 + 2, \dots, N \quad (3)$$

where $\beta_i = \left(\beta_i^{(1)}, \dots, \beta_i^{(k)}\right)'$ and $0 \leq N_1 < N$.

Dumitrescu and Hurlin (2012) proposed to use the average of individual Wald statistics associated with the test of the non-causality hypothesis for the ith country ($i = 1, \dots, N$). The average statistic $W_{N,T}^{Hnc}$ associated with the null Homogeneous Non-Causality hypothesis is defined as (Dumitrescu & Hurlin 2012, p. 1453):

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

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

Dumitrescu and Hurlin (2012) proposed two statistics:

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

$$Z_{N,T}^{Hnc} = \sqrt{\frac{N}{2K}} \left(W_{N,T}^{Hnc} - K \right) \underset{T, N \to \infty}{\Longrightarrow} N(0,1) \quad (5)$$

often 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):

$$\tilde{Z}_N^{Hnc} = \sqrt{\frac{N}{2K} \cdot \frac{T - 3K - 5}{T - 2K - 3}} \cdot \left[\frac{T - 3K - 3}{T - 3K - 1} \cdot W_{N,T}^{Hnc} - K \right] \underset{N \to \infty}{\Longrightarrow} N(0,1) \quad (6)$$

often marked as $\tilde{Z}$ and referred to as the Ztilde statistic (Lopez & Weber 2017, p. 4). Statistics (6) is a modification (Lopez & Weber 2017, p. 4) of the original formula laid out in the work (Dumitrescu & Hurlin 2012, p. 1456).

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

The research procedure was as follows:

1. The model (1) for panel data was defined.

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

3. A model (1) for each country was estimated and statistics (5) and (6) were calculated.

4. 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 residual matrix with dimensions ($N \times T - K$) was determined.

5. The block bootstrap procedure was applied to the residual matrix. The residuals were resampled with replacement by considering a block of size 1 in time-series and size N in the panel dimension. Based on the results of the block bootstrap procedure, a new residual matrix was built.

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

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

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

8. Stages 5, 6 and 7 were repeated 999 times.

9. Based on the values of statistics (5) and (6) obtained in successive replications (stage 8), empirical critical values were calculated, corresponding to the quantiles (0.90, 0.95, 0.99, respectively) of the distribution of statistics (5) and (6) (taken in absolute value), assuming the null hypothesis of no-causality is true.

10. The values of the statistics obtained in stage 3 were compared with the empirical critical values calculated in stage 9.

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

5. Empirical Results

The empirical research started from checking whether there is cross-sectional dependence in the panel sets under analysis. For this purpose, Pesaran CD test for cross-sectional dependence in the panels was used. The results are presented in Table 1.

Table 1. Pesaran CD Test for Cross-sectional Dependence in the Panels (*p*-value)

Variable	CD test (*p*-value)
SSFrevenue	2.101e-09
SSFexpenditure	< 2.2e-16
SSFbalance	1.789e-10
GDPgrowth	< 2.2e-16
UnemplRate	< 2.2e-16
Inflation	< 2.2e-16

Notes: H_0: cross-sectional dependence does not exist in panel data; H_1: cross-sectional dependence exists in panel data.

Source: the authors' own calculations.

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

Thus, the problem of cross-sectional dependence was taken into account in further analyses.

The next step checked whether the variables are stationary. For this purpose, Pesaran's CIPS test for unit roots in the panels was used. The results are presented in Table 2.

Table 2. Pesaran's CIPS Test for Unit Roots in Panels (p-value)

Variable	CIPS test (p-value)	
	Levels	Differences
SSFrevenue	> 0.10	0.08630
SSFexpenditure	0.07815	0.03905
SSFbalance	0.02016	< 0.01
GDPgrowth	0.09888	< 0.01
UnemplRate	< 0.01	0.03509
Inflation	< 0.01	< 0.01

Notes: H_0: variable has a unit root; H_1: variable is stationarity.
Source: the authors' own calculations.

The results of the analysis indicate that at the significance level of 0.10 it may be assumed that such variables as SSFexpenditure, SSFbalance, GDPgrowth, UnemplRate and Inflation are stationary in the panel sets under analysis. As regards the SSFrevenue variable, the first differences of this variable – i.e. the ΔSSFrevenue variable – should be considered. Further analyses were carried out taking into account the results of the analysis of the stationarity of variables in the panels at the significance level of 0.10.

The Granger causality analysis was carried out with the use of the bootstrap panel Granger causality test. The results obtained for the variable ΔSSFrevenue can be found in Table 3, the results obtained for the variable SSFexpenditure in Table 4, and the results obtained for the variable SSFbalance in Table 5.

Table 3. Results of the Granger Causality Analysis in the Panels for Variables ΔSSFrevenue and GDPgrowth, UnemplRate, Inflation

GDPgrowth	Lag	Zbar	Q_0.90	Q_0.95	Q_0.99	Ztilde	Q_0.90	Q_0.95	Q_0.99
ΔSSFrevenue ~ GDPgrowth	1	1.223	2.767	4.027	8.084	1.217	1.848	2.816	5.933
	2	1.771	2.202	2.335	2.529	1.656	1.950	2.040	2.172
	3	2.548	3.009	3.111	3.289	2.039	2.293	2.349	2.447
GDPgrowth ~ ΔSSFrevenue	1	0.001	2.549	4.588	9.377	0.278	1.766	3.247	6.927
	2	2.116	2.201	2.350	2.593	1.891	1.945	2.049	2.196
	3	1.556	3.074	3.177	3.330	1.494	2.329	2.385	2.470

Table 3 cnt'd

UnemplRate	Lag	Zbar	Q_0.90	Q_0.95	Q_0.99	Ztilde	Q_0.90	Q_0.95	Q_0.99
ΔSSFrevenue ~ UnemplRate	1	**6.865**	2.476	3.375	5.037	**4.997**	1.640	2.315	3.593
	2	**2.497**	1.963	2.166	2.532	1.247	1.780	1.901	2.137
	3	0.742	2.860	3.008	3.195	1.046	2.211	2.292	2.395
UnemplRate ~ ΔSSFrevenue	1	**5.822**	2.099	2.816	4.150	**4.196**	1.484	1.886	2.911
	2	1.759	2.352	2.467	2.708	1.648	2.049	2.125	2.273
	3	2.588	3.152	3.260	3.390	2.061	2.370	2.428	2.501
Inflation	Lag	Zbar	Q_0.90	Q_0.95	Q_0.99	Ztilde	Q_0.90	Q_0.95	Q_0.99
ΔSSFrevenue ~ Inflation	1	**4.068**	2.492	3.420	5.356	**2.848**	1.679	2.350	3.838
	2	0.897	2.206	2.366	2.579	0.159	1.951	2.061	2.206
	3	1.198	2.987	3.135	3.381	1.297	2.279	2.360	2.494
Inflation ~ ΔSSFrevenue	1	0.115	2.003	2.689	4.635	0.189	1.490	1.789	3.284
	2	1.337	2.187	2.352	2.599	1.361	1.938	2.049	2.191
	3	2.261	3.033	3.151	3.341	1.882	2.306	2.371	2.476

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

Source: the authors' own calculations.

Table 4. Results of the Granger Causality Analysis in the Panels for Variables SSFexpenditure and GDPgrowth, UnemplRate, Inflation

GDPgrowth	Lag	Zbar	Q_0.90	Q_0.95	Q_0.99	Ztilde	Q_0.90	Q_0.95	Q_0.99
SSFexpenditure ~ GDPgrowth	1	**5.930**	2.873	4.399	8.009	**4.379**	1.986	3.180	6.006
	2	**3.442**	2.581	2.683	2.861	1.999	2.242	2.314	2.439
	3	1.151	3.285	3.390	3.563	0.080	2.541	2.603	2.705
GDPgrowth ~ SSFexpenditure	1	**3.279**	2.915	3.930	5.986	**2.304**	2.019	2.813	4.422
	2	2.196	2.224	2.413	2.988	1.121	1.971	2.069	2.270
	3	0.297	3.067	3.208	3.393	0.776	2.412	2.495	2.605
UnemplRate	Lag	Zbar	Q_0.90	Q_0.95	Q_0.99	Ztilde	Q_0.90	Q_0.95	Q_0.99
SSFexpenditure ~ UnemplRate	1	**9.459**	3.940	5.156	7.300	**7.141**	2.821	3.773	5.451
	2	0.458	2.031	2.235	2.586	0.102	1.848	1.995	2.217
	3	1.442	3.122	3.232	3.422	1.452	2.445	2.510	2.622
UnemplRate ~ SSFexpenditure	1	**6.595**	3.316	4.501	6.803	**4.899**	2.333	3.261	5.062
	2	0.753	2.944	2.986	3.050	0.955	2.497	2.527	2.572
	3	2.311	3.444	3.536	3.663	1.965	2.635	2.690	2.764

Table 4 cnt'd

Inflation	Lag	Zbar	Q_0.90	Q_0.95	Q_0.99	Ztilde	Q_0.90	Q_0.95	Q_0.99
SSFexpenditure ~ Inflation	1	**19.137**	3.871	5.017	8.017	**14.715**	2.767	3.664	6.012
	2	**5.526**	2.384	2.523	2.710	**3.466**	2.102	2.197	2.328
	3	2.269	3.159	3.241	3.435	0.741	2.466	2.515	2.629
Inflation ~ SSFexpenditure	1	**6.789**	2.110	2.954	6.139	**5.051**	1.570	2.050	4.542
	2	1.604	2.327	2.461	2.699	0.705	2.061	2.154	2.322
	3	0.066	3.070	3.206	3.398	0.561	2.414	2.494	2.607

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

Source: the authors' own calculations.

Table 5. Results of the Granger Causality analysis in the Panels for Variables SSFbalance and GDPgrowth, UnemplRate, Inflation

GDPgrowth	Lag	Zbar	Q_0.90	Q_0.95	Q_0.99	Ztilde	Q_0.90	Q_0.95	Q_0.99
SSFbalance ~ GDPgrowth	1	**6.994**	2.932	4.289	7.816	**5.211**	2.032	3.095	5.855
	2	1.008	2.409	2.534	2.829	0.285	2.107	2.192	2.360
	3	1.093	3.155	3.264	3.468	1.246	2.464	2.529	2.649
GDPgrowth ~ SSFbalance	1	**5.463**	2.761	3.715	7.089	**4.013**	1.899	2.645	5.286
	2	0.106	2.309	2.446	2.739	0.499	2.048	2.144	2.350
	3	1.863	3.054	3.196	3.368	1.701	2.404	2.488	2.590
UnemplRate	Lag	Zbar	Q_0.90	Q_0.95	Q_0.99	Ztilde	Q_0.90	Q_0.95	Q_0.99
SSFbalance ~ UnemplRate	1	1.645	2.365	3.257	5.495	1.026	1.597	2.287	4.039
	2	1.768	2.102	2.274	2.593	1.669	1.893	2.020	2.208
	3	2.770	3.005	3.115	3.349	2.237	2.375	2.440	2.579
UnemplRate ~ SSFbalance	1	1.737	2.173	2.870	4.675	1.097	1.517	1.984	3.397
	2	1.277	2.472	2.586	2.834	1.324	2.158	2.236	2.395
	3	2.619	3.251	3.350	3.463	2.148	2.521	2.579	2.646
Inflation	Lag	Zbar	Q_0.90	Q_0.95	Q_0.99	Ztilde	Q_0.90	Q_0.95	Q_0.99
SSFbalance ~ Inflation	1	**4.334**	2.882	4.111	6.745	**3.130**	1.993	2.955	5.016
	2	0.031	2.305	2.479	2.700	0.446	2.048	2.170	2.325
	3	1.368	3.109	3.220	3.402	1.408	2.437	2.502	2.610
Inflation ~ SSFbalance	1	0.938	1.888	2.691	5.103	0.472	1.463	1.844	3.731
	2	2.121	2.166	2.324	2.588	1.918	1.948	2.061	2.247
	3	2.104	2.978	3.102	3.345	1.843	2.359	2.433	2.576

Notes: Zbar, Ztilde – statistics (5), (6); 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: the authors' own calculations.

In Tables 3–5, results (at the significance level of 0.10) indicating the presence of causality in the Granger sense are written in bold. On the basis of these results, at the significance level of 0.10, it may be concluded that the Granger causality occurs between some of the variables analysed in the panel sets. A synthetic summary of the results of the analysis of Granger causality is presented in Table 6.

6. Conclusions

The causality study provides knowledge on how past decisions about specific variables affected the levels of other variables in the past. A synthetic approach to the Granger causal relationships is presented in Table 6.

Table 6. Results of the Granger Test – Synthetic Approach

Variable	ΔSSFrevenue	SSFexpenditure	SSFbalance
GDPgrowth	no Granger causality	SSFexp ← GDPgrowth** SSFexp → GDPgrowth*	SSFbalance ← GDPgrowth** SSFbalance → GDPgrowth**
UnemplRate	ΔSSFrev ← UnemplRate*** ΔSSFrev → UnemplRate***	SSFexp ← UnemplRate*** SSFexp → UnemplRate**	no Granger causality
Inflation	ΔSSFrev ← Inflation**	SSFexp ← 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: the authors' own calculations.

The present research has shown that in most of the analysed pairs of variables there is two-way Granger causality. More specifically, the changes in GDP constitute the cause in the Granger sense of the balance and expenditure of the SSF sector in the EU-CEE countries, and *vice versa*. This may mean that the response of the balance to changes in the output gap is significant in these countries; however, GDP is not a Granger cause for changes in the income of this sector. In the case of the unemployment rate, two-way Granger causality occurs for the expenditure of the SSF sector, but the unemployment rate is not a Granger cause for the balance of this sector. The inflation rate is a Granger cause for the SSF expenditure, and *vice versa*. Additionally, inflation is a Granger cause for changes in the income and balance of this sector, but not the other way around. That changes in the income of the SSF sector are a Granger cause for the unemployment rate, and *vice versa*, suggests that a different approach is necessary. But they are not a Granger cause for GDP and the inflation rate. The expenditure of the SSF sector is a Granger cause for GDP, the unemployment rate and inflation, and *vice versa*. And the balance of the SSF sector is a Granger cause for GDP, and *vice versa*. However, it is not a Granger cause for the unemployment rate and inflation.

Factors that could justify the different results of our study can be seen in the amount and pace of changes in macroeconomic indicators, the level and pace of changes in income and expenditure of the SSF, and the degree of sensitivity of these categories to changes in the economic situation. The nearly equal level of income and expenditure in nominal terms observed does not allow us to conclude, however, that the amounts of these categories is the basis for differences in the results of the study. Moreover, the similar scope of allocation and redistribution of income in the EU-CEE countries in total does not justify why expenditure is a Granger cause for all macroeconomic variables, and *vice versa*. At the same time, income changes are not a Granger cause for GDP and the inflation rate. The income of the SSF sector changed at a slow pace and was subject to slight fluctuations. In turn, a significant fluctuation is characteristic of the category of expenditure, which is also characterised by a similar pace of changes (available at https://ec.europa.eu/eurostat/web/main/data/database, accessed: 20.09.2021).

While this sheds some light on the evaluation of the results, it does not allow for a clear answer confirming or denying that it conditions two-way Granger causality, in terms of SSF finance and other macroeconomic variables. It is possible that the observed differences may be based on the adopted systemic solutions in the field of social security (pay-as-you-go or funded system), which may be more or less resistant to changes in some categories than in others. The pay-as-you-go system is essentially immune to inflation and economic slumps, but not immune to rising unemployment and falling production, nor to demographic changes. However, many countries have a mixed system. The reason for the varied results may also be the range of discretionary decisions which distort, strengthen or inhibit the operation of automatic stabilisers of the economic situation. Both social insurance contributions and expenditure on social benefits are automatic stabilisers of the economic situation, but at the same time their degree of flexibility in relation to economic fluctuations varies. Discretionary policy, which reduces insurance rates or introduces solutions that reduce the tax base, may, in effect, influence the flexibility of the categories under analysis here. The occurrence of inflation / deflation may correct the degree of influence of discretionary decisions on the real sphere of the economy. Presumably, for a causal relationship in this field, the sources of financing of SSF income may also be of indirect relevance.

One-way Granger causality from SSF finance to macroeconomic variables demonstrated in five out of nine observations shows that redistribution of income plays a smaller role than allocation. There was no Granger causal relationship in income – GDP and balance – Unemployment Rate, and *vice versa*. This may mean that the private sector in the EU-CEE plays a greater role in financing social security and in boosting the economy than the public sector. If the balance of the SSF is an indirect result of changes that occur in an economic situation and, further, is

an effect of the social security policy pursued, it can be assumed that this is why Granger causality does not exist between the balance of the SSF and the unemployment rate. However, the sheer variety of factors determining state finances (the political business cycle, fiscal illusion, etc.) and those determinants that cause changes in the labour market (individual decisions) make it difficult to explain this observation.

Our study confirms that in both the theory of economics and the results of empirical research there is no unanimity as to a two-way Granger causality with regard to the social security sector and macroeconomic indicators. However, the study confirmed that including delayed values of macroeconomic indicators in the forecasting model may improve finance forecasting in the SSF sector, with particular emphasis on the expenditure side. Including the expenditure of the SSF sector may help improve the forecasting of all of the macroeconomic indicators under analysis in this paper. And maintaining stable economic growth can contribute to the financial stability of social security.

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