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Impact of GDP Fluctuations on the Social Security Fund Revenues in Poland

Abstract

The level of social security contributions depends on the level of wages, which depend on the cyclical fluctuations of GDP. Thus, The Social Security Fund revenues depend on the cyclical fluctuations of GDP. This study is an attempt to estimate the sensitivity of The Social Security Fund own revenues to the GDP fluctuations in the years 1995-2002 in Poland. It is estimated the article that the short term output elasticity of The Social Security Fund own revenues (revenues from social security contributions) is higher than one. In the years 1995-2002 it was 1,05 on average. It means that output fluctuations cause more than proportional The Social Security Fund own revenues fluctuations, and social security contributions serve as an automatic business stabilizer.

The Social Security Fund revenues consist of own revenues and subsidies from State Budget. The main component of Social Security Fund own revenues are social security contributions. The level of social security contributions depends on the level of wages, which depend on the cyclical fluctuations of GDP. Thus, The Social Security Fund revenues depend on the cyclical fluctuations of GDP. Economic revival causes The Social Security Fund revenues to increase, whereas recession causes it to decrease. The higher the sensitivity of a given revenue to output, the stronger the impact of such a revenue as an automatic stabilizer. Moreover, a high sensitivity of The Social Security Fund revenues to economic fluctuations causes significant public sector deficit fluctuations within a cycle. This study is an attempt to estimate the sensitivity of The Social Security Fund own revenues to the GDP fluctuations in the years 1995–2002 in Poland.

Sensitivity of public revenues to the business cycle is usually analysed according to estimates of short term output elasticity.

Short term output elasticities of particular budget categories may be calculated according to the econometric macro-model. According to a simulation, we define the influence of the shock caused by changing the output gap value by 1 per cent point on budget income (van den Noord 2000). This approach enables us to specify the influence of various shocks, e.g. the European Commission using the Quest macro-model compares the effects of economic shocks resulting from private consumption, investment and export changes (European Commission 2000). At the same time, however, the value of budget income and expenditure elasticities obtained according to the econometric model is conditioned by the specification of a particular macro-model, which makes international comparisons more difficult.

The GDP elasticity of budget revenues can be also calculated by estimating the regression line, where a dependant variable is a budget revenue and independent variables are changes in the taxation system (comp. van den Noord 2000). The econometric analysis is applied to define budget income elasticity in, among others, the Great Britain (comp. H M Treasury 1999). The economic analysis application in defining budget revenue elasticity is tackled, among others, by T. Url. In Url (1997) each budget component is decomposed into a structural element resulting from a potential output and fiscal policy parameters changing in time, and into cyclical element resulting from an output gap (comp. also Brandner, Diebalek, Schuberth 1998):

(1) $$\ln R_{i,t} = a_{i,t} + \delta_i \ln Y_t^P + \varepsilon_i \left(\ln Y_t - \ln Y_t^P \right) + \eta_{i,t}$$

where: $R_{i,t}$ – category *i* budget revenue,

Y_t – GDP,

Y_t^P – potential GDP,

$a_{i,t}$ – parameter defining fiscal policy changes[1],

δ_i – long term output elasticity of a given budget category (usually close to one),

ε_i – short term output elasticity of a given budget category,

It means that the budget income level is defined by system changes, potential output and output deviations from the potential level. The real output is decomposed into a potential output and an output gap, which is related to the assumption that short-term output deviations from the potential level may affect budget revenue to the extent other than a potential output.

In the approach suggested by Url (1997) estimating the short-term output elasticity of a given budgetary category largely depends on the output gap estimation method. The method suggested by Bouthevillain and Quinet is devoid of this disadvantage. The short-term elasticity of budget revenue in Bouthevillain and Ouinet's work (1999) is estimated according to growth pace development , that is based on the following equation:

(2) $$\overset{\circ}{R}_{i,t} = \varepsilon_i \overset{\circ}{Y}_t + \nu_{i,t}$$

where: $\overset{\circ}{R}_{i,t}$ – category *i* budget revenue growth rate,

$\overset{\circ}{Y}_t$ – GDP rate of growth.

Values of short-term elasticities calculated according to the equation are not affected by the way of potential output calculation, at the same time however, based on this method we cannot calculate long-term output elasticities of budget revenue. Calculating elasticity

[1] Parameter defining system changes defined as the following stochastic trend (Url 1997):
$a_{i,t} = a_{i,t-1} + b_{i,t} + \xi_{i,t}$,
$b_{i,t} = b_{i,t-1} + \zeta_{i,t}$.

according to the econometric analysis only, which makes budget revenue dependant on output gap or GDP rate of growth, entails certain limitations:

- Estimation precision largely depends on the adequacy of applying the variables defining system changes in the fiscal policy (van den Noord 2000).
- With little observation and changing system solutions the results obtained according to the regression line may be burdened with a considerable error. Increasing the number of observations by applying monthly data, on the other hand, is connected with a considerable seasonality problem resulting from the terms of tax collection within a year (Momigliano, Stedrini 1999).
- If the government systematically takes discretional decisions as the reaction against business cycle development, then the influence of these discretional country's activities will be included in estimating the output elasticity of budget income (Murchison, Robbins 2002).
- Basing elasticity calculation only on the econometric analysis makes the elasticities calculated define only the medium influence of output gap on budget income in the period analysed, however they do not show elasticity of a given year. This problem is especially crucial in case of system changes occurring in the public sector. According to de Cos (1999) in case of occurring a significant system change regarding the taxation system another elasticity estimation is recommended, especially when it aims at predicting budget income elasticity in the future.

To avoid the above mentioned limitations elasticity estimation may be based on legal solutions analysis regarding the taxation system. A method of defining the output elasticity of budget income which uses legal solutions analysis is a two-step method. First step is to analyse the dependence between budget revenue and tax basis (or the macroeconomic variable being the approximation of tax basis), ant the second step is to define the regression equation between the tax basis (or the macroeconomic variable being the approximation of tax basis) and GDP (Coricelli, Ercolani 2002). Therefore, output elasticity of budget revenue is divided into two components: output elasticity of tax basis and tax basis elasticity of budget revenue (Momigliano, Staderini 1999). Thus:

$$\varepsilon_{R,Y} = \varepsilon_{TB,Y}\varepsilon_{R,TB} \tag{3}$$

where: $\varepsilon_{R,Y}$ – short-term output elasticity of budget revenue,

$\varepsilon_{R,TB}$ – tax basis elasticity of budget revenue,

$\varepsilon_{TB,Y}$ – short-term GDP elasticity of tax basis (or macroeconomic variable being the approximation of the tax basis).

Elasticity of tax value in relation to the tax basis depends on such system solutions as taxation, value of average and marginal tax rates and terms of payment. In case of occurring changes in the taxation system for each year of the term analysed, a separate legal solutions analysis is necessary. While defining elasticity for the whole period analysed according to the taxation system analysis only for a particular year the influence of legal solutions applied in previous and following years on the estimated elasticity value is ignored, which in case of system changes may mean that elasticity estimates are burdened with considerable error[2].

Two-step method of calculating elasticity which uses the legal solutions analysis is applied while examining the influence of GDP fluctuations on budget revenue, among others by OECD and IMF (budget revenues and expenditures elasticities are calculated based on the approach presented by Giorno, Richardson, Roseveare, van den Noord (1995). Dividing the influence of GDP changes on budget income into GDP influence on tax base and the influence of tax base changes on tax income was also applied in previous years, for example this method was applied in Lewis (1962).

In this study the short term output elasticity of The Social Security Fund own revenues was obtained according to a two-step elasticity calculation method.

Usually instead of the tax base is applied a macroeconomic variable being on the one hand the approximation of the tax base and directly dependant on GDP on the other. The more the chosen macroeconomic variable is an approximation of the tax base and the more it is deeply connected with GDP, the more precise tax elasticity estimation based on legal solutions analysis (Momigliano, Staderini 1999).

The fund of wages is a macroeconomic variable being the approximation of tax base of The Social Security Fund own revenues. Thus:

$$\varepsilon_{TBSSF,Y} = \frac{\partial F}{\partial Y}\frac{Y}{F} \tag{4}$$

where: $\varepsilon_{TBSSF,Y}$ – short term output elasticity of social security contributions tax base,

[2] For practical reasons, especially in case of international comparisons, elasticities are often defined according to the taxation system analysis of a particular year, for example this is the way elasticities are defined by OECD and European Commission (European Commission 2000).

F – total fund of wages.

Because:

(5) $F = wL$

where: w – wages,

L – employment,

thus:

(6)

$$\frac{\partial F}{\partial Y}\frac{Y}{F} = \left(\frac{\partial L}{\partial Y}w + \frac{\partial w}{\partial Y}L\right)\frac{Y}{wL} = \frac{\partial L}{\partial Y}\frac{Y}{L} + \frac{\partial w}{\partial Y}\frac{Y}{w} = \frac{\partial L}{\partial Y}\frac{Y}{L} + \left(\frac{\partial w}{\partial L}\frac{L}{w}\right)\left(\frac{\partial L}{\partial Y}\frac{Y}{L}\right)$$

Taking into account equation and equation one can see that:

(7) $$\varepsilon_{TBSSF,Y} = \left[\left(\frac{\partial w}{\partial L}\frac{L}{w}\right)+1\right]\left(\frac{\partial L}{\partial Y}\frac{Y}{L}\right)$$

Assuming that new employees are characterized by the same income contribution as the ones employed earlier (com. Giorno, Richardson, Roseveare, van den Noord 1995) we obtain the following equation for short term output elasticity of The Social Security Fund own revenues:

(8) $$\varepsilon_{RSSF,Y} = \left[\left(\frac{\partial(RSSF/L)}{\partial w}\frac{w}{(RSSF/L)}\right)(\frac{\partial w}{\partial L}\frac{L}{w})+1\right](\frac{\partial L}{\partial Y}\frac{Y}{L})$$

where: $RSSF$ – The Social Security Fund own revenues (revenues from social security contributions),

$\frac{\partial(RSSF/L)}{\partial w}\frac{w}{(RSSF/L)}$ – short term wage elasticity of The Social Security Fund own revenues for one employed person,

$\varepsilon_{RSSF,Y}$ – short term output elasticity of The Social Security Fund own revenues.

Short term wage elasticity of The Social Security Fund own revenues for one employed person may be estimated by calculating the relation of the marginal tax rate to the average tax rate for each tax section, and then defining the weighed average, where the weighs are contributions of tax revenues obtained from particular tax sections (comp. Giorno, Richardson, Roseveare, van den Noord 1995). In case of social security Fund the average level of social security contributions is proportional to the average level of wage. This means

unit wage elasticity of The Social Security Fund own revenues for one employed person:

$$\frac{\partial(RSSF/L)}{\partial w}\frac{w}{(RSSF/L)}=1 \tag{9}$$

thus:

$$\varepsilon_{RSSF,Y}=\left[1+\left(\frac{\partial w}{\partial L}\frac{L}{w}\right)\right]\left(\frac{\partial L}{\partial Y}\frac{Y}{L}\right) \tag{10}$$

Thus the short term output elasticity of Social Security Fund own revenues depend on short term output elasticity of employment and short term employment elasticity of wages.

Short term output elasticity of employment and short term employment elasticity of wages was estimated according to quarterly Central Statistical Office data of the years 1995–2002.

Short term output elasticity of employment was estimated according to the dependency between GDP and employment deviations from the levels corrected by cyclical fluctuations:

$$(11) \qquad \ln L_t^{SA} - \ln L_t^{HP} = \alpha_0 + \alpha_1 (\ln Y_t^{SA} - \ln Y_t^{HP}) + \xi_t$$

where: L_t^{SA} – employment seasonally adjusted,

Y_t^{SA} – GDP at constant prices seasonally adjusted,

L_t^{HP} – employment corrected by cyclical fluctuations,

Y_t^{HP} – GDP at constant prices corrected by cyclical fluctuations[3].

Defining the short term elasticity according to deviations from the levels corrected by cyclical fluctuations is applied among others by van den Noord (2000). This approach considers the dependency between the levels of variables examined within a cycle. On the other hand, calculating elasticity according to deviations from the values corrected by cyclical fluctuations is based on non-observable values which cannot be defined precisely and explicitly[4]. The estimated parameters of equation are as follows (in brackets – t-Student statistics):

$$(12) \qquad \ln\left(\frac{L_t^{SA}}{L_t^{HP}}\right) = \underset{(-0,5)}{-0,001} + \underset{(5,4)}{0,76_1} \ln\left(\frac{Y_t^{SA}}{Y_t^{HP}}\right) \qquad R^2=0,51$$

Short term output elasticity of employment was also calculated according to the equation:

$$(13) \qquad \overset{\circ}{L}_t = \alpha_0 + \alpha_1 \overset{\circ}{Y}_t + \varepsilon_t,$$

where: $\overset{\circ}{L}_t$ – employment growth rate in relation to the analogous quarter of the previous year,

$\overset{\circ}{Y}_t$ – real GDP growth rate in relation to the analogous quarter of the previous year.

[3] The employment was calculated according to the Central Statistical Office data on unemployment rate and the number of people unemployed. The data was de-seasoned by multiplicative method using the moving average. Series corrected by cyclical fluctuations were defined by smoothing the time series corrected by seasonal fluctuations with the use of Hodrick-Prescott filter (the standard 1600 level smoothing parameter for quarterly data was applied).

[4] There are a lot of alternative methods of defining values corrected by cyclical fluctuations. The methods can be divided into two main groups: methods based on smoothing time series (among which Hodrick-Prescott filter is most commonly used) and methods based on economic foundations (mostly on production function and NAIRU natural unemployment rate).

The estimated parameters of equation are presented below:

$$\overset{\circ}{L}_t = -0{,}03 + 0{,}76\overset{\circ}{Y}_t \qquad R^2=0{,}68 \tag{14}$$

(–6,0) (7,6)

Both according to equation and equation the short term output elasticity of employment equals 0,76. The short term output elasticity of employment is lower than one, which means that output fluctuations, according to Okun's law, lead to relatively low employment fluctuations. GDP fluctuations are to a certain extent absorbed by work efficiency fluctuations.

The impact of output fluctuations on wages fund may reveal itself not only by influencing employment, but also by influencing the average wage rate. The short term output elasticity of wages was obtained as the product of output elasticity of employment and employment elasticity of wage rate:

$$\frac{\partial w}{\partial Y}\frac{Y}{w} = \left(\frac{\partial w}{\partial L}\frac{L}{w}\right)\left(\frac{\partial L}{\partial Y}\frac{Y}{L}\right) \tag{15}$$

The dependence between wage rate and employment might be interpreted as the employment influence on wages resulting from Phillips curve. Therefore, employment growth should entail the growth of the average wage rate. At the same it must be remembered that in a recession period workers with qualifications worse than average are most often the ones to be dismissed, which affects the growth of minimum wage rate (Lubiński 2002).

In a long term the growth of an average wage rate to a great extent depends on work labour productivity growth. Also in a short term labour productivity fluctuations may affect wages. As a result the influence of business fluctuations on wages might be exerted not only by employment changes
but also by labour productivity changes (the lower employment growth rate,
in relation to a certain economic growth, the higher labour productivity growth rate).

However, the calculations made indicate that short term labour productivity fluctuations do not have a statistically significant influence on
the average wage rate. Therefore, later in the study it was assumed that the influence of output fluctuations on the average wages is exerted by fluctuations of employment.

The short term employment elasticity of wages was estimated according to the dependence between employment and wages deviations from the levels corrected by cyclical fluctuations:

$$\ln w_t^{SA} - \ln w_t^{HP} = \alpha_0 + \alpha_1 (\ln L_t^{SA} - \ln L_t^{HP}) + \varepsilon_t \quad (16)$$

where: w_t^{SA} – real wages seasonally adjusted,

w_t^{HP} – real wages corrected by cyclical fluctuations[5].

The results of the estimation of the equation are as follows:

$$\ln\left(\frac{w_t^{SA}}{w_t^{HP}}\right) = \underset{(0,003)}{0,000005} + \underset{(3,4)}{0,36} \ln\left(\frac{L_t^{SA}}{L_t^{HP}}\right) \qquad R^2=0,27 \quad (17)$$

The short term employment elasticity of wages was also defined according to the equation:

$$\overset{\circ}{w}_t = \alpha_0 + \alpha_1 \overset{\circ}{L}_t + \varepsilon_t , \quad (18)$$

where: $\overset{\circ}{w}_t$ – the growth rate of an average real wages in relation to the analogous quarter of the previous year.

The results of the estimation of the equation are presented below:

$$\overset{\circ}{w}_t = \underset{(10,0)}{0,03} + \underset{(3,2)}{0,38} \overset{\circ}{L}_t \qquad R^2=0,24 \quad (19)$$

Short term employment elasticity of wages defined according to the equation is 0,38 and approximates the results obtained according to the equation (0,36). Because of the fact that the estimates obtained according to the equation are based on a arbitrarily chosen method of defining unobservable cyclically adjusted variables, the elasticity estimation based on the equation of growth rates (equation) was applied in further calculations.

Thus, on base of equation and obtained estimations short term output elasticity of employment (0,76) and short term employment elasticity of wages (0,38), short term output elasticity of Social security Fund own revenues is equal 1,05. It means that the fluctuations of Social Security Fund own revenues are relatively higher then the fluctuations of GDP.

[5] The data corrected by seasonal fluctuations and cyclical fluctuations analogically to the equation .

The analysis of the impact of GDP fluctuations on the Social Security Fund own revenues in Poland let us draw the following conclusions:

1. Social Security Fund own revenues (social security contributions) fluctuations resulting from GDP fluctuations can be decomposed into two elements:
   the change of Social Security Fund revenues caused by the change of wages fund and the change of wages fund caused by GDP fluctuations.
2. The change of wages fund corresponds to the proportional change of Social Security Fund own revenues.
3. Short term GDP elasticity of employment is lower than one. However, since the level of employment also influences the average wage rate, thus the short term output elasticity of wages fund exceeds one.
4. The short term output elasticity of The Social Security Fund own revenues (revenues from social security contributions) is higher than one – in the years 1995–2002 it was 1,05 on average. It means that output fluctuations cause more than proportional The Social Security Fund own revenues fluctuations, and social security contributions serve as an automatic business stabilizer.

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