GOSPODARKA NARODOWA

6
(274)
Rok LXXXIV/XXV
listopad–grudzień
2014
s. 81–101

Tomasz JĘDRZEJOWICZ*
Kamila SŁAWIŃSKA**

Shifting from Labor to Consumption Taxes: The Impact on Tax Revenue Volatility

Abstract: This paper provides estimates of tax revenues with respect to their individual tax bases, focusing on differences between long- and short-run elasticities and allowing for asymmetries in the speed of adjustment as well as in short-run volatility. Estimates are presented for two major tax categories in Poland: value added tax, and employer and employee social contributions for the 1999–2013 period. Our results indicate that long-run elasticities are close to unity. An analysis of short-run elasticities based on considering their asymmetric responses to economic fluctuations, complemented by a rolling regression exercise, suggests that VAT revenues are subject to greater volatility. Therefore, a shift in taxation from labor income to consumption increases the sensitivity of public finances to the business cycle.

Keywords: fiscal policy, tax revenue elasticities, value added tax, social contributions

JEL classification codes: E62, H2, H68

Artykuł nadesłany 18 czerwca 2014 r., zaakceptowany 5 listopada 2014 r.

Introduction

The global economic crisis has led to a severe deterioration of fiscal positions in developed countries. While several factors contributed to this, including discretionary stimulus efforts and financial assistance to ailing banks, overall the most important factor was probably the decline in tax revenue associated with the cyclical downturn. In many cases, budget balances worsened more

* National Bank of Poland (NBP), e-mail: tomasz.jedrzejowicz@nbp.pl
** National Bank of Poland (NBP) and Warsaw School of Economics, Collegium of Economic Analysis, e-mail: kamila.a.slawinska@gmail.com

dramatically than expected. The likely reason for this was the underestimation of the extent to which they vary with the economic cycle. A key concept in this context is that of elasticity of tax revenue, which determines to what extent tax receipts change in response to a change in the tax base.

Fiscal policy analyses conventionally assume that tax elasticities are stable over time and that elasticity with respect to the base is unitary unless the taxes in question are progressive. This is indeed a sensible assumption for the long-run value of the tax elasticity as there is no reason for the ratio of tax revenue to tax base to persistently rise or decline. However, practice shows that in the short term there is often a substantial variation in tax receipts, implying a deviation of elasticities from this assumption.

The size of tax elasticities is a crucial variable for the assessment of the underlying fiscal position and fiscal policy stance. This is usually done using cyclically-adjusted budget balances, with the cyclical sensitivity of the budget balance calculated using the assumed elasticities of respective tax categories with respect to output. Cyclically-adjusted budget balances are also gaining relevance as policy variables used in European and national fiscal rules. In addition, tax elasticities are important for budgetary planning and forecasting. All of the above implies that short-term variations in tax elasticities may increase uncertainty and thus impede execution and real-time monitoring of fiscal policy.

This paper looks empirically at the variability of tax elasticities. Two approaches are used to capture the fluctuations of elasticities. First, we estimate long- and short-term elasticities of taxes with respect to their bases using an error correction model. We allow for asymmetries in the error correction mechanism in order to test whether the behavior of elasticities is different depending on whether they are above or below their long-run equilibrium. Second, we track the changes in tax elasticities over time using rolling window regressions.

Our study focuses on the case of Poland, an economy that has undergone a considerable transformation in recent decades, associated with the transition to a market system and its entry to the European Union. This transformation has also affected public finances and the tax system. In order to accurately measure the relationship between tax receipts and tax bases it is therefore essential to correct for the impact of these changes. We do so using a detailed database of tax measures compiled at the National Bank of Poland based on an analysis of legal regulations.

We focus specifically on the elasticities of two of the largest sources of general government revenue in Poland, namely VAT and social contributions. Based on a preliminary survey of the data as well as existing literature, we *a priori* expect to find more variation in the elasticities of VAT than for social contributions.

The paper contributes to the literature as the first (to our knowledge) study of tax elasticities in Poland. It is also one of the first studies of the variability of tax elasticities that covers the period of the global economic crisis, which

may be expected to have affected the relationship between tax receipts and their respective bases.

The paper is structured as follows. We first briefly discuss the concept of tax elasticities and the related empirical literature. Next we present an overview of the tax system in Poland and how it has evolved over our sample period. We then discuss the data used and present our empirical approach. Finally, we discuss our results and close with conclusions.

Tax Elasticities – an Overview

There are three concepts of tax elasticities used in the literature [Koester, Priesmeier, 2012]. The first are tax base elasticities, which describe the relationship between the relevant tax base and macro variables such as GDP. This elasticity is particularly relevant for studies of sales taxes at the U.S. state level [e.g. Bruce et al., 2006], as these studies are often based on precise data on tax bases obtained from the tax administration. The second are elasticities of tax receipts with respect to GDP. These are useful for calculating cyclically-adjusted budget balances using an aggregated method, where a cyclical component of the budget balance is estimated by multiplying the aggregated elasticity of revenue and expenditure components by the output gap. The third are elasticities of tax receipts with respect to macroeconomic variables, which can be considered proxies for their tax bases. These elasticities may be used to estimate cyclically-adjusted budget balances using the so-called disaggregated approach (for a detailed description see Bouthevillan et al., 2001), whereby the cyclical component of each tax category is calculated using separate trends and gaps are calculated for each tax base.

We consider the last of these concepts to be the most relevant, in particular because both the relationship between tax receipts and their respective macroeconomic proxies, as well as the relationship between these proxies and GDP may vary over time. By focusing on only one of these relationships, the third concept should allow us to better capture the link between tax receipts and macroeconomic developments than the second one, in which changes in the structure of GDP growth could additionally complicate the assessment.

For the purposes of calculating cyclically-adjusted budget balances, as well as preparing fiscal plans and projections, it is common to assume that tax elasticity is constant over time. This implies that the elasticity in question is a long-term one. Such elasticities are often estimated drawing on analyses of the tax code, as in the case of Girouard and Andre [2005], who estimated elasticities for OECD countries, or Mourre et al. [2013].

However, as noted earlier, the above assumption does not hold in practice, as tax elasticities often vary considerably. This has led to the development of the concept of short-term elasticities describing the fluctuation of tax receipts within the economic cycle, and to the emergence of a strand of literature estimating short- and long-term elasticities using time series methods. This

approach has been pioneered by Sobel and Holcombe [1996], who evaluated the dynamic properties of different categories of tax elasticities for several tax categories and different U.S. states. Bruce et al. [2006] extended this approach, also applying it to U.S. states, by additionally allowing for asymmetry in short-run elasticities.

The methodology of Bruce et al. [2006] has been subsequently applied to European countries by Wolswijk [2007], Koester and Priesmeier [2012] and Bettendorf and van Limbergen [2013]. Our paper is most closely related to these studies. The studies use an error correction model to estimate long- and short-run tax elasticities. In addition, the first and the third test for asymmetry in the error correction depending on whether tax receipts are above or below the equilibrium value. This may be associated with the economy being in either "good" or "bad" times. The asymmetry may apply to both the size of short-run elasticity and adjustment speed towards the equilibrium. All three studies use data adjusted for the impact of legislative measures on tax receipts.

Wolswijk [2007] conducted his study using annual data for the Netherlands for the 1970–2005 period. He considered five tax categories, in each case estimating a long-term and a short-term elasticity using an error correction model. He found a significant asymmetry, particularly in the case of VAT and other indirect taxes. For these taxes, separate short-term elasticity values were found to be significant, both when revenues were above and below their equilibrium. However, the short-term VAT elasticity for taxes above the equilibrium was only slightly higher than the long-term elasticity (1.01 vs. 0.90). In the case of personal income taxes, no asymmetry of short-term elasticities was found, while for corporate taxes and other direct taxes, elasticities for taxes below the equilibrium were not statistically significant.

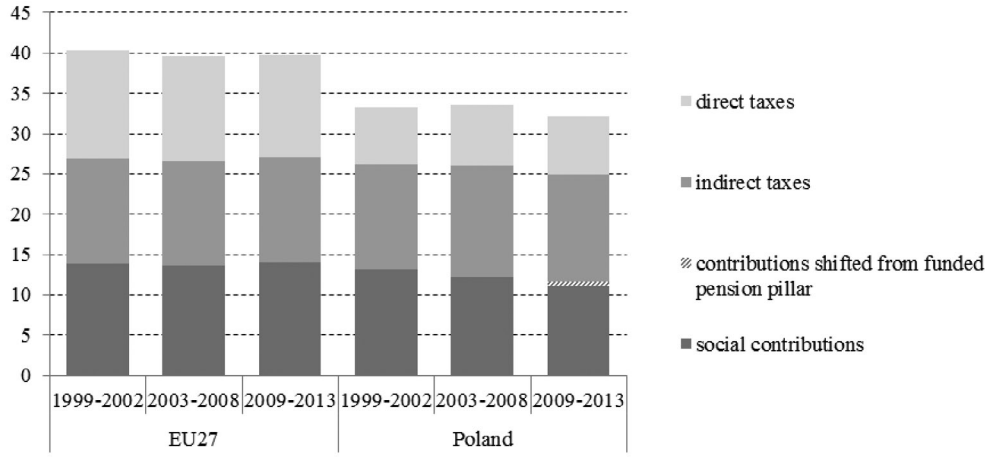
Bettendorf and Limbergen [2013] performed an exercise similar to Wolswijk's [2007], also using data for the Netherlands, but extending the dataset to include 2011 and correcting for a structural break in PIT revenues, as well as testing for different bases of VAT. They focus on two tax categories: VAT and personal income taxes. For VAT, they estimate a long-run elasticity of 0.97 and a short-run elasticity of 1.0. They also find an asymmetry in VAT elasticities, as short-run values estimated separately for instances when tax receipts are above and below the equilibrium amount to 1.2 and 0.7 respectively, and both are statistically significant. The authors also test for an alternative measure of "good" and "bad" times, namely the output gap, in this case estimating the elasticities at 1.06 and 0.83 respectively and also finding them to be statistically significant. Meanwhile, for PIT, they estimate a long-run elasticity of 0.89 and a short-run elasticity of 1.07. Again, they find a statistically significant asymmetry in the short-run elasticity with a value of 1.27 for tax receipts above the equilibrium and 0.65 for taxes below the equilibrium. In addition, Bettendorf and Limbergen [2013] assess the variability of tax elasticities over time using rolling window regressions. They find no clear pattern in the VAT elasticity and an upward trend in the PIT elasticity.

Tax System in Poland

One of the elements of Poland's transition to a market economy was the establishment of a modern tax system in the early 1990s. Corporate income tax was introduced in 1989, personal income tax in 1992, and value-added tax in 1993. These taxes, together with excise tax and social contributions levied still before the transition, constitute the core of the government's revenue sources.

Figure 1 presents a summary comparison of the structure of tax revenue in Poland and EU countries on average. These structures are broadly similar, with one notable exception—the share of direct taxes in Poland is clearly lower than the EU average. This reflects lower taxes paid by households, which is partly due to relatively low headline PIT rates (18% and 32%), but in particular due to the deductibility of healthcare contributions from PIT. Poland has a slightly higher share of indirect taxes that has been increasing over the past 15 years. Meanwhile, the share of social contributions is lower than in the EU on average and has visibly decreased over the last 15 years. This shows that Poland has been one of the countries that shifted the tax burden from labor to indirect taxes.

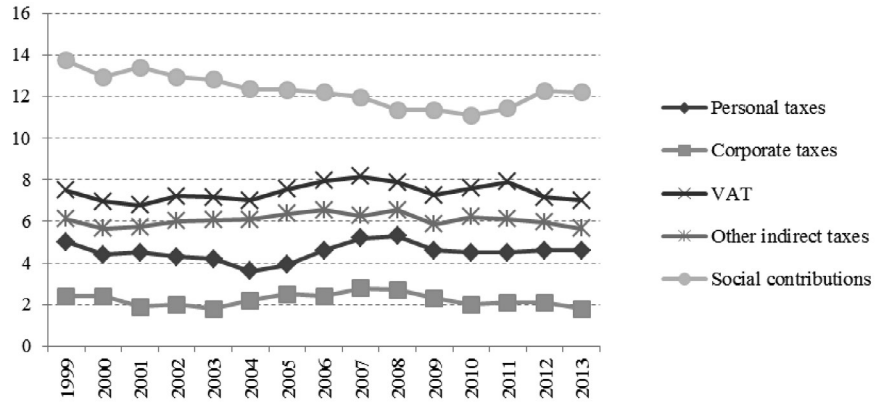
Figure 1. Composition of Tax Revenue in Poland and the EU27 (% of GDP)



Source: Eurostat.

The overall structure of revenue from taxes and social contributions over the past 15 years has been quite stable, while the fluctuations in the overall level of tax revenue as a percentage of GDP are mainly attributable to the impact of the economic cycle (Figure 2).

Figure 2. Main Tax Categories in Poland in 1999–2013 (% of GDP)



Source: Eurostat.

The decline of the ratio of social contributions to GDP over the 1999–2006 period is partly due to the falling level of employment in the early part of this period and partly due to the gradual impact of the shift to a partly funded pension scheme. The social contributions of new employees entering the labor market in that period were being partly diverted to the funded pillar, classified outside the general government, while those of retiring older employees were paid fully to the government pension scheme. Then, in 2007 and 2008, a large cut in social contributions was implemented in an effort to increase employment by reducing the tax wedge. Once the economic crisis started, the government implemented wide-ranging fiscal adjustment measures, including changes in the pension scheme entailing a shift of contributions between the funded pillar and the government pension scheme. In addition, in 2012 the reduction in social contributions from five years earlier was partly reversed.

Personal income taxes were also lowered over the period in question, first through the introduction of a flat 19% tax rate for the self-employed in 2004 and then by moving from three tax brackets with a top rate of 40% to two brackets, with a top rate of 32% in 2009. Meanwhile, the gradual decline in PIT revenue in the 1999–2003 period, followed by its increase in 2004–2008, were related to cyclical developments. In addition, in the mid-2000s receipts additionally increased due to the abolition of some breaks and the freezing of tax brackets. The main change in corporate income taxes was a reduction of the tax rate from 27% to 19% in 2004.

Revenues from value-added taxes were driven to a large extent by the cycle and Poland's EU accession in 2004. The increase in revenue in 2004–2005 was related to the country's EU entry, although not all of that increase can be attributed to specific legislative measures. EU entry may be seen as a far-reaching shock to trade with repercussions for VAT receipts. In 2011, as part of a fiscal consolidation process, VAT rates were raised from 22% to 23% and from 7% to 8%. The remaining fluctuations, particularly a sizeable upturn in 2006–2007 and a sharp decline in 2012–2013, were related to the economic cycle.

Data

In this paper we estimate the elasticities of tax revenues with respect to their tax bases. Facing the problem of short time series, which are available for Poland, we use quarterly data for 1999 through 2013. The data are seasonally adjusted following the methodology applied by the Eurostat. The Tramo-Seats method with working days correction is used to seasonally adjust our data.

As noted earlier, because of changes taking place in the tax system over the period in question, it is important to correct the data for the impact of discretionary measures, including legal changes in tax rates, tax base definitions and tax administration. We do this by following Wolswijk [2007] and Bettendorf and van Limbergen [2013] and applying the proportional adjustment method introduced by Prest [1962]. The basic idea is to obtain time series as if there were no discretionary changes, using the officially reported tax revenues and the predictions of adjustments in tax yield due to discretionary changes. The benchmark is given by the prevailing tax structure in the base year. Hence the adjusted tax revenues (*AT*) are equal to the observed tax revenues (*T*).

$$AT_0 = T_0 \tag{1}$$

In the next year, the projected impact of fiscal changes on tax revenues (*D*) is subtracted for the observed ones. So the adjusted tax revenues in period $t = 1$ are equal to

$$AT_1 = T_1 - D_1 \tag{2}$$

Bearing in mind that permanent discretionary changes influence not only revenues in the current period but also in the following ones, the cumulative effect has to be determined. This can be done by multiplying the corrected term $(T-D)$ in the current period with the ratio of the adjusted to actual tax revenues in the previous ones. In the case of quarterly data, the adjusted tax revenue in period t is as follows

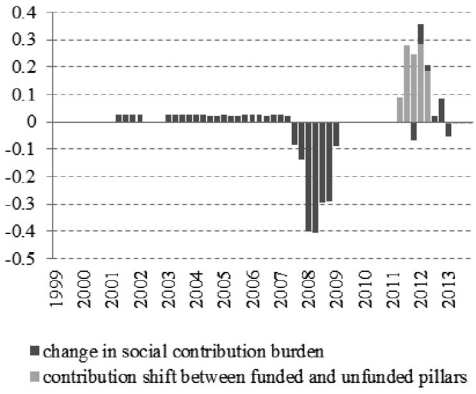
$$AT_t = (T_t - D_t)\frac{AT_{t-4}}{T_{t-4}},\ \mathrm{t} > 4 \tag{3}$$

The quality of the adjusted data depends to a large extent on the accuracy of estimates of the impact of new tax measures. Our estimates are based on official government sources whenever these were available, complemented with our own calculations.

In our analysis, we focus on two types of taxes, which constitute a lion's share of general government revenues (Figure 2), namely social contributions and indirect taxes. Over the time period of our study, social contributions accounted for 32% of overall general government revenues on average, whereas VAT revenues represented 19%. Altogether these two tax categories accounted for more than 50% of all tax revenues over the investigated period on average. Another reason for focusing on these two categories, aside from their

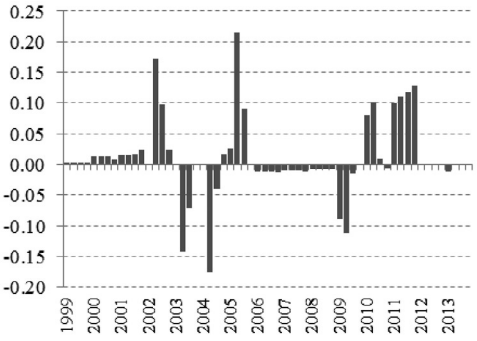
relative size, is that they may serve as a representation of the tax reforms that took place in Poland over the 1999–2013 period. Specifically, as in many other countries, these reforms entailed a shift from taxing labor towards taxing consumption. By examining tax elasticities of these two forms of taxation, we may draw policy conclusions regarding the impact of such reforms on the volatility of tax receipts.

Figure 3. Impact of Legislative Measures on Receipts from Social Contributions (% of Annual GDP)



Source: NBP estimates.

Figure 4. Impact of Legislative Measures on Receipts from VAT (% of Annual GDP)



Source: NBP estimates.

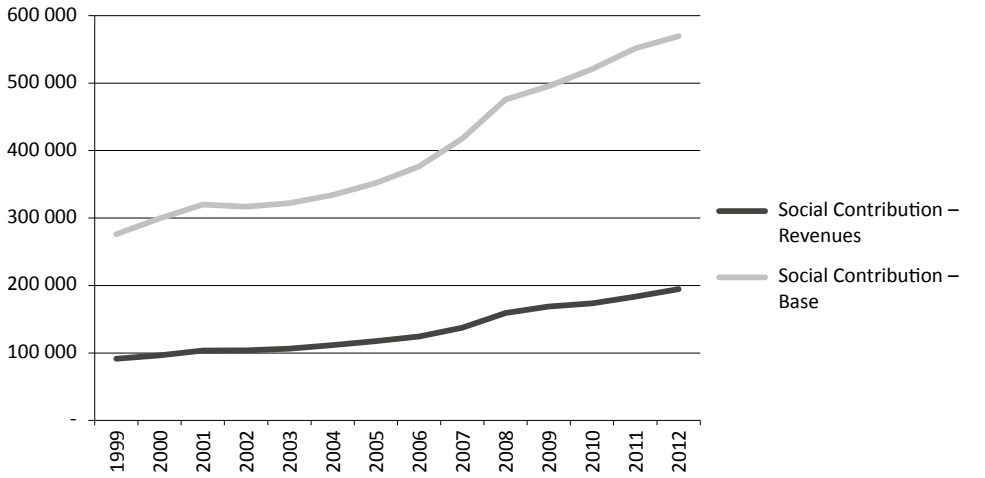
Figure 3 and Figure 4 show the estimated effect of the discretionary changes on tax revenues (expressed as a percentage of GDP). In general, the legislative measures led to a growth (decline) of 0.4% of GDP or 0.2% of GDP respectively in the case of social contributions and VAT receipts. The impact of changes in social contributions is broken down into measures that change the tax burden, such as reductions in social contributions in 2007–2008 and changes arising from the shifting of contributions between the funded and unfunded pension pillars, which do not change the overall burden faced by taxpayers.

As mentioned above, the aim of this paper is to estimate the elasticities of tax revenues with respect to their tax bases. Therefore, properly defining the tax bases for the taxes of interest seems to be crucial to obtain reliable results. For social contributions, we take the national accounts category "compensation of employees" (ESA code D.1). The literature [e.g. Girouard, Andre, 2005] typically indicates private consumption as the VAT base. However, as noted by Wolswijk [2005] and Bettendorf and Limbergen [2013], other macroeconomic categories are also taxed with VAT, specifically government investment, government intermediate consumption and private residential investment. The results of these studies suggest that private consumption displays greater long- and short-term volatility in comparison to other VAT base components. In our paper, we examine two different VAT bases: a narrower one that comprises private consumption, and a broader one that additionally includes intermediate consumption and fixed capital formation. However, as both tax bases show a similar trend

and there is no significant difference between estimates using the narrower and broader tax bases, we have decided to present the results only for the models in which the broader base is used.

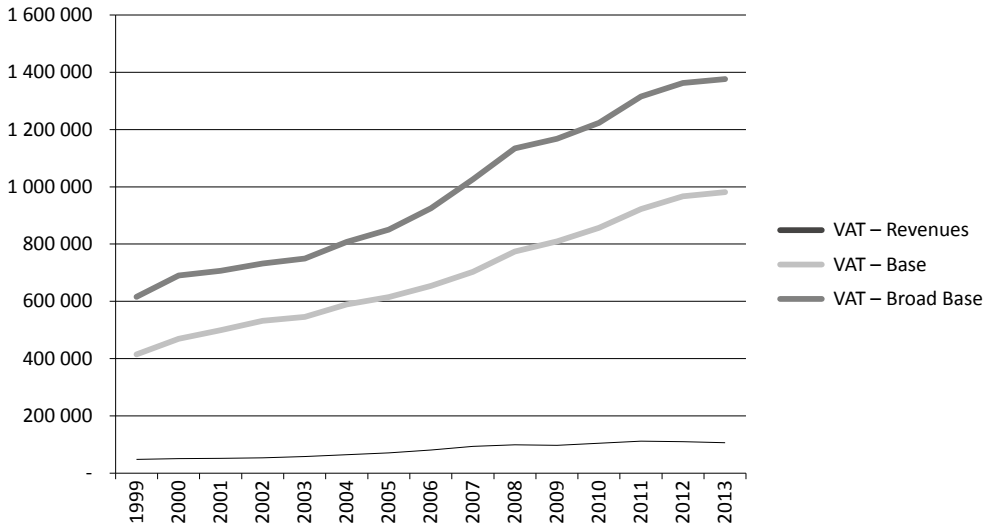
Figure 5 and Figure 6 show tax revenues and their bases. In both cases, the tax bases grow more rapidly than tax revenues in the entire period. Moreover, regardless of the definition, the VAT bases follow the same pattern.

Figure 5. Revenue from Social Contributions and Employee Compensation (in Millions of Polish Zlotys)



Source: Eurostat, National Bank of Poland.

Figure 6. VAT Revenues and Their Bases (in Millions of Polish Zlotys)



Source: Eurostat, National Bank of Poland.

Methodology

The main empirical challenge of our research is to examine whether there is a long- and short-run relationship between tax revenues and their individual bases, as well as to check if there are any differences in tax revenue behavior depending on the business cycle.

To generate testable hypotheses, we employ the approach applied by researchers including Wolswijk [2007] and Bruce et al. [2006] and estimate the long-run relationship using cointegration techniques to avoid the problem of spurious regressions as usually both tax revenues and their bases are integrated in order (Appendix A).

The long-run equilibrium relation in the most general model can be described as follows:

$$\ln TR_t = \alpha_0 + \alpha_1 \ln TB_t + \varepsilon_t \tag{4}$$

where $\ln TR_t$ is the natural logarithm of tax revenues in period t, $\ln TB_t$ is the natural logarithm of tax base, ε_t is the error term, and α_1 is our parameter of interest as it reflects the long-run tax revenue elasticity.

The short-run equation is expressed in terms of growth rates:

$$\Delta \ln TR_t = \delta(\ln TR_{t-1} - \ln TB_{t-1}) + \beta \Delta \ln TB_t + \xi_t \tag{5}$$

The cyclical variability of tax revenues is given by the estimate of β and represents the direct short-run elasticity [Koester, Priesmeier, 2012]. However, the error correction term, which is defined as the lagged disturbance term of the long-run equation, constitutes the other important element of the error correction model. Any deviations from the long-run equilibrium are corrected if the adjustment speed parameter (δ) is negative and greater than –1. ξ_t is the serially uncorrelated and homoscedastic error term.

The literature provides evidence that short-run elasticities differ depending on the business cycle [Bettendorf, van Limbergen, 2013]. Therefore, to complement our initial approach, two types of asymmetries are allowed in our model. First, it seems fairly reasonable to assume that tax revenues grow more than proportionally as the tax base increases in "good" times, which are defined as periods in which revenues exceed their long-run equilibrium. Consequently, the elasticity is below unity when the economy faces a recession. Last but not least, the speed of adjustment might also be unequal within the business cycle.

$$\begin{aligned} \Delta \ln TR_t = {} & \beta^+(\ln TR_{t-1} - \ln TB_{t-1})^+ + \delta^-(\ln TR_{t-1} - \ln TB_{t-1})^- + \\ & \beta^+ \Delta \ln TB_t^+ + \beta^- \Delta \ln TB_t^- + \eta_t \end{aligned} \tag{6}$$

$$\begin{aligned}(\ln TR_t - \ln TB_t)^+ &= (\ln TR_t - \ln TB_t), \text{ if } (\ln TR_t - \ln TB_t) \geq \text{otherwise} \\ (\ln TR_t - \ln TB_t)^- &= (\ln TR_t - \ln TB_t), \text{ if } (\ln TR_t - \ln TB_t) \leq \text{otherwise}\end{aligned} \tag{7}$$

$$\begin{aligned}\Delta \ln TB_t^+ &= \Delta \ln TB_t, \text{ if } (\ln TR_t - \ln TB_t) \geq 0;0 \text{ otherwise} \\ \Delta \ln TB_t^- &= \Delta \ln TB_t, \text{ if } (\ln TR_t - \ln TB_t) \leq 0;0 \text{ otherwise}\end{aligned} \tag{8}$$

For the purpose of our analysis, we implement the two-step Engle-Granger approach, which allows us to estimate the long-run equilibrium relationship and the corresponding error correction model [Engle, Granger, 1987]. In the first step, the dynamic ordinary least squares (DOLS) estimator proposed by Stock and Watson [1993] is used to obtain our baseline long-run tax revenue elasticity. This estimator offers several advantages in comparison to the traditional ordinary least square technique. First, the obtained estimates are superconsistent. Moreover, as the leads and lags of the explanatory variables are included in the model, the negative impact of possible endogeneity and autocorrelations is mitigated. Last but not least, even though the model describes a relationship between nonstationary variables, the distributions of the basic tests' statistics are known. Therefore, it is possible to test linear restrictions imposed on the parameters. In the second step, the short-run elasticity is computed on the basis of the error correction model using ordinary least squares (OLS).

In order to obtain reliable and precise estimates, the model has to be well specified. For this purpose, we test several various specifications, e.g. including trend or richer dynamic structure to avoid the problem of serial correlation. On the other hand, taking into account the short time period of our analysis, we finally decide to include one lag and lead in the DOLS model and not to include any lags in the ECM model as there is no serial correlation. We also attempt to find evidence of structural breaks that occurred in the analyzed period. The first natural breaking point might be Poland's EU entry in the second quarter of 2004. The European Union's enlargement had a tangible impact on trade and resulted in a flow of transfers from the EU budget, which are likely to increase consumption and investment. This has an impact on VAT revenues and is therefore included in our model.

In the last part of our analysis, the robustness of the obtained results is checked. The sensitivity analysis is twofold. On the one hand, we use ordinary least squares and fully-modified ordinary least squares (FM-OLS) to test the stability of estimates from our baseline model describing the long-run relationship [Phillips, 1995]. Moreover, lagged residuals for these individual models are included as a deviation from the equilibrium in the error correction models. The second approach is based on the rolling regression.

Results
Value-Added Tax

Table 1 presents the results of estimation using household consumption, intermediate consumption and gross capital formation as the tax base. All of the presented models include an additional deterministic component—Poland's accession to the European Union in May 2004. This variable has a significant impact on VAT revenues in the long run regardless of the estimation technique we apply. As expected, EU entry stimulated both private consumption and investment, leading to an increase in VAT revenues. The estimate of the long-run elasticity in our baseline model is 1.06, however it is not significantly different from unity. The short-run value is equal to 0.96, and there is no evidence to reject the null hypothesis of a unit short-run elasticity. The adjustment speed parameter indicates that VAT revenues get back to their long-run path after seven months. Our baseline results seem to be fairly stable. Although, the estimates of the long-run elasticities using OLS or FM-OLS are numerically below 1, they are not significantly different from unity. In the case of the short period, only the model in which residuals from the FMOLS regression are used, suggests that the short-run elasticity is larger than 1.

Table 1. Long- and Short-Run VAT Elasticities

Long-Run Relationship			
Variable	(1) OLS	(2) DOLS	(3) FM-OLS
Constant	–2.088[a] (1.215)	–3.381[c] (0.788)	–1.253 (0.821)
Log(VAT_base)	0.960[c] (0.101)	1.062[c] (0.065)	0.890[c] (0.068)
EU	0.125[b] (0.057)	0.075[b] (0.037)	0.161[c] (0.036)
Obs	57	57	57
Short-Run Relationship			
Variable	OLS	DOLS	FM-OLS
Error correction term	–0.253[c] (0.088)	–0.247[b] (0.116)	–0.275[c] (0.085)
Δlog(VAT_base)	1.185[c] (0.228)	0.960[c] (0.224)	1.211[c] (0.225)$^{+++}$
Obs	56	56	56

Standard errors in parentheses. The [a–] symbol refers to the p-value of the significance test for individual coefficients, with [a] 0.1 p-value, [b] 0.05 p-value, [c] 0.01 p-value. The [+] symbol refers to the p-value of the linear restriction test ($\beta = 1$).

We also explore whether or not changes in the tax base in "good" and "bad" times affect tax revenues in different ways. We define "good" times as periods when tax revenues are above their long-run equilibrium and "bad" times as

those when tax revenues are below their long-run equilibrium. As there are no significant asymmetries in the speed of adjustment, we only report the results of asymmetric tax elasticities in Table 2. The estimates show that tax elasticity increases when the economy picks up. At a time of economic boom tax elasticity is significant and exceeds one, while the tax elasticity for an economic downturn is insignificant.

Our results are not in line with the findings of other authors. Bettendorf and van Limbergen [2013] as well as Koester and Priesmeier [2012] find long-run elasticity to be below unity. Moreover, Bettendorf and van Limbergen [2013], and Wolswijk [2007] encounter clear evidence of an asymmetric response of tax revenues to changes in their tax bases. Meanwhile, our estimates indicate that only economic upturns play an important role in tax collection. The discrepancies might result from different time series used in these analyses. First, this research is based on quarterly data instead of yearly ones. Although the sample contains almost 60 observations, the impact of no more than two business cycles is captured in our data. Hence, a part of the short-run volatility could be attributed to the long-run relationship, and consequently the negative impact of an economic downturn is insignificant.

Table 2. Asymmetric Short-Run VAT Elasticities

Short-Run Relationship	
Variable	
Error correction term	–0.461[c] (0.122)
$\Delta\log(\text{VAT\_base})^{+}$	1.585[c] $(0.265)^{++}$
$\Delta\log(\text{VAT\_base})^{-}$	–0.097 $(0.361)^{+++}$
Obs	55
Asymmetry of elasticity (p-value)	0.000

Standard errors in parentheses. The $^{a-}$ symbol refers to the p-value of the significance test for individual coefficients, with [a] 0.1 p-value, [b] 0.05 p-value, [c] 0.01 p-value. The $^{+}$ symbol refers to the p-value of the linear restriction test ($\beta = 1$).

In the final step of our analysis, we examine the stability of the estimates by applying a rolling regression covering 32 observations. To obtain the most comparable estimates for the entire period, we decided against including any additional deterministic variables. An inclusion of a structural break, for example, could lead to perfect collinearity with a constant for some periods.

The long-run elasticity fluctuates significantly within the analyzed period. Figure 7 shows a declining trend in it from the beginning of 2001. In addition, the elasticity reaches its lowest level (below unity) for the last periods, which also cover years during and after the crisis. The short-run elasticity seems to

be more stable (Figure 8). It hovers around one. However, in the last period the elasticity remains below unity. Hence it is possible to conclude that the latest crisis has had a negative impact on tax revenues.

Figure 7. Rolling Regression of VAT Long-Run Elasticity

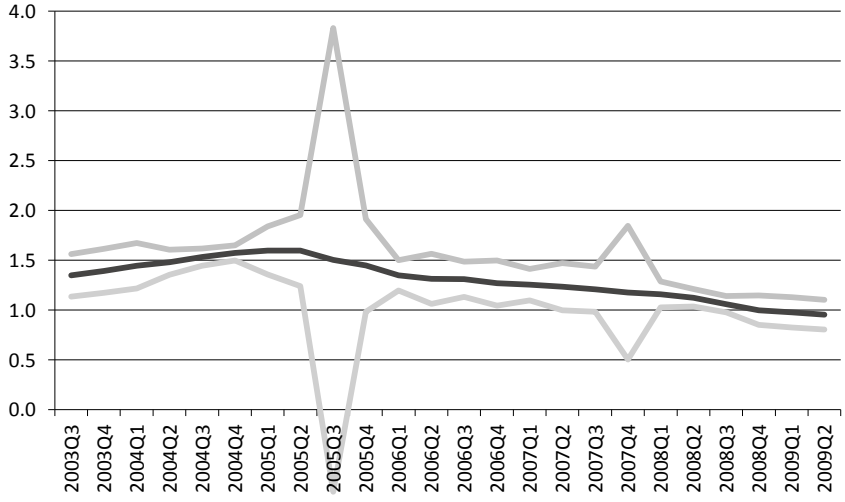
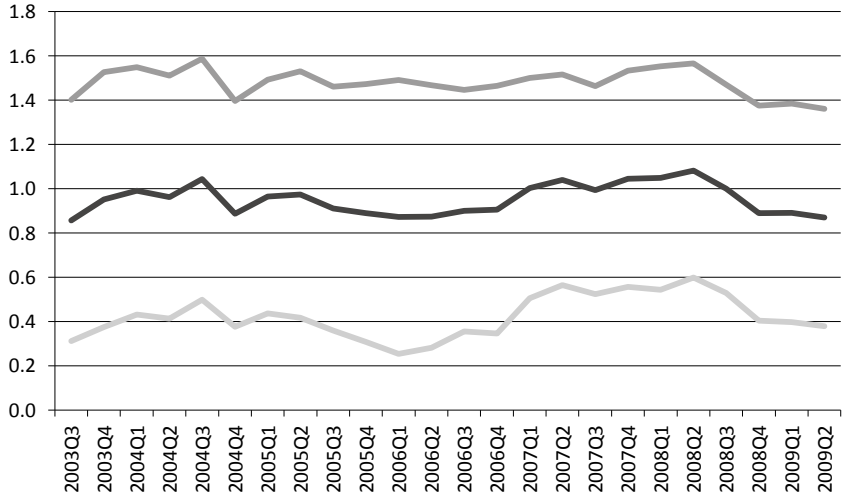


Figure 8. Rolling Regression of VAT Short-Run Elasticity



Revenues from Employer and Employee Social Contributions

The final specification of our model contains only one deterministic component—a dummy variable for the last quarter of 2008. The inclusion of this dummy can be justified by legislative changes concerning social contributions that took place in 2008, the effect of which is not fully addressed using the proportional adjustment method. We first show the results of the long-run and short-run elasticities in Table 3. Our benchmark estimations presented in column (2) imply that the long-run elasticity is equal to 1.05 and is significantly different from 1. Additionally, the short-run elasticity is 0.73 and, assuming a statistical significance level equal to 0.1, it is below unity. The results obtained for two other estimators are similar: the long-run elasticity is greater than one, whereas there is no evidence of the short-run elasticity being below or above one. The adjustment speed is relatively high at 0.84 and shows that revenues adjust quickly to deviations from the long-run equilibrium. Last but not least, social contributions display a higher speed of adjustment than VAT revenues.

Table 3. Long- and Short-Run Social Contribution Elasticities

Long-Run Relationship			
Variable	(1) OLS	(2) DOLS	(3) FM-OLS
Constant	–1.656[c] (0.159)	–1.619[c] (0.166)	–1.671[c] (0,173)
Log(compensation)	1.048[c] (0.014)+++	1.045[c] (0.014)+++	1.049[c] (0.015)+++
2008 Q4	0.104[c] (0.005)	0.118[c] (0.014)	0.091[c] (0.027)
Obs	56	56	56
Short-Run Relationship			
Variable	OLS	DOLS	FM-OLS
Error correction term	–0.796[c] (0.133)	–0.837[c] (0.143)	–0.796[c] (0.134)
Δlog(compensation)	0.752[c] (0.162)	0.728[c] (0.160)+	0.737[c] (0.162)
Obs	56	56	56

Standard errors in parentheses. The [a–] symbol refers to the p-value of the significance test for individual coefficients, with [a] 0.1 p-value, [b] 0.05 p-value, [c] 0.01 p-value. The [+] symbol refers to the p-value of the linear restriction test ($\beta = 1$).

The next step of our analysis is to allow for asymmetric elasticities in the short run (Table 4). The outcomes suggest that the elasticity for the compensation of employees in "good" times is significant and insignificantly different from unity, whereas in "bad" times it is equal to zero.

Table 4. Asymmetric Short-Run Social Contribution Elasticities

Short-Run Relationship	
Variable	
Error correction term	–0.952[c] (0.149)
Δlog(compensation)$^{+}$	1.065[c] (0.221)
Δlog(compensation)$^{-}$	0.374 (0.228)$^{+++}$
Obs	55
Asymmetry of elasticity (p-value)	0.036

Standard errors in parentheses. The [a–] symbol refers to the p-value of the significance test for individual coefficients, with [a] 0.1 p-value, [b] 0.05 p-value, [c] 0.01 p-value. The [+] symbol refers to the p-value of the linear restriction test ($\beta = 1$).

To complement our sensitivity analysis, we investigate the stability of our estimates. Figure 9 shows no clear trend in the long-run elasticity. Figure 10 indicates some instability at the beginning of the studied period. However, the short-run elasticity does not vary significantly from the beginning of 2001.

Figure 9. Rolling Regression of Social Contribution Long-Run Elasticity

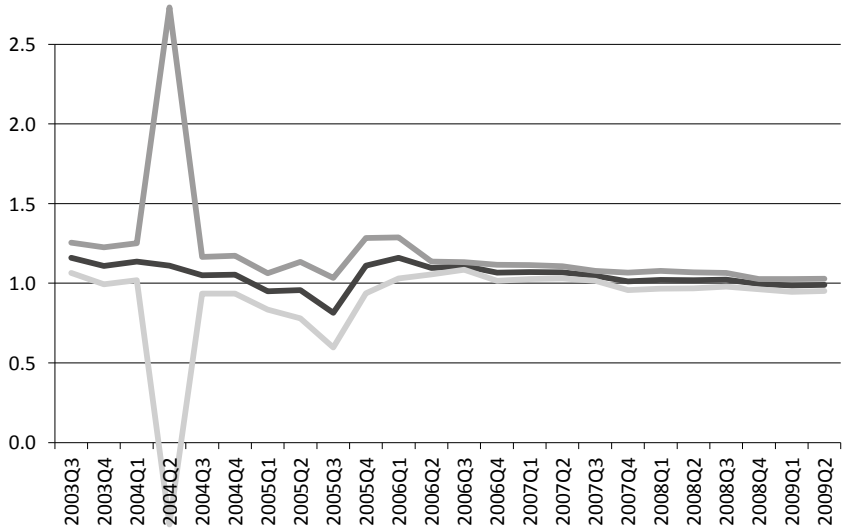
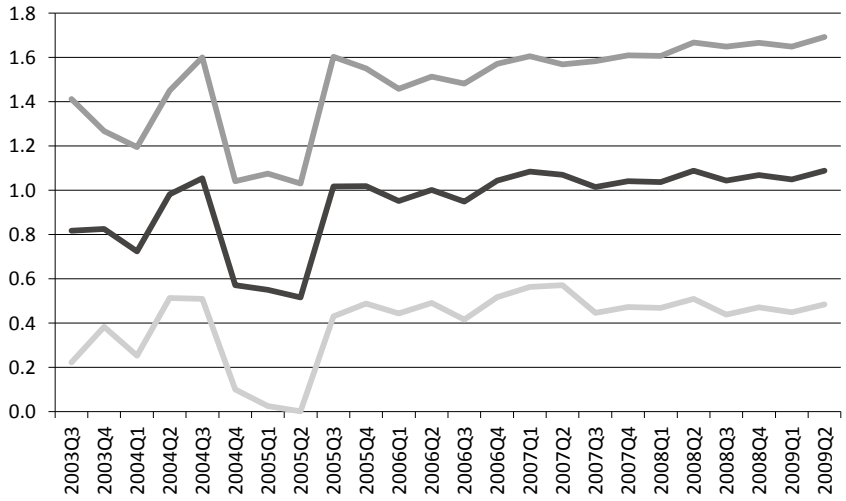


Figure 10. Rolling Regression of Social Contribution Short-Run Elasticity



Conclusions

In this paper, we estimate short- and long-run tax elasticities in Poland. We focus on VAT and social contributions, two large tax categories that together account for more than half of general government revenue. These two sources of revenue are also representative of the shift in the tax burden away from labor towards consumption that has taken place in Poland and many other countries. We have found both revenue sources to have long-term elasticities close to unity, which is consistent with what is assumed in the literature for these types of taxes as well as with their design.

In the case of social contributions, short-term elasticities were lower than 1 and lower than the long-term elasticity. Meanwhile, for VAT receipts, short--term elasticities in some of the specifications were higher than 1, which would indicate that VAT revenue tends to fluctuate more than the tax base in the short run.

We have examined the asymmetry of short-term elasticities, but the results were not fully conclusive. In the case of VAT, the asymmetry is somewhat more visible, as in the case of receipts above the equilibrium value (in "good times") the short-run elasticity is statistically significant and clearly higher than 1, i.e. the long-run elasticity, amounting to 1.5. This difference is also statistically significant. For social contributions, the elasticity value for revenue above the long-run equilibrium is also significant, but it is not significantly different from the long-run elasticity. In both cases, we were unable to establish a statistically significant elasticity value for revenues below the long-run equilibrium ("bad times").

We have also examined the variability of elasticities over time using rolling regressions. The long-run elasticity of social contributions is relatively stable

and very close to 1 for most of the analyzed period. The picture is quite different for VAT receipts, where in the period before the global economic crisis the long-run elasticity reached levels exceeding 1.5. This was a period of strong growth in the Polish economy, which may have been associated with an increase in the proportion of transactions covered by VAT reporting, as opposed to those in the shadow economy. However, afterwards the long-run elasticity declined to 1, implying that these positive developments ended with the onset of the crisis.

Our results need to be interpreted with caution as the differences in the results obtained for VAT and social contribution elasticities are relatively small. There is clearly an issue of a short data sample. Other studies of tax elasticities are usually based on annual data from at least 30 years, which was not an option for us. In order to ensure a sufficient number of observations, we used quarterly data, but there is still the problem of a small number of business cycles in the sample.

Overall, we have found VAT elasticities to be more volatile than social contribution elasticities. The asymmetry of short-run elasticities was more pronounced and the asymmetric short-run elasticities were found to be different from long-run ones in a statistically significant manner. This result is in line with our expectations and the existing literature. In the case of VAT, the potential for revenues to diverge from the underlying tax bases is considerable. This may stem from changes in the structure of consumption, for example. When agents reduce their consumption during an economic downturn, they are likely to limit their consumption of luxury goods, which are usually taxed with the maximum VAT rate, rather than the consumption of staple goods such as food, which are often taxed with reduced rates. Another effect well established in the literature is the impact of asset prices on tax receipts. This effect is more likely to appear in VAT receipts than in social contributions. Finally, VAT is a more complex tax, with numerous reduced rates and deductions. This may be exploited in the form of tax abuse, which is likely to have a procyclical pattern and additionally increase the fluctuations of receipts.

These results have implications for tax reforms that are often overlooked. Many countries have introduced reforms shifting the tax burden from labor to consumption, particularly since such policies are considered beneficial for employment. While taxation of consumption has been shown to be less detrimental to growth, policymakers also need to be aware of the likely increase in revenue volatility associated with such a shift and incorporate this factor in their budgetary plans.

References

Bettendorf L., van Limbergen D. [2013], *The Stability of Tax Elasticities in the Netherlands*, "CPB Discussion Paper", no. 256.

Bouthevillan C., Cour-Thimann P., van den Dool G., Hernandez de Cos P., Langenus G., Mohr M., Momigliano S., Tujula M. [2001], *Cyclically Adjusted Budget Balances: An Alternative Approach*, "ECB Working Paper", no. 77.

Bruce D., Fox W.F., Tuttle M.H. [2006], *Tax Base Elasticities: A Multi-State Analysis of Long-Run and Short-Run Dynamics*, "Southern Economic Journal", vol. 73, no. 2, p. 315–341.

Engle R.F., Granger C.W.J. [1987], *Co-Integration and Error Correction: Representation, Estimation, and Testing*, "Econometrica", vol. 55, no. 2, p. 251–276.

Girouard N., André C. [2005], *Measuring Cyclically-Adjusted Budget Balances for OECD Countries*, OECD Economics Department Working Paper, no. 434.

Johansen S., Mosconi R., Nielsen B. [2000], *Cointegration Analysis in the Presence of Structural Breaks in the Deterministic Trend*, "Econometrics Journal", vol. 3, no. 2, p. 216–249.

Koester G.B., Priesmeier C. [2012], *Estimating Dynamic Tax Revenue Elasticities for Germany*, "Deutsche Bundesbank Discussion Paper", no. 23.

Mourre G., Isbasoiu G-M., Paternoster D., Salto M. [2013], *The Cyclically-Adjusted Budget Balance Used in the EU Fiscal Framework: An Update*, "European Economy. Economic Papers", no. 478.

Perron P. [1989], *The Great Crash, the Oil Price Shock and the Unit Root Hyphotesis*, "Econometrica", vol. 57, no. 6, p. 1361–1401.

Perron P., Vogelsang T.J. [1992], *Nonstationarity and Level Shifts with an Application to Purchasing Power Parity*, "Journal of Business and Economic Statistics", vol. 10, no. 3, p. 301–320.

Perron P., Vogelsang T.J. [1993], *The Great Crash, the Oil Price Shock and the Unit Root Hypothesis: Erratum*, "Econometrica", vol. 61, no. 1, p. 248–249.

Phillips P.C.B. [1995], *Fully Modified Least Squares and Vector Autoregression*, "Econometrica", vol. 63, no. 5, p. 1023–1078.

Sobel R.S., Holcombe R.G. [1996], *Measuring the Growth and Variability of Tax Bases over the Business Cycle*, "National Tax Journal", vol. 49, no. 4, p. 535–552.

Stock J.H., Watson M.W. [1993], *A Simple Estimator of Cointegrating Vectors in Higher Order Integrated Systems*, "Econometrica", vol. 61, no. 4, p. 783–820.

Wolswijk G. [2007], *Short- and Long-Run Tax Elasticities. The Case of the Netherlands*, ECB Working Paper Series, no. 763.

Appendix A

Table A.1. Augmented Dickey-Fuller Tests for Variables (Levels and First Differences)

Variable name	Intercept	Intercept with Trend	First Difference
Social contributions revenues	0.351	–2.646	–10.710[c]
Social contributions base	0.701	–1.523	–2.655[a]
VAT revenues	–0.816	–1.431	–3.177[a]
VAT base	0.151	–1.166	–5.638[c]
VAT broad base	0.171	–2.466	–4.812[c]

Number of lags chosen on the basis of BIC criterion.
[a,b,c] significant at 10%, 5% and 1% level respectively.

Table A.2. Modified Dickey-Fuller Test Proposed by Elliott, Rothenberg and Stock for Variables (Levels and First Differences)

Variable name	Intercept	Intercept with Trend	First Difference
Social contributions – revenues	1.787	–2.597	–1.128
Social contributions – base	1.031	–1.851	–1.103
VAT revenues	0.327	–1.543	–2.093[c]
VAT base	0.874	–1.571	–5.026[c]
VAT broad base	0.850	–2.206	–2.703[c]

Number of lags chosen on the basis of BIC criterion.
[a,b,c] significant at 10%, 5% and 1% level respectively.

To complement our analysis, Perron's unit root test under a structural break for VAT revenues is computed [Perron, 1989, Perron, Vogeslang,1993]. The test's results are in line with those presented for the traditional ADF test and the DF-GLS test.

Table A.3. Augmented Dickey-Fuller Test on Residuals from Long-Term DOLS Equation

Variable Name	No Intercept	Intercept
Social contributions revenues	–5.386[c]	–5.318[c]
VAT revenues	–4.372[c]	–4.764[c]

Number of lags chosen on the basis of BIC criterion.
[a,b,c] significant at 10%, 5% and 1% level respectively.

Additionally, Johansen's procedure of cointegration with a structural break is used for VAT revenues [Johansen et al., 2000]. The results denote the existence of one cointegration vector.

PRZEJŚCIE OD OPODATKOWANIA PRACY DO OPODATKOWANIA KONSUMPCJI – WPŁYW NA ZMIENNOŚĆ DOCHODÓW PODATKOWYCH PAŃSTWA

Streszczenie

Celem artykułu jest wyznaczenie długo- i krótkookresowych elastyczności wpływów podatkowych względem ich bazy podatkowej oraz sprawdzenie występowania asymetrii w tempie dostosowań a także krótkookresowych odchyleniach od stanu równowagi. Badanie obejmuje dwie najważniejsze kategorie podatków w Polsce – podatek od wartości dodanej oraz składki na ubezpieczenia społeczne – w latach 1999–2013. Otrzymane wyniki wskazują, że elastyczności długookresowe dla obydwu kategorii podatków są bliskie jedności. Ponadto elastyczności krótkookresowe oszacowane na podstawie asymetrycznego modelu korekty błędem oraz regresji rolowanej wskazują na większą wahliwość wpływów z podatku VAT. Zatem wzrost obciążenia podatkami konsumpcyjnymi prowadzi do większej podatności finansów publicznych na wahania związane z cyklem gospodarczym.

Słowa kluczowe: polityka fiskalna, elastyczności podatkowe, podatek od wartości dodanej, składki na ubezpieczenie społeczne

JEL classification codes: E62, H2, H68