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PERFORMANCE OF BANK TAX REVENUES COMPARED TO OTHER SECTORAL TAXES. EVIDENCE FROM POLAND

Abstract

Aim: The aim of this study is to verify the hypothesis of decreasing volatility of budget revenues obtained from the bank tax (although still high compared to traditional taxes). The background for the research of the bank tax and conclusions resulting from it are other sectoral taxes existing in Poland, the revenues from which are, however, lower than those from the bank tax.

Methods: The analysis of the variability of revenues from individual sectoral taxes in Poland in years 2016 – 2021 was conducted using descriptive statistics, Hodrick-Prescott (HP) filter and ANOVA approach. Then the Pearson correlation is examined to compare empirical data with figures resulting from the HP filter.

Results: The results indicate that just after the introduction of the bank tax the volatility of inflows from this levy was relatively higher. There were also significant divergences between the budget forecasts and actual execution.

Discussion: One expects that with introduction of other new taxes the development might be similar (i.e. revenues will be difficult to estimate in first two or three years and more accurate assumptions will be made in the following periods). To the authors' knowledge, this study is the first to analyse the volatility of bank tax revenues, and the conclusions drawn (especially regarding trends in volatility changes and deviations from original expectations) are relevant to the theory and practice of fiscal policy. In turn, the inference regarding the share of bank tax revenues in Poland in relation to total tax revenues brings for the banking lobby arguments in favour of liberalizing the bank tax assessment rules.

Keywords: *bank tax, sectoral tax, fiscal policy, volatility of tax inflows, ANOVA, HP filter*

JEL Classification: *G21, G28, H21*

Introduction

There is a worldwide trend of introduction of new taxes and duties. There are several niche taxes. Examples of them are as follows:

- taxes on insurance premiums or contracts,
- advertisement tax,
- tax on fertilizers, on pesticides, on chemicals, on waste, fee to the vehicle scrap fond, levy on dangerous waste,
- tax on tourism, hotels, restaurants, air travel tax,
- contribution for the promotion of arts,
- tax on secondary residences or recreational homes,
- packing contribution,
- levy on particular pharmaceutical products, sales representative employees of medical corporations,
- special contribution from the electricity corporations or gas and oil sector,
- tax on entertainment, taxes on luxury expenses,
- defence contributions,

- innovation tax,
- tax for protection of wild animals or animal wellbeing tax, hunting and fishing taxes.

Some of them – often in other form – exist already in Poland. It might be expected that those that are not in force in Poland would be eventually introduced also here. In 2020 and 2021 in Poland several new levies entered into force – retail sale tax, some form of digital tax, so called "sugar tax", fee for sales of small alcohol bottles, power fee, "plastic tax" or deposit fee on used engine oil. What most of these taxes have in common is that unlike traditional taxes (such as Value Added Tax, Corporate or Personal Income Taxes) they affect only particular sectors of economy. These taxes are referred to in this article as sectoral taxes. Separately they provide significantly less tax revenues than those traditional taxes. But concurrently they may be less distortive to the economy or may execute well stimulation or destimulation function. Such small taxes may diminish also overall deadweight loss connected with state tax system (because of lower taxation rates). They may be also precisely targeted at goods with less elastic supply or demand – which also have a positive effect on limitation of deadweight loss. Due to those features we may expect that in the following years other new taxes may emerge – especially levied on some market niche. Sectoral taxes are usually levied on large entities, often listed on the stock exchange. The transparency of the finances of these taxpayers reduces the cost to the state of gathering the respective data and the risk that the method of obtaining the data necessary to determine the tax burden is considered illegal. The issue of the legality of data acquisition by the state has been written about by, among others, Sitek and Bednarek (2013).

The subject of analysis in this article are all types of sectoral taxes functioning in Poland for at least 5 years (i.e. bank tax, game tax and mineral tax). For the remaining sectoral taxes, the period of operation (less than 2 years) is too short to make comparisons and draw conclusions.

Although with respect to existing taxes sometimes in recent years tax bases were broadened (e.g. excise duty was introduced on electronic cigarette liquid), we did not analyse them. The reasons are the following: (i) they are not standalone taxes but only share of bigger tax, (ii) usually the tax base was

extended in recent years and there is not enough periods for quantitative analysis and finally (iii) – unlike bank tax, game tax or mineral tax – there are no monthly data on such extended taxes.

The bank tax was introduced in Poland in early 2016. The tax covered not only banks, but also cooperative savings and credit unions, insurance companies and credit institutions. In case of domestic banks, branches of foreign banks and branches of credit institutions, the taxable base is the surplus of the taxpayer's assets resulting from the statement of transactions and balances determined on the last day of the month on the basis of entries in the general ledger accounts – over the amount of PLN 4 billion. For these groups of taxpayers, the tax base is also reduced by own funds and Treasury securities. State-owned banks were exempted from paying the tax. Tax is charged monthly on assets at a rate of 0.0366%, or 0.44% p. a. (Law of January 15, 2016 on Tax on Certain Financial Institutions).

New legislation on game tax is binding from 2010. Initially it was imposed on games of chance, mutual wagering, slot machine games and (from April 2017) also on card games. Depending on the type of the game the tax base is defined as revenues from sale of lottery tickets, value of stakes, the face value of the playing cartons, amount of winnings etc. To various games different tax rates are assigned. From perspective of our research it is important that in the observed period there was almost no legislative changes in this respect.

Initially mineral tax was imposed only on extraction of cooper and silver. From 2016 mining of natural gas and crude oil is also subject to that tax. Therefore, in the analysed period the scope of the tax did not change. The tax base is generally connected with the quantity (cooper and silver – hence a per unit tax rates are imposed here) or value of mineral yielded (gas and crude oil – in this respect an ad valorem tax rate is used). There were slight amendments in the tax rates prescribed for cooper and silver in the considered period: (i) connected with yearly inflation index, (ii) monthly adjustments to the market price and (iii) there was slight decrease of the rates in periods of fall in quoted prices. No changes in the rates were introduced for gas and crude oil. Overall, in the considered time-span the legal regulations in respect of that tax were relatively stable and amendments introduced were of limited character.

Total receipts from taxes and compulsory social contributions in Poland in 2020 exceeded PLN 831 billion. At the same time revenues from bank tax were at the level of PLN 4.7 billion (i.e. less than 0.6% of total budget inflows). The share of bank tax revenues (although small compared to traditional taxes) in total budget revenues in Poland is among the highest in Europe (please refer to Figure 1). Revenues from game tax amounted to PLN 2.3 billion (almost 0.3% of that value) and from mineral tax reached nearly PLN 1.7 billion (less than 0.2%). Thus in 2020, those three taxes altogether represented ca. 1% of total budget revenues. Basic descriptive statistics with respect to those taxes are presented in tables 1 – 3. At the same time VAT inflows were responsible for 22.4% of budget revenues, PIT for 14.8% and CIT for 6.4%. The scale is therefore incomparable. Thus, in case of sectoral taxes probably fiscal function play lesser role in comparison to stimulation/destimulation function. However, small taxes transform into insignificant deadweight loss.

The aim of this paper is to verify the hypothesis of decreasing volatility of budget revenues obtained from the bank tax (although still high compared to traditional taxes). The background for the analysis of the bank tax and its conclusions are other sectoral taxes operating in Poland, the revenues from which are, however, lower than those from the bank tax. The bank tax also has a very significant impact on economic growth (Łaszek and Trzeciakowski, 2016).

The analysis of the volatility of inflows from individual sectoral taxes in Poland from 2016 to 2021 is conducted using descriptive statistics, Hodrick-Prescott (HP) filter and ANOVA approach. Then the Pearson correlation is examined to compare empirical data with figures resulting from the HP filter.

The remainder of this article is structured as follows. Section 2 reviews the most relevant literature. The next one describes the data and methodology employed in the empirical research. Section 4 presents results and their discussion. The last part of the manuscript contains the main conclusions.

Literature review

The review of the literature related to the issues presented in this paper can be divided into three main streams. The first focuses on contemporary trends in fiscal policy and how sectoral tax policy fits into that trend. The second relates to the stability of tax revenues, and the third to the consequences of the introduction of a bank tax as the most significant tax from the point of view of the budget among all sectoral taxes.

The subprime crisis and the sovereign debt crisis in Europe have led to a shift in views about the possibility of stabilizing economies through fiscal policy. The debate currently centers around the impact of the capital gains tax on the dynamics of social inequality and the role of fiscal policy as a tool for macroeconomic stabilization. Overall, the most significant change that fiscal policy has undergone since the financial crisis preceding the COVID-19 pandemic has been the shift from the application of certain rigid rules (e.g. automatic stabilizers) to the definition of a spectrum of objectives (e.g. reducing inequality, stimulating demand, confining climate change, European convergence). Achieving these goals should go hand in hand with a coordinated path of public debt reduction (so that it does not distort demand and increase inequality), based on new fiscal rules with less pro-cyclicality than before. This requires defining a new fiscal policy paradigm with new European institutions coordinating the fiscal policies of individual member states (Ragot, 2018). A fairly similar approach is represented by the authors of the OECD report on fiscal policy directions after the pandemic crisis, emphasizing the importance of tax policies for inclusive and sustainable growth beyond the COVID-19 crisis (OECD, 2021). They point to the need to structure fiscal policy so that it supports sustainable growth. This context includes taxes related to climate policy, but also taxes on minerals and broadly defined sin taxes or public health taxes, i.e. taxes imposed on the consumption of potentially harmful goods for health. These include sugar-sweetened beverages, tobacco, alcohol, among others (Miracolo et al., 2021). Growing public resistance to taxation makes it necessary to look for types of taxes that will meet with relatively little criticism. Such an area is taxes on socially undesirable consumption (Brzezinski, 2021), the sin taxes just mentioned. Combining the goals of reducing public

debt, the intent of balancing the budget, reducing the negative impact of taxes on demand, diminishing inequality and addressing social disadvantages, an increasing number of countries are introducing new types of taxes that affect only selected groups of taxpayers. Such taxes are referred to as "painless taxes" because the goods or services taxed are not necessities (Clotfelter, 2005). Declared as the most important social goal of introducing such fiscal burdens is accompanied by the objective of increasing budget revenues.

Public health taxes and all kinds of tributes related to the exploitation of the environment, or imposed with the intention of additional (apart from fiscal revenues) objectives of a public good nature (e.g. financial stability) are examples of sectoral taxes (i. e. imposed on selected sectors of the economy) whose importance varies widely across countries. For example, in Finland the gambling tax is an important source of budget revenue (Kotakorpi et al., 2016), which cannot be said about Poland and many other countries. Countries where sectoral taxes play a rather marginal role in terms of their share in total tax revenues are among the majority.

This thesis with respect to excise-type duties on non-alcoholic beverages is confirmed by Preece (2013), who additionally points out the offset between the additional government revenue and the deterioration of the taxed industry's eco-financial performance and ultimately the decrease in the amount of taxes paid by the industry. Such doubts and reservations related to the construction of the mineral extraction tax are pointed out, among others, by Połczynski (2014). For some countries, the problem remains to determine the scale of the market which goods and services are to be taxed and the feasibility of taxation (Koltsova et al., 2018). The issue of other negative effects associated with sectoral taxes (using the gambling tax as an example) is highlighted by Roukka and Salonen (2020) who show that lower income, less educated and rural area living individuals are expected to be the "losers" of the Finnish gambling taxation system. The above conclusion with respect to sin taxes is confirmed by Brzezinski (2021). The key issue, therefore, remains the final assessment of sectoral taxes. In most cases, however, this balance confirms the legitimacy of such tributes. With reference to the above statement, one can quote the conclusion made by O'Donoghue and Rabin (2006) that imposing

taxes on unhealthy items and returning the proceeds to consumers generally contributes to the total social surplus.

In addition to the widely understood reasons and consequences of introducing sectoral taxes, from the point of view of the state budget an important issue is the stability of budget revenues and their predictability. Low tax revenue volatility should be a feature of an optimal (i.e. fair and efficient) tax system (Felix, 2008). It is important to identify incomes that are less susceptible to changing business cycle phases. This is a condition for long-term, stable and predictable fiscal policy. Typically, however, states have difficulty estimating future budget revenues. This is due to, among other things, the use of a progressive tax model, frequent changes in tax law, or the tendency of businesses and individuals to avoid paying taxes (Creedy and Gemmell, 2008). Among the theoretical models devoted to optimizing the structure of tax revenues so that they exhibit the least possible sensitivity to a change in the phase of the business cycle, the White (1983) model comes to the fore. The concept of stabilizing sales tax revenues based on income elasticities of wealth, on the other hand, is proposed by Kwak (2013). Williams et al. (1973) point out that personal income tax inflows and sin taxes (taxes on alcohol and tobacco) are characterized by high volatility and low predictability. Fox and Campbell (1984) as well as Dye and McGuire (1991) empirically confirm the higher volatility of sales taxes relative to income taxes. Bruce et al. (2006) however come to the opposite conclusion, i.e. prove relatively higher volatility of income taxes. The introduction of new types of taxes promotes the diversification of revenue sources and reduces their volatility (Yan, 2012). At the same time, it should be added that most of the studies on variability of tax revenues concern the United States. Among the studies devoted to European tax systems, the article by Alfonso and Furceri (2010) stands out, in which the authors prove a negative correlation between the volatility of tax revenues and public expenditures and economic growth. Similar conclusions regarding the relationship between tax revenue volatility and Gross Domestic Product (GDP) are reached by Riscado et al. (2010) as well as Karpowicz and Majewska (2018). Bleaney et al. (1995) find that tax revenue volatility is higher in developing open economies struggling with high inflation. Seegert (2016), in turn, examines the sources of variation in tax revenue across U. S. states.

Using an Oaxaca-Blinder decomposition he concludes that states' tax policy changes account for 59% of the growth of tax revenue volatility whereas that increased state GDP volatility is a determinant responsible only for 22%. The study gives the evidence that the changes American states made to their tax portfolios are important determinants of tax revenue instability.

This study analyzes the amount and variability of bank tax revenues in Poland in comparison with other sectoral taxes and constitutes a development of the research conducted by Karpowicz et al. (2022c) focusing on identification of relation between stability of bank tax stability and bank tax model. The bank tax may be credited to a separate stabilization fund, or the proceeds may go directly to the state budget. In Central and Eastern Europe, bank tax revenues are mostly directed to the state budget (Szołno – Koguc and Twarowska – Ratajczak, 2021), which, according to Borowski et al. (2016) and Balutel and Voia (2021), does not contribute to financial stability and results in a weakening of the credit portfolio augmentation. Cannas et al. (2014) develop a model that optimizes the design of a bank tax from the perspective of equitably distributing the cost of systemic risk. Karpowicz et al. (2022b) identify macroeconomic and bank specific determinants of bank tax inflows. The rules for determining the bank tax, including the rate and the choice of the basis of taxation (assets or liabilities) have an impact on the business models of commercial banks (Devereux et al., 2015). This is especially true for the deposit-based bank tax model (liabilities less own funds or own funds plus deposits covered by the deposit guarantee scheme), in which banks tend to increase their own funds, take relatively more risk, and increase lending. If the bank tax is calculated based on the balance of deposits (sometimes only those that are not covered by the deposit guarantee scheme), the bank finances lending from its own funds to reduce the tax burden. The cost of equity along with the bank tax burden have a negative impact on the return on equity (ROE). At the same time, by reducing leverage, there is space for more Risk Weighted Assets (RWA), which together stimulates more credit risk taking. Higher-risk exposures are also accompanied by higher yields. These conclusions are supported by the findings of Bremus et al. (2020). They demonstrate that the introduction of a bank tax provides an incentive for deleveraging. The opposite view is taken by Borowski et al. (2016) who, however, study the

bank tax in Poland, where it is calculated on the basis of assets. Findings from studies focusing on the impact of the bank tax on bank performance are mixed. On the one hand, for example, Kogler (2019) proves an increase in net interest margin (NIM) as a result of bank tax implementation, while on the other hand Puławska (2021) points to a decline in ROA. Despite the ban in some countries (e.g. Poland), increased tax burden is passed on to bank customers, as confirmed by Chiorazzo and Milani (2011), Weder di Mauro (2010), Giżyński (2021), Karpowicz et al. (2022a) and Kogler (2019). The latter proves also the relatively higher efficiency of the tax shifting process in countries with high banking sector concentration and low competition. Taking into account the segmentation of bank customers, according to Capelle-Blancard and Havrylchyk (2017) the increase in costs connected with introduction of the bank tax is mainly experienced by households. It should also be added that banks respond to higher (additional) taxes by raising margins, while the increase in government revenues comes at the cost of a long-term decline in GDP, an increase in lending rates, a slowdown in lending, and an erosion of banks' own funds (Bosca et al., 2019). Relatively little research has been devoted to the sustainability of bank tax revenues, hence the analysis presented in this article fills a research gap. An exception in this regard are the findings of Buch et al. (2016). The aforementioned authors argue that bank tax revenues in Germany turned out to be lower than expected, with the dominant portion coming from large commercial banks. This effect is consistent with the a priori assumption that the amount of tax paid by individual banks should be correlated with their contribution to systemic risk.

Data and methodology

It was decided to focus on tax on selected financial institutions (commonly referred to as bank tax), which is the newest sectoral tax for which reasonable quantity of data is available. The performance of this tax was compared with other sectoral taxes, i.e. tax on extraction of some minerals and game tax. The study is based on detailed data provided by Polish Ministry of Finance (annual Operative Reports on the Implementation of the State Budget for years

2016-9M2021). Information on monthly revenues from bank tax from the moment of its entry into force in March 2016 up to September 2021 was used (which is the newest data available). As a result the whole period when bank tax was collected in Poland and for which figures are accessible was considered. Monthly data for the same period for mineral tax and game tax were used as well. Consequently, a balanced panel to compare performance of those taxes was built.

Such monthly approach enabled to: (i) perform more detailed analysis than standard annual observations (we had 67 samples instead of six that would be the case if years were selected) and (ii) arrive at more interesting/robust conclusions. In addition for obvious reasons there is no data for bank tax revenues for some months of 2016 and 2021. Hence, yearly approach would be misleading as the data set would not be balanced and comparable with full years 2017-2020. Such monthly approach is connected with potentially more outliers. It should be noted that if an outstanding value is caused by error or may lead to an erroneous result (biased estimator), consideration should be given to removing it using appropriate procedures [e.g. by removing erroneous information, using of winsorization, implementation of least trimmed squares (LTS) or least absolute deviations (LAD) procedures]. In the analyzed cases, however, we cannot speak of an error, as we rely on real empirical data. In addition, such outliers add significant value to our analysis as they actually justify the higher volatility of tax revenues in a given case and ensure comparability between sources. With the methods used, we also do not have to pay attention to the potential bias of the estimator. Therefore, in the analyzed situation, the use of such procedures could be redundant and even to some extent may distort the informative value of the results.

All data we work on are in Polish zloty. It was decided not to consider inflation as except for months of 2021 prices were relatively stable (HICP index ranged from minus 0.6% in 2016 to 3.4% in 2020). Secondly, it was referred also to budget forecasts published in January or February each year for the following year, which obviously cannot consider actual inflation but only some predictions. Finally, even if working on real values the conclusions would not change and informational value of calculations will not increase. Volatility of the aforementioned taxed using different tools was analysed. In particular:

I. Descriptive statistics – the aim was to calculate coefficient of variation for revenues from each tax. Then to compute average coefficient of variation for particular tax. And finally to compare performance for verified taxes.
II. Hodrick–Prescott filter – a trend curve was estimated, that unlike standard approach in not linear but characterized by better fit to empirical data. Next again descriptive statistics was used – this time for such estimated values.
III. ANOVA –an alternative calculation to analyse the volatility of inflows from particular taxes was made. The statistics was run for four groups of data, whereas the groups were named as years from the period 2017 – 2020. Years 2016 and 2021 were not considered for ANOVA due to lack of full data. The objective was to verify the null hypothesis that assumes that there is no difference between the means of the groups. T-test or Wilcoxon test are not used here as in this study there are more than two groups that are being compared, whereas while having three or more groups those test cannot be implemented and ANOVA is the right choice.
IV. Pearson correlation – empirical data was compared with figures produced by HP filter. In doing so it was verified how well actual fiscal results follow the trend curve.
V. Comparison of performance of particular taxes in terms of rising revenues with budget assumptions – at the beginning of each year state budget is estimated. Such estimation includes projection of revenues from particular taxes. An analysis was performed to what extent their actual performance followed such initial budget assumptions. In this respect years 2016-2020 were considered (9M2021 was not taken into account due to lack of monthly data for year end and hence there is no possibility for comparison).

Results and discussion

Bank tax provided for much more stable tax revenues over months within a particular year than other analysed sectoral taxes. When focusing on months highest coefficient of variation was recorded in 2020 – i.e. 11.8%. In other years volatility was significantly smaller. As a result the average coefficient for period 2M2016-9M2021 was 4%. For game tax such average was 11% and for mineral 16.3% (Table 4). For numbers estimated with HP filter statistics fell to 1.3%, 4.4% and 9.3% respectively (Table 5). Consequently, according to both calculations most stable tax revenues are provided by bank tax followed by game tax and there is high volatility of budget inflows for mineral tax.

At the same time the calculation of the correlation of empirical data with numbers estimated with usage of HP filter resulted in the coefficient of 0.78 for bank tax, 0.92 for game tax and 0.85 for mineral tax respectively. Such results suggest that game tax revenues follow some clear trend, whereas for mineral tax and bank tax revenues such trend is less apparent. Yet for bank tax there are few outliers recorded in every month in the period November 2019 – April 2020. Not for them the performance of this tax would significantly increase.

Further calculations with use of ANOVA for 2017-2020 were made (as balanced panel was required, months of 2016 and 2021 were not taken into consideration). For bank tax and game tax the p-statistics is less than 0.05. Therefore, the null hypothesis was rejected, according to which there are no differences between the population means. For mineral tax p-statistics exceeds 0.05 and the null hypothesis was not rejected (Tables 6 – 8). Such conclusions seem reasonable, when comparing the results with graphs (Figures 2 – 7). Namely, only in mineral tax the trend was horizontal over the whole period 2017-2020 (tax revenues indeed rose for this tax also but it happened in 2021, which was not considered for ANOVA).

Government achieved best result in estimation of revenues from game tax. Most inaccurate budget assumptions were made in 2019, when actual results from tax collection exceeded the budget calculations by 12.3%. Over the years 2016-2020 on average government was wrong by 4.1%. For bank tax such figure is 10.6%. However, in years 2018-2020 the number fell to just 2.1%. Is seems that it is most difficult to anticipate revenues

from mineral tax – average error in the period 2016-2020 amounts to 27.5% (Table 9).

Our analysis shows that of all sectoral taxes, the bank tax is the most stable burden. Stability of inflows and their limited elasticity are desirable features of the tax. They provide the possibility of better forecasting of budget revenues and thus increase the credibility of declarations about the budget deficit or surplus. From the point of view of the government and the taxed entities, the stability of inflows (the government's perspective) and burdens (the taxed entities' point of view) is a premise that the tax formula will not be modified. For this reason, the conclusions formulated in this study have practical implications for the government and the banking sector. Regarding other sectoral taxes, the results of our research allow us to conclude that if there is no adjustment and stabilization process (as in the case of the banking tax), modification is expected.

Conclusions

During the COVID-19 pandemic, one of the widely debated issues was the appropriateness of maintaining a bank tax or the need to modify its design. This is especially true in Poland, where this tax is one of the highest in Europe. This is evidenced by the conclusions of a simulation conducted by Mielczarek (2020). Indeed, banks have become part of the support system for businesses and households experiencing the negative effects of the pandemic crisis. This came at the expense of their performance (Bernardelli et al., 2021; Demirguc-Kunt et al., 2020; Korzeb et al., 2021), which is characterized on the one hand by a satisfactory level of own funds and liquidity, but on the other hand by a systematically deteriorating profitability, to which the bank tax undoubtedly contributes. Such factors as the impact of the tax on the condition of the banking sector and the pace of lending, its importance for the state budget in terms of the amount of revenue and its volatility will determine the legitimacy of abolishing or at least changing the design and lowering the burden. With bank tax it is visible that at the beginning the volatility was greater. There were also significant divergences between the budget forecasts

and actual execution. It seems that when the government gained experience in estimating and collecting the tax, and the banks probably developed a model of operation suitable for themselves – we observed that the fiscal revenues became more stable. We may expect that with introduction of other new taxes the development might be similar (i.e. revenues will be difficult to estimate in first two or three years and more accurate assumptions will be made in the following periods).

Stability of the tax base play a key role for maintenance of certain level of budget inflows. Governments may consider to design taxes in a way that would avoid high volatility of the tax base. On the other hand one of the features of theory of optimal taxes is their elasticity meant as capacity to adjust to current economic situation. Therefore, governments should avoid levying taxes that met the criteria of stability of revenues they provide but at the same time are inelastic and exert too much pressure on taxpayers in unfavorable economic periods.

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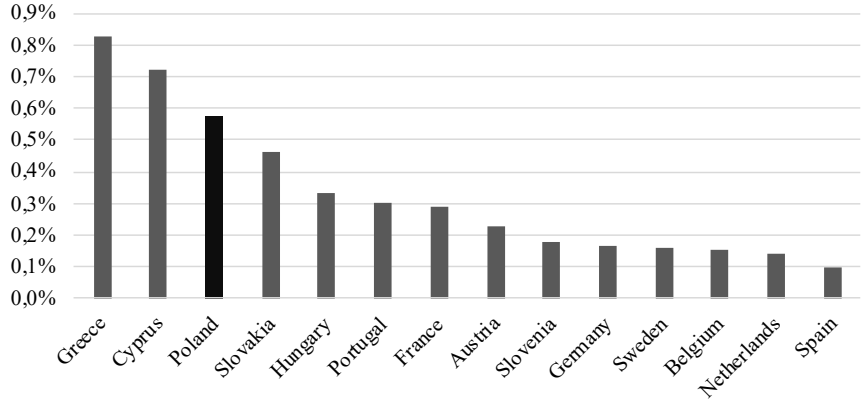
Appendix

Figure 1. *Revenues from bank tax as a percentage of total tax revenues and social security contributions (2020)*



Source: own calculations based on Eurostat database

Table 1. *Basic descriptive statistics on bank tax (PLN)*

Year	Min	Max	Range	Average	Median	Standard deviation
2016	336 401.8	364 197.8	27 796.0	350 681.0	349 417.7	8 910.5
2017	349 705.4	369 181.4	19 476.0	361 768.4	365 234.0	6 979.1
2018	367 812.7	384 417.3	16 604.6	375 615.5	375 918.4	4 869.0
2019	364 486.3	438 097.9	73 611.7	391 698.3	392 588.2	17 704.1
2020	303 986.0	508 405.6	204 419.6	401 842.7	412 794.1	47 226.9
2021	416 826.5	447 204.6	30 378.1	432 985.8	434 156.7	9 482.3

Source: own calculations based on annual Operative Reports on the Implementation of the State Budget for years 2016-9M2021 (Polish Ministry of Finance)

Table 2. *Basic descriptive statistics on game tax (PLN)*

Year	Min	Max	Range	Average	Median	Standard deviation
2016	108 582.6	156 576.8	47 994.2	119 272.8	115 350.7	13 544.2
2017	108 703.4	166 276.8	57 573.4	136 683.6	129 625.5	18 180.6
2018	144 726.8	175 462.4	30 735.5	158 492.9	154 995.0	9 873.0
2019	171 063.8	224 430.8	53 367.0	194 714.5	190 767.4	15 448.3
2020	114 071.8	240 403.7	126 331.9	194 822.8	210 772.6	38 872.5
2021	209 157.1	268 193.5	59 036.3	239 991.1	240 050.0	17 289.6

Source: own calculations based on annual Operative Reports on the Implementation of the State Budget for years 2016-9M2021 (Polish Ministry of Finance)

Table 3. *Basic descriptive statistics on mineral tax (PLN)*

Year	Min	Max	Range	Average	Median	Standard deviation
2016	93 866.4	136 966.5	43 100.1	109 724.7	108 162.5	10 702.0
2017	127 983.5	169 403.9	41 420.5	148 852.0	150 825.9	11 273.1
2018	122 911.7	174 588.7	51 676.9	140 760.1	133 280.4	14 789.1
2019	103 669.3	156 528.3	52 859.1	128 042.4	128 616.6	18 448.7
2020	103 955.3	180 326.6	76 371.3	139 342.7	133 668.1	24 488.6
2021	128 246.4	526 610.6	398 364.2	286 155.9	309 616.3	109 386.7

Source: own calculations based on annual Operative Reports on the Implementation of the State Budget for years 2016-9M2021 (Polish Ministry of Finance)

Table 4. *Coefficient of variation (empirical data)*

Year	Bank tax	Game tax	Mineral tax
2016	2,5%	11,4%	9,8%
2017	1,9%	13,3%	7,6%
2018	1,3%	6,2%	10,5%
2019	4,5%	7,9%	14,4%
2020	11,8%	20,0%	17,6%
2021	2,2%	7,2%	38,2%
Average	4,0%	11,0%	16,3%

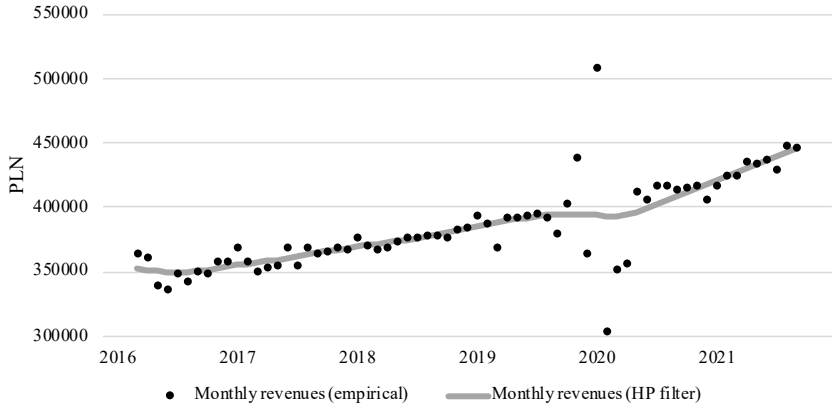
Source: own calculations based on annual Operative Reports on the Implementation of the State Budget for years 2016-9M2021 (Polish Ministry of Finance)

Table 5. *Coefficient of variation (HP filter)*

Year	Bank tax	Game tax	Mineral tax
2016	0,4%	0,9%	9,9%
2017	1,2%	7,4%	2,9%
2018	1,2%	4,2%	3,0%
2019	0,9%	3,8%	4,8%
2020	2,1%	4,9%	17,1%
2021	1,9%	5,4%	17,9%
Average	1,3%	4,4%	9,3%

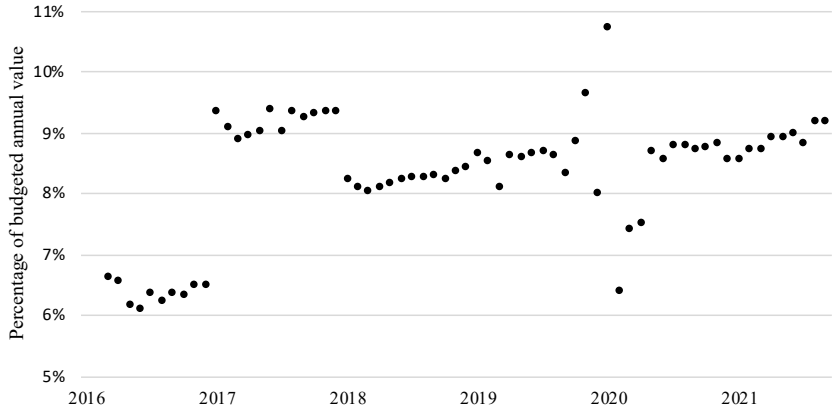
Source: own calculations based on annual Operative Reports on the Implementation of the State Budget for years 2016-9M2021 (Polish Ministry of Finance)

Figure 2. *Monthly bank tax revenues for 3M2016-9M2021(empirical data + HP filter)*



Source: own calculations based on annual Operative Reports on the Implementation of the State Budget for years 2016-9M2021 (Polish Ministry of Finance)

Figure 3. *Bank tax revenues for 3M2016-9M2021*



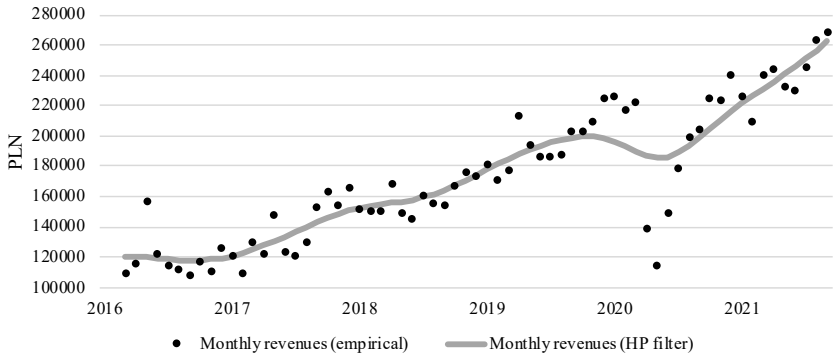
Source: own calculations based on annual Operative Reports on the Implementation of the State Budget for years 2016-9M2021 (Polish Ministry of Finance)

Table 6. *ANOVA for bank tax*

Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	1,12E+10	3	3,74E+09	5,245735275	0,003501	2,816466
Within Groups	3,14E+10	44	7,14E+08			
Total	4,26E+10	47				

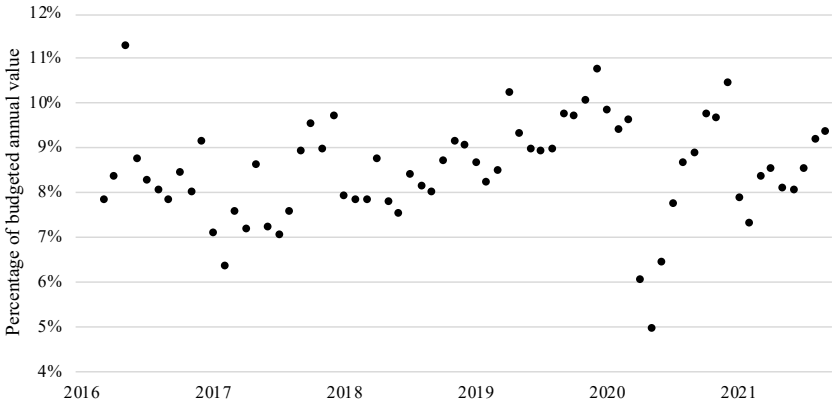
Source: own calculations based on annual Operative Reports on the Implementation of the State Budget for years 2016-9M2021 (Polish Ministry of Finance)

Figure 4. *Monthly game tax revenues for 3M2016-9M2021 (empirical data + HP filter)*



Source: own calculations based on annual Operative Reports on the Implementation of the State Budget for years 2016-9M2021 (Polish Ministry of Finance)

Figure 5. *Game tax revenues for 3M2016-9M2021*



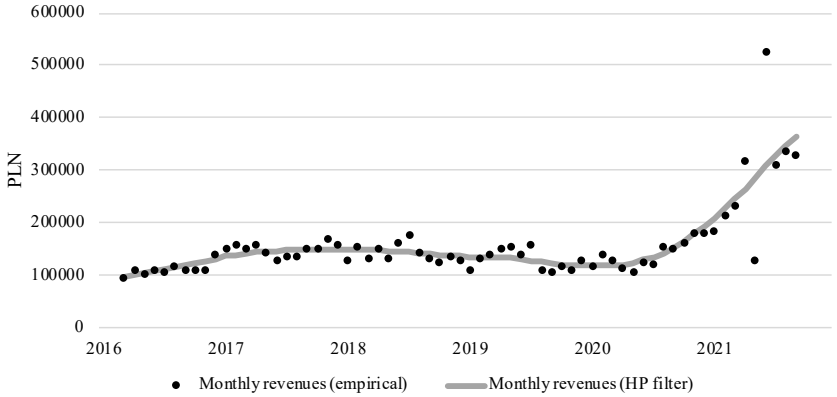
Source: own calculations based on annual Operative Reports on the Implementation of the State Budget for years 2016-9M2021 (Polish Ministry of Finance)

Table 7. *ANOVA for Game tax*

Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	1,1E+10	11	1E+09	0,807902	0,631997	2,066608
Within Groups	4,47E+10	36	1,24E+09			
Total	5,57E+10	47				

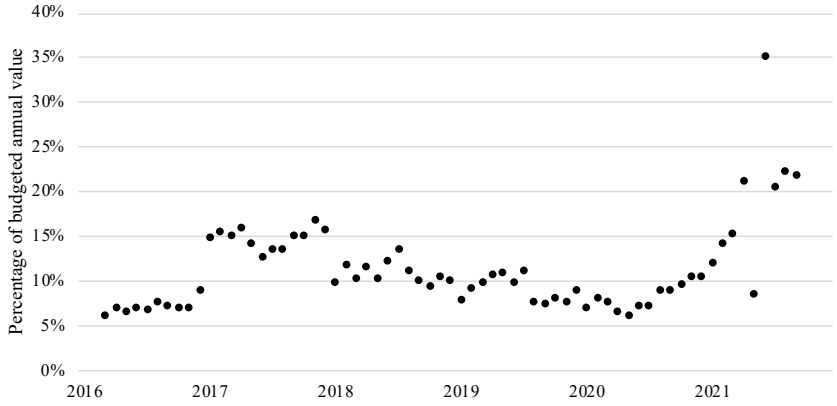
Source: own calculations based on annual Operative Reports on the Implementation of the State Budget for years 2016-9M2021 (Polish Ministry of Finance)

Figure 6. *Monthly mineral tax revenues for 3M2016-9M2021 (empirical data + HP filter)*



Source: own calculations based on annual Operative Reports on the Implementation of the State Budget for years 2016-9M2021 (Polish Ministry of Finance)

Figure 7. *Mineral tax revenues for 3M2016-9M2021*



Source: own calculations based on annual Operative Reports on the Implementation of the State Budget for years 2016-9M2021 (Polish Ministry of Finance)

Table 8. *ANOVA for Mineral tax*

Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	2,64E+09	3	8,8E+08	2,510488	0,070968	2,816466
Within Groups	1,54E+10	44	3,51E+08			
Total	1,81E+10	47				

Source: own calculations based on annual Operative Reports on the Implementation of the State Budget for years 2016-9M2021 (Polish Ministry of Finance)

Table 9. *Deviation of budget execution from initial assumptions*

Year	2016	2017	2018	2019	2020	Average
Bank tax	36,2%	10,3%	1,3%	3,3%	1,7%	**10,6%**
Game tax	1,7%	4,0%	0,6%	12,3%	1,6%	**4,1%**
Mineral tax	16,5%	78,6%	30,9%	9,8%	1,6%	**27,5%**

Source: own calculations based on annual Operative Reports on the Implementation of the State Budget for years 2016-9M2021 (Polish Ministry of Finance)