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Liabilities of Local Government Units in Poland: Identification and Analysis of Diversification Factors

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Abstract:

Purpose: *The article aims to identify the factors that influence the levels of debt in Polish local governments. Specifically, we look at the structure of local units' revenue and expenditure and try to determine which of the characteristics have a significant impact on debt levels.*
Design/Methodology/Approach: *We divide our analysis into three types of municipalities, urban, rural, and urban-rural municipalities. We find that each of this type of municipality has different determinants of debt level.*
Findings: *This article provides a solid recommendation for researchers and policy makers to carefully derive conclusions from analyses made on the total population of local units, as their heterogeneity may significantly impact the research results. Therefore, policy recommendations and actions should not be homogeneous across all types of local governments.*
Practical Implications: *The article identifies income factors of local budgets that are statistically significant and influence positively or negatively the size of the public debt of local government units. Practical aspect of the paper means that results can be used to manage local government units or assess their stability by external agencies.*
Originality/Value: *The obtained results are in line with the previous research results and extend the knowledge in the stability and indebtedness of local government units. The study carried out allows to extend this knowledge and proves that the indebtedness of local government units is also affected by the structure of income of these units.*

Keywords: *Local government unit (LGU), financial stability*.

JEL Codes: *H72, H77, F42, F65.*

Research type: *Research Article.*

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1. Introduction

As a result of the last global recession, the state's financial stability, both in the macroeconomic aspect and on the level of individual public and private entities, has become one of the most critical topics in economic sciences. The scale of the recession and its consequences for societies require undertaking adequate legislative actions to minimize the risk of another crisis. However, to enable it, it is necessary to understand the nature of the recession itself, the factors that cause it, and those that counteract it.

In recent years, there have been a vast number of publications on the sources of the recession. It is impossible to quote all of them. As far as local, territorial self-government is concerned, the existing research studies provide knowledge about the stability of the local and regional public finance system. However, it is necessary to identify the factors that determine maintaining financial stability across various types of LGUs. Due to differences in size, revenue sources, or budgets, the factors that negatively affect the financial stability of large metropolitan municipalities and small rural ones may vary. The objective of this paper is to identify these differences.

The authors of the paper set the following central research hypothesis: The factors that determine the financial stability of the given local government unit are different, depending on the type of LGU. Three auxiliary hypotheses accompany the central hypothesis:

- The financial stability of LGU is determined by expenditure-related factors.
- Property expenditure has a significant influence on the financial stability of LGU.
- Higher stability levels also characterize
- Units with a higher level of revenues.

The analyzed period is the years 2005-2017. The research has been based on Polish local government units. They are divided into three types: urban, rural, and urban-rural municipalities. Such division allows us to search for differences between two main areas: cities and rural areas. Thus, the analysis of Polish data may be a basis for concluding other countries.

2. Literature Review

Identifying the factors that influence local government debt can be done in the context of many different issues. One of these is to examine the sustainability of the public finance system - or in other words, sustainable debt (IMF, 2020). Identifying the factors affecting debt thus allows one to identify the factors that weaken or strengthen the financial sustainability of a given local government unit. On this basis, it is possible to determine which factors should be strengthened in local fiscal policy, which should be weakened because they generate excessive risks to sustainability.

Financial stability is a multifaceted, complex notion that originates from the analyses of the market financial system, in which the banking sector plays a significant role in the EU. The financial recession and its results led to intensified research efforts to evaluate the conditions, causes, and effects of lack of stability in the market financial system. In this light, the question arises what the conditions, factors, and the desired final state of public finance are. This also refers to the finances of Local Government Units in terms of maintaining their financial stability.

In recent years the management of public finances evolved from the concept of financial condition or financial distress to the concept of financial sustainability. This process accelerated significantly after the global financial crisis when the prior indicators could not predict the financial problems of the public sector. While the previous concepts focused mainly on past events, the idea of financial sustainability is central to the future (López-Subires and Rodríguez-Bolívar, 2017).

Financial stability in the public sector may be defined as the ability of public institutions to finance present and future commitments without changing taxation and indebtedness level (EC, 2016; Bisogno *et al.*, 2017). Financial stability is related to the financial condition or financial health, but its core lies in the state's ability to deliver public services constantly and is usually determined by a broad set of indicators (Rodríguez-Bolívar *et al.*, 2016a; Bisogno *et al.*, 2017; López-Subires, Rodríguez-Bolívar, 2017).

International Federation of Accountants indicates three dimensions of long-term financial sustainability, service dimension, revenue dimension, and debt dimension (IFAC, 2013). Although financial accounting information has some disadvantages, its analysis is a promising approach in the financial sustainability assessment, both from the theoretical and practical perspective (EC, 2011; IFAC, 2013; Navarro-Galera *et al.*, 2016; Caruana *et al.*, 2019).

There is extensive subject literature on public finance's stability, particularly considering the analysis of public debt as the main factor that may destabilize public finance (Merola and Sutherland, 2012; Hamilton and Flavin, 1986; Trehan and Walsh, 1991; Hakkio and Rush, 1991; Bohn, 2006). Apart from public debt, literature also links the stability of public finance to the government's capability to incur debt, the increase in GDP resulting from a deficit, and inflation (high inflation level points to structural problems) (Gadanecz and Jayaram, 2009).

More profound studies of public finance stability focus on a broader analysis of public debt. Anastasio Guscin from the International Monetary Fund presents the assumption that public debt, and thus also public finance stability, are connected with the reliability of the monetary policy and the internal financial market (IMF 2008). These studies also demonstrate the significance of political risk and quality of bureaucracy as the factors that influence stability. The last element was also pointed out by other researchers from the International Monetary Fund. They emphasize that improper debt management leads to a deterioration of financial stability, which harms

debt servicing. According to these authors, during the last financial recession, some situations occurred when initially insignificant budget items later negatively affected the economy and stability of finance (IMF, 2010). It is doubtless that qualitative factors, apart from quantitative ones, are crucial for public finance stability.

A more detailed analysis of public debt is presented in the study conducted again by Anastasio Guscin together with Olivier Jeanne. They emphasize that the amount of debt is essential and its structure, which consists of maturity, denomination/indexation of the principal, interest rate (fixed or variable) (IMF, 1998). Their research demonstrated that previous monetary recessions might affect debt structure in developing countries by replacing debt in national currency with long-term debts in foreign currencies. One should doubtlessly assume that this phenomenon has a negative influence on the financial system's stability, as it exposes the system to a significant risk of instability caused by foreign exchange rate fluctuations.

Hana Polackova presented an exciting approach to the issue of financial stability from the World Bank. She divided the risks connected with public finance instability into two areas. The first one – "direct, explicit liabilities" – includes foreign and domestic sovereign, budgetary expenditures, budgetary expenditures legally binding in the long term. The second type is "explicit contingent liabilities." According to Polackova, they include future and uncertain liabilities, which, if materialized, generate a burden for the budget. These include future recurrent costs of public investment projects, future public pensions, social security schemes, future health care financing, future recurrent costs of public investments (Polackova, 1998). The proposed classification highlights the problem of liabilities that are not listed in public budgets. Most analyses omit this problem due to the lack of possibility to quantify this type of liabilities and their uncertainty. However, some studies exist that use future, uncertain variables. An example may be the aging of populations and the connected intergenerational settlements included in the European Commission's methodology for analyzing public finance stability (EC, 2016).

It should be noted that the number of publications on public finance stability is very high and that they include the analysis of a wide range of variables – from simple variables related to indebtedness and GDP increase, as described above, to more complex ones, such as the share of older adults in the population or the political orientation of the government (Sturm, de Haan, and de Groot 2008).

Several contributions have been analyzing the factors influencing levels of local government sustainability. However, the international literature exploring this area is not especially large. The main reason is that cross-country studies are not representative, as the rules concerning local governments in different countries are not consistent. Therefore most of the existing studies focus on one specific country. We divide this literature into two parts: a broad approach, financial sustainability, and a narrow one, concerning only debt level.

Wällstedt *et al.* (2014) basing on case studies from municipal organizations in Sweden, prove the importance of management or governance system in achieving financial sustainability. Rodríguez-Bolívar *et al.* (2016a) studied a sample of 110 Spanish municipalities with over 50,000 inhabitants to identify the principal risk factors and drivers of financial sustainability in local government. Authors find the increases in the unemployment rate and the population aged under 16 years as the risk factors, and the budget result as the main driving factor. The same group of authors basing on another sample of 139 Spanish municipalities with large population shows that the unemployment rate, the dependent population, the immigrant population, and the level of education of the population are the critical determinants of the financial sustainability in local governments (Rodríguez-Bolívar *et al.*, 2016b). García-Sánchez *et al.* (2012) also took for analysis the Spanish municipalities (153 largest ones), but authors considered the influence of political ideology on financial sustainability. They found that progressive-oriented governance leads to the better financial performance of municipalities than conservative-oriented.

Similarly, strong citizen support results in the better financial condition of local government. Drew and Dollery (2014) check whether merging local authorities gives more financial viability. The example of Greater Sydney metropolitan shows that such actions are counter-effective. Population size should be treated instead as a risk factor than the driver of local government sustainability (Bisogno *et al.*, 2017). Finally, Brusca *et al.* (2015) compare Spanish and Italian municipalities to investigate differences in the determinants of financial sustainability between countries. Indeed authors find that political ideology or unemployment rate impacts the financial condition of municipalities in Spain but do not have in Italy (vice versa in the case of population density).

In the matter of the factors influencing debt levels, Cropf and Wendel (1998) examined the impact of selected social, political, and economic factors on municipal debt behavior based on the sample of 42 largest US cities. They found that local officials have an increasing preference for revenue debt over general-obligation debt, probably due to greater accountability of the latter to the voters. Ashworth *et al.* (2005) analyzed the government fragmentation influence on indebtedness in 298 Flemish municipalities. They found that weak governments have no long-run effects on debt levels, while there is a positive effect of several parties in a coalition on the municipality's indebtedness in the short term.

Feld *et al*. (2011) performed an analysis for 137 largest Swiss cities and villages. They found that, among other things, a high degree of fiscal autonomy (measured by the share of own revenue to total revenue) leads to a lower level of local debt. Balaguer-Coll *et al*. (2016) investigated three types of forces that may impact the municipal debt in Spanish local governments: financial, political, and social. They proved a varying effect of different covariates depending on the municipality's specific debt level. Ehalaiye *et al*. (2017) analyzed the relationship between critical financial variables and the local government borrowing in New Zealand. They found that council income is the significant financial determinant of local debt in New

Zealand rather than infrastructural spending. Bastiaens *et al.* (2001) examined an advert relationship – the influence of local public debt and unconditional grants on a local government's spending and taxing decisions. The sample covered 308 Flemish municipalities. They found that a significant debt burden negatively affects local non-debt expenditures, but it does not affect the local government's taxing behavior.

3. Financial Situation of Municipalities in Poland between 2005-2017

In this article, we do not consider social nor political issues influencing the local debt levels. We concentrate our analysis only on financial factors. Specifically, we look at the structure of the local government's revenue and expenditure. This approach gives us a view on these determinants of the financial stability of municipalities, which are to a large extent under the control of local officials. Moreover, we perform our analysis separately for three municipalities: urban, rural, and urban-rural municipalities. This allows us to look into the differences in determinants of local debt levels in different local government dimensions. Table 1 presents the independent variables selected for the model and their share in revenue and expenditure in each type of municipality in Poland.

Corporate Income Tax (CIT) and Personal Income Tax (PIT) are public levies set by the central government. However, each local government has its share in CIT and PIT collected by tax offices operating in their area. In 2017 all municipalities were entitled to receive 50% of total PIT revenues and 23% of CIT revenues collected by tax offices (Council of Ministers, 2016). Therefore the CIT and PIT revenue is recognized as part of the own revenue of municipalities. The share of the revenue from this source in total revenue varies considerably between different types of municipalities. As the economic and social activities usually concentrate in cities and agglomerations, the highest share of CIT and PIT revenue is observed in urban municipalities (1,2% and 22% respectively), and the lowest in rural municipalities (0,4% and 14% respectively).

Table 1. *Independent variables used in the model and their share in total revenue and expenditure by type of municipality*

Category		**Urban municipalities**	**Urban-rural municipalities**	**Rural municipalities**
Number of units (as of 1st January 2017)		302	621	1555
Variable name	**Description**	**Share in total revenue (year: 2017)**		
ICIT	Income from Corporate Income Tax	1%	1%	0%
IPIT	Income from Personal Income Tax	22%	17%	14%
IRET	Income from Real Estate Tax	14%	13%	10%
IP	Income from property	5%	3%	1%
CS	Customs Subsidiary	27%	31%	33%
GS	General Subsidiary	18%	23%	29%

Variable name	Description	Share in total expenditure (year: 2017)		
PE	Property expenditure	14%	14%	15%
ES	Salaries	27%	26%	26%
EDS	Debt service	1%	1%	1%

Source: *Own elaboration based on the Ministry of Finance data.*

Real Estate Tax, contrary to CIT and PIT, is a local tax. Local authorities have the power to set the height of the tax rate. However, they have to restrict the maximum tax rate for each type of property imposed by the Ministry of Finance. Similarly to CIT and PIT, the revenue from Real Estate Tax in total revenue is highest in urban municipalities (14%) and the lowest in rural municipalities (10%). The same rule applies to income from property. Municipalities are allowed to manage the property being in their possession to gain additional income. The importance of this source is significantly higher in urban municipalities than in rural municipalities.

Customs Subsidiary and General Subsidiary are the two types of subsidies that municipalities receive from the central government. They account for 44% of total revenue in urban municipalities, 54% of total revenue in urban-rural municipalities, and 61% of total revenue in rural municipalities. According to this data, urban municipalities are much less dependent on the subsidiaries from the central government (have more fiscal autonomy) than the rural and urban-rural municipalities. Customs Subsidiaries are dedicated for specified purposes. Mainly they concern tasks performed by municipalities on behalf of the central administration, e.g., payments of certain benefits. In the case of General Subsidiaries, municipalities themselves decide about their destination. However, each General Subsidiary is divided into few parts, of which the largest is the subsidiary for educational tasks.

Our analysis also includes three independent variables concerning municipalities' expenditure, property expenditure, salary expenditure, and debt service expenditure. Interestingly, contrary to variables included on the revenue side, there are no significant differences in the three categories of expenditure between different types of municipalities. The property expenditure account for 14–15% of total expenditure, salary expenditure for 26–27%, and debt service expenditure for around 1%.

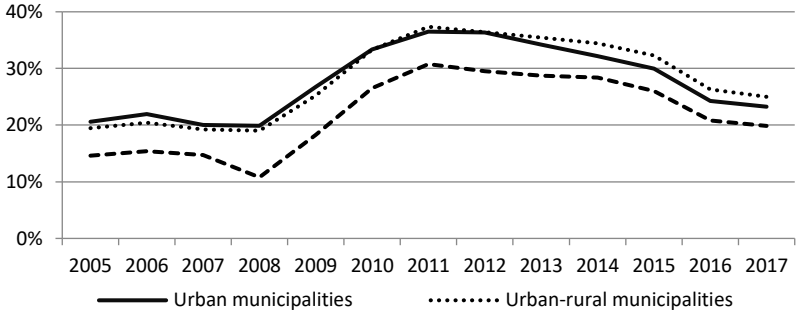
The property expenditure broadly reflects the capital expenditure made by local governments on infrastructural assets. Infrastructural investments are often a justification for local officials to increase the local debt. Therefore we expect to find a positive relationship between property expenditure and debt levels. Such a relationship has been already found in other publications, e.g., Benito and Bastida (2004) and Balaguer-Coll *et al.* (2016). However, Ehalaiye *et al.* (2017) found a statistically significant negative relationship between the amount invested in infrastructural assets by local councils in New Zealand and council borrowing. Authors suggest two explanations: first, local councils might have build up infrastructural assets before the study period, which led to less need for debt financing

later; second, there could have been specific limitations (such as high-interest rates on debt) to borrow to finance infrastructural assets during a significant part of the study period.

The salary expenditure includes all salaries paid by municipalities – not only for the workers directly hired by the local authority but also salaries of workers hired in institutions being subject to the municipality. This means in particular schools and teachers' salaries, as education is the central area of local government activities in Poland.

The expenditure on debt service has a relatively low share in the total expenditure of municipalities. However, we expect this variable to have a significant impact on local debt levels. However, the direction of this impact is not apparent. On the one hand, high debt service expenditure increases the need for debt financing (as they increase the total expenditure), but on the other hand, debt service expenditure may be perceived by local officials and voters as "wasted" expenditure (expenditure which does not bring any tangible benefits). Therefore high debt service costs may induce local officials to limit other expenditures and increase revenue, and as a result to decrease the debt levels.

Figure 1. *Debt to revenue ratios in the three types of municipalities in Poland in the period 2005–2017*



Source: *Own elaboration based on the Ministry of Finance data.*

We use in the model one dependent variable – the amount of municipalities' debt at the end of each year. As indicated in the previous section, we identify this amount as representative for assessing the local government's financial stability. Figure 1 shows the changes in municipalities' debt in the analyzed period – about revenue and divided into three main types of municipalities. There are two main insights from this figure. First, there was a visible deterioration of the local government's financial stability in 2009–2011. The debt to revenue indicator almost doubled in urban and urban-rural municipalities and tripled in rural municipalities when comparing 2011 to 2008. Second, rural municipalities are characterized by a lower level of indebtedness than urban and urban-rural municipalities. However, this difference seems to get smaller over time.

4. Results and Discussions

4.1 Data and Methodology

In order to estimate the factors of total liabilities (TL), we used the OLS (Ordinary Least Squares Method OLS (Classical Linear Regression Method, CLRM):

$$\boldsymbol{y_t} = \alpha_0 + \alpha_1\, \boldsymbol{x_{1t}} + \alpha_2\, \boldsymbol{x_{2t}} + \cdots + \alpha_k\, \boldsymbol{x_{kt}} + \boldsymbol{\xi_t} \quad (1)$$

where:
n is the number of estimated units; k is the number of independent variables X_i; $\alpha_0, \alpha_1, \ldots \alpha_k$ are the parameters; t = 1,2, …, n; and ξ_i is the random component.

We used the model consisting of the dependent variable total liabilities (TL) and the nine independent variables.

$$\text{ld\_}TL_t = \alpha_0 + \alpha_1\ \text{ld\_}ICIT_t + \alpha_2\ \text{ld\_}IPIT_t + \alpha_3\ \text{ld\_}IRET_t + \alpha_4\ \text{ld\_}IPT_t + \alpha_5\ Id\_CS_t + \alpha_6\ \text{ld\_}GS_t + \alpha_7\ \text{ld\_}PE_t + \alpha_8\ \text{ld\_}ES_t + \alpha_9\ \text{ld\_}EDS + \xi_t \quad (2)$$

where:
TL – Total liabilities (PLN)
$ICIT$ – Incomes from Corporate Income Tax (CIT) (PLN)
$IPIT$ – Incomes from Personal Income Tax (PIT) (PLN)
$IRET$ – Incomes from Real Estate Tax (PLN)
IPT – Income from Property Tax (PLN)
CS – Customs Subsidiary (PLN)
GS – General Subsidiary (PLN)
PE –Property expenses (PLN)
ES – Expenditure on salaries (PLN)
EDS – Expenses on debt service (PLN)
t – period.

The all-time series of variables were taken from the Ministry of Finance (MF) in Poland Internet databases and were annual data. The data concerned the years 2005-2017. These variables respond to the primary aggregate of total liabilities (TL) for local government units: urban, rural, and urban-rural municipalities. Of the nine independent variables such as ICIT, IPIT, IRET, IPIT, CS, and GS represent sources of income. Variables such as PE, ES, and EDS represent expenditures. The first differences of selected variables were used for the analysis, containing stationary time series.

Before the estimation of the model, we were using the first differences of selected variables. The time series of all model variables were stationary. We have prepared three econometric models individually for the local territorial unit. The OLS method allowed us to estimate significant statistical variables.

The correctness of the econometric models has been verified by evaluation of summary statistics, correlation coefficients, and appropriate tests, such as the F-Snedecor, the coefficient of determination (R^2), the test statistic for normality (Jarque-Bery, JB), White's test for heteroskedasticity, non-linearity test (squared terms, log-term), variance inflation factors (VIF) and, Breusch-Godfrey test for autocorrelation: test statistic LMF, Ljung-Box Q^`, the Durbin-Watson statistics) and ARCH (AutoRegressive Conditional Heteroscedasticity) test.

4.2 Modelling of Total Liabilites for Local Government Units

Urban Municipalities: The summary statistics, including the values of the standard deviation (Std. Dev.), showed that the most significant changes were shown by the variable EDS (0.22354) and PE (0.20442), while the lowest change (the most stable) were IRET (0.019560) and G.S. (0.024943). Coefficients of variation (C.V.) that is, the measures of differentiation confirmed that the highest level of this differentiation occurred for the variable EDS (6.3916) and PE (4.4585) against the lowest for IRET (0.44360) and G.S. (0.55186) (Table 2).

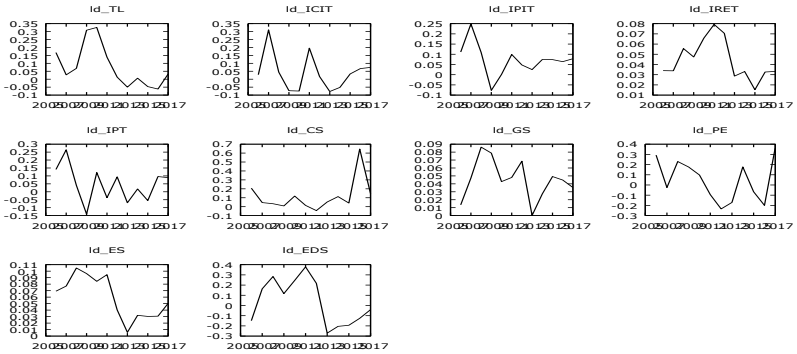
Table 2. *Summary statistics using the observations from 2005 to 2017*

Variable	Mean	Median	Minimum	Maximum	Std. Dev.	C.V.	Skewness	Ex. kurtosis
ld_TL	0.077649	0.030147	-0.061954	0.32616	0.13218	1.7023	0.86771	-0.50267
ld_ICIT	0.041278	0.030748	-0.077546	0.31094	0.11614	2.8135	1.0816	0.53490
ld_IPIT	0.071228	0.074062	-0.076902	0.24897	0.076878	1.0793	0.42805	1.2968
ld_IRET	0.044093	0.033870	0.015225	0.079274	0.019560	0.44360	0.50627	-0.91005
ld_IPT	0.046750	0.064694	-0.14066	0.26463	0.11088	2.3717	0.14286	-0.40754
ld_CS	0.11496	0.048888	-0.044179	0.64578	0.18072	1.5720	2.2933	4.4805
ld_GS	0.045197	0.046101	0.00016176	0.086277	0.024943	0.55186	-0.059112	-0.52749
ld_PE	0.045850	0.036393	-0.23482	0.36874	0.20442	4.4585	0.087061	-1.3547
ld_ES	0.059651	0.059841	0.0057735	0.10490	0.032258	0.54077	-0.084065	-1.2990
ld_EDS	0.034974	0.037778	-0.27109	0.37852	0.22354	6.3916	0.074690	-1.4977
ld_TL	0.077649	0.030147	-0.061954	0.32616	0.13218	1.7023	0.86771	-0.50267
ld_ICIT	0.041278	0.030748	-0.077546	0.31094	0.11614	2.8135	1.0816	0.53490

Source: *Own calculations on the basis of Ministry of Finance, Poland, GRETL program.*

The time series of the variables examined are shown in the Figure 2. In order to analyze the correlations between the dependent variable being total liabilities (TL) and independent variables. The highest positive linear correlation occurred between ES and TL (R_xy=0.7362), next between EDS and TL 〖(R〗_xy=0.5093). The highest negative linear correlation occurred between IPIT and TL 〖(R〗_xy=-0.4291), next between CS and TL R_xy=-0.2479) and between ICIT and TL 〖(R〗_xy=-0.2432).

***Figure 2**. Curves of model variable charts for municipalities urban municipalities in Poland in the years 2005-2017*



***Source:** Own calculations on the basis of Ministry of Finance, Poland, GRETL program.*

Before the estimation of the model used first differences of selected variables, the significance of structural parameters (t-distribution, F-Snedocor test) was examined as well as the goodness of fit of the model (the coefficient of determination, R^2) (Greene, 2003). In the input version of the estimated model, the variable significant at the 10% significance level were IPIT and ES. The coefficient of determination equaled R2 = 0.976809, which proved a high level of explanation. The Durbin-Watson autocorrelation test DW=1.844562 (Table 3).

***Table 3**. Estimation of TL values urban municipalities in Poland by the CLRM for the period 2005-2017 (input data, dependent variable: ld_TL)*

	Coefficient	*Std. Error*	*t-ratio*	*p-value*	α
const	−0.0505453	0.203087	−0.2489	0.8267	
ld_ICIT	0.227779	0.374827	0.6077	0.6052	
ld_IPIT	−1.84856	0.567754	−3.256	0.0828	*
ld_IRET	0.465502	2.92544	0.1591	0.8882	
ld_IPT	0.690172	0.266293	2.592	0.1222	
ld_CS	−0.213145	0.123011	−1.733	0.2253	
ld_GS	−1.79606	1.16385	−1.543	0.2628	
ld_PE	−0.123432	0.123913	−0.9961	0.4241	
ld_ES	5.37421	1.41069	3.810	0.0625	*
ld_EDS	−0.330714	0.458845	−0.7208	0.5459	
R-squered = 0.976809		Adjusted R-squared=0.872449	DW= 1.844562	d_L =0.6291	d_U=1.6993

***Nonte:** α = 0.01 (***), where α = 0.05 (**), α = 0.10 (*).*
***Source:** Own calculations on the basis of MF, GRETL program.*

Factual verification of the final model of total liabilities of urban municipalities for Poland in the period 2005–2017 estimated the ultimate results (sequentional elimination of variables using two-sided p-value = 0.10). The significant independent variables for TL became the variables IPIT and ES (α = 0.01), and GS (α = 0.05) and

IPT (α = 0.10). The coefficient of the model determination was maintained at a level R^2 = 0.934968. The F-Snedecor test performed confirmed the overall suitability of the model as $F\,(4,7) = 25.15999 > F^* = 4.12031$. The Durbin-Watson autocorrelation test DW =2.469046, at d_L = 0.5120 and d_U = 2.1766 (Table 4).

Table 4. *Estimation of TL values for urban municipalities in Poland by the CLRM for the period 2005-2017 (final data, dependent variable: ld_TL)*

	Coefficient	*Std. Error*	*t-ratio*	*p-value*	α
const	0.00582965	0.0318088	0.1833	0.8598	
ld_IPIT	−1.32636	0.235162	−5.640	0.0008	***
ld_IPT	0.373505	0.163573	2.283	0.0564	*
ld_GS	−2.12252	0.656453	−3.233	0.0144	**
ld_ES	4.10328	0.505609	8.116	<0.0001	***

R-squared	0.934968	Adjusted R-squared	0.897807
F(4, 7)	25.15999	P-value(F)	0.000300
rho	−0.313522	Durbin-Watson	2.469046

Note: *α = 0.01 (***), where α = 0.05 (**), α = 0.10 (*).*
Source: *Own calculations on the basis of MF, GRETL program.*

In order to analyze the stationarity of the analyzed variables, an augmented Dickey-Fuller test (ADF) was employed. For all analyzed variables, a unit root a = 1 was noted; integration row I(1) indicated the non-stationarity of the time series. Normality of the distribution of residuals was assessed with the use of the Doornik–Hansen test, which confirmed that the distribution of residuals had the features of normal distribution: $Chi - square(2) = 1.357$ with p-value=0.50738 >α=0.10; $JB = 1.357 < \chi^2\,(2) = 4.606$).

According to White's test for heteroskedasticity, the p-value = P(Chi-square(8) > 6.295441) = 0.614175. The condition of maintaining the linear form of the model has been fulfilled because TR^2 = 6.295441< χ^2(10%, 8) = 13.3616. White's test for non-linearity (logarithms) was used for the assessment of the linearity of the analytical form of the model and confirmed the validity of the linear form model. According to auxiliary regression for non-linearity test (log terms): Test statistic: TR^2 = 1.21183, with p-value = P(Chi-square(2) > 1.21183) = 0.545575. It means that: TR^2 = 1.21183 < Chi-square (1%, 2) = 9.21034. Next, auxiliary regression for non-linearity test (squared terms): Test statistic: TR^2 = 6.42964, with p-value = P(Chi-square(4) > 6.42964) = 0.169278 it means that: TR^2 = 6.42964 < Chi-square (10%, 4) = 7.77944 (Studenmund, 2019).

The assessment of the degree of collinearity of explanatory variables was made using the VIF measure (variance inflation factors) determined by the formula:

$$VIF_j = \frac{1}{1-R_j^2} \tag{3}$$

where:
For j = 1,2, ... k, where R_j^2 is the multiple correlation coefficient between the variable x_j and the other variables of the model.

All analyzed variables maintained the level of $VIF_j < 10$, which is a sign of the lack of collinearity. This means that these variables do not disturb the quality of the constructed econometric model. Values VIF_j were for: ld_IPIT = 2.014, ld_IPT = 2.026, ld_GS = 1.652 and ld_ES = 1.639, respectively.

Similarly, econometric modeling procedures as for urban municipalities were also carried out for rural and urban-rural municipalities.

Rural municipalities: The summary statistics, including the values of the standard deviation (Std. Dev.), showed that the most significant changes were shown by the variable C.S. (0.72780) and EDS (0.23963), while the lowest change (the most stable) were IRET (0.018431) and ICIT (0.099075). For these variables, coefficients of variation (C.V.) confirmed that the highest level of this differentiation occurred for the variable C.S. (5,5451) and EDS (3.7824) against the lowest for IRET (0.31488) and ICIT (1.4332).

In order to analyze the correlations between the dependent variable being total liabilities (T.L.) and independent variables. The highest positive linear correlation occurred between P.E. and T.L. (R_xy=0.4343), next between E.S. and T.L. 〖(R〗 _xy=0.4240). The highest negative linear correlation occurred between IPIT and T.L. 〖(R〗 _xy=-0.6562).

In the input version of the estimated model, the variable significant at the 10% significance level were IPIT and IPT. The coefficient of determination equaled R2 = 0.978888, which proved a high level of explanation. The Durbin-Watson autocorrelation test DW=1.496713 (Table 5). Factual verification of the final model of total liabilities for rural municipalities for Poland in the period 2005–2017 estimated the ultimate results. The significant independent variables for TL became the variables IPIT, IPT and EDS (α = 0.01), and ICIT, IRET and CS (α = 0.10). The coefficient of the model determination was maintained at a level R^2 = 0.978061. The F-Snedecor test performed confirmed the overall suitability of the model as $F\,(6,5) = 37.15066 > F^* = 4.95029$. The Durbin-Watson autocorrelation test DW =1.715601 (Table 6).

Normality of the distribution of residuals was assessed with the use of the Doornik–Hansen test, which confirmed that the distribution of residuals had the features of normal distribution: $Chi - square(2) = 0.122$ with p-value= 0.94086 > α=0.10; $JB = 0.122 < \chi^2\,(2) = 4.606$) (Figure 3).

Table 5. *Estimation of TL values for rural municipalities in Poland by the CLRM for the period 2005-2017 (input data, dependent variable: ld_TL***)**

	Coefficient	*Std. Error*	*t-ratio*	*p-value*	α
const	0.465778	0.405673	1.148	0.3697	
ld_ICIT	0.958763	1.74149	0.5505	0.6372	
ld_IPIT	−3.54195	0.995578	−3.558	0.0707	*
ld_IRET	−2.23238	5.28836	−0.4221	0.7140	
ld_IPT	1.19088	0.376797	3.161	0.0872	*
ld_CS	−0.108976	0.0974340	−1.118	0.3797	
ld_GS	0.0409327	0.338179	0.1210	0.9147	
ld_PE	−0.0482578	0.501952	−0.09614	0.9322	
ld_ES	−0.150481	2.80220	−0.05370	0.9621	
ld_EDS	0.530714	0.416562	1.274	0.3307	
R-squered = 0.978888		Adjusted R-squared=0.883885	DW= 1.496713	dL=0.6291	dU=1.6993

Note: *α = 0.10 (*).*
Source: *Own calculations on the basis of MF, GRETL program.*

Table 6. *Estimation of TL values for rural municipalities in Poland by the CLRM for the period 2005-2017 (final data, dependent variable: ld_TL)*

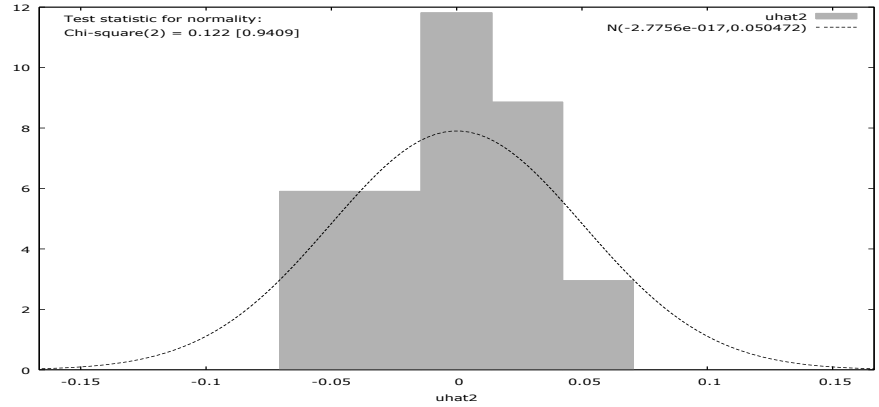
	Coefficient	*Std. Error*	*t-ratio*	*p-value*	α
const	0.484117	0.0886469	5.461	0.0028	***
ld_ICIT	0.716629	0.337288	2.125	0.0870	*
ld_IPIT	−3.40575	0.397770	−8.562	0.0004	***
ld_IRET	−2.72114	1.34213	−2.027	0.0984	*
ld_IPT	1.21327	0.183506	6.612	0.0012	***
ld_CS	−0.0961569	0.0430493	−2.234	0.0758	*
ld_EDS	0.538223	0.0820557	6.559	0.0012	***
R-squared	0.978061	Adjusted R-squared		0.951734	
F(6, 5)	37.15066	P-value(F)		0.000544	
rho	−0.028003	Durbin-Watson		1.715601	

Note: *α = 0.01 (***) and α = 0.10 (*).*
Source: *Own calculations on the basis of MF, GRETL program.*

According to Breusch-Pagan test for heteroskedasticity test statistic: LM = 1.935366, with p-value = P(Chi-square(6) > 1.935366) = 0.925546.

White's test for non-linearity (logarithms) was used for the assessment of the linearity of the analytical form of the model and confirmed the validity of the linear form model. According to auxiliary regression for non-linearity test (log terms): Test statistic: TR^2 = 1.02836, with p-value = P(Chi-square(1) > 1.02836) = 0.310545. It means that: TR^2 = 1.02836 < Chi-square (1%, 1) = 2.70554.

Figure 3. *Jargue`a Bery test statistic for normality*



Source: *Own calculations on the basis of MF, GRETL program.*

Resuts of Breusch-Godfrey test for first-order autocorrelation confirmed lack of autocorrelation in the residual part. The empirical p levels are higher than the nominal level α=0.05. Lag order for test =1.

$$LMF = \frac{T-(k+m+1)}{m} \times \frac{R^2}{1-R^2} \tag{4}$$

where: T – number of observations, k – number of base model variables forresidues, m - number of delayed rest processes added. Test statistic: LMF = 0.005582, with p-value = P(F(1,4) > 0.00558225) = 0.944. Alternative statistic: TR^2 = 0.016723, with p-value = P(Chi-square(1) > 0.0167234) = 0.897 and Ljung-Box Q' = 0.00672276, with p-value = P(Chi-square(1) > 0.00672276) = 0.935.

Results of variance inflation factors (VIF_j) were lower than values < 10.0, because: ld_ICIT=4.822, ld_IPIT= 4.391, ld_IRET=2.642, ld_IPT=3.324, ld_CS=4.239 and ld_EDS=1.670. Moreover, test for ARCH of order 1 estimated test statistic: LM = 0.237256, with p-value = P(Chi-square(1) > 0.237256) = 0.626195. It means, that $LM = (T-p)R2 = 0.237256 < \chi^2\ (p=1) = 2.70554$ and no ARCH effect is present.

Urban-rural municipalities: According to the summary statistics, including the values of the standard deviation (Std. Dev.) showed that the most significant changes were shown by the variable EDS (0.23332) and PE (0.20894), while the lowest change (the most stable) were IRET (0.017454) and E.S. (0.029761). For these variables, coefficients of variation (C.V.) confirmed that the highest level of this differentiation occurred for the variable EDS (3.8241) and PE (3.3619) against the lowest for IRET (0.30549) and E.S. (0.48401).

The Pearson's correlation coefficient confirmed the negative correlation between total liabilities (debt) and budget incomes and a positive correlation between changes in total liabilities and budget expenditures. The highest negative linear correlation

occurred between IPIT and T.L. 〖(R)〗_xy=-0.4647), IRET and T.L. 〖(R)〗_xy=-02947), C.S. and T.L. 〖(R)〗_xy=-0.2468), ICIT and T.L. 〖(R)〗_xy=-0.2217). The highest positive linear correlation occurred between E.S. and T.L. (R_xy=0.7402), next between P.E. and T.L. 〖(R)〗_xy=0.5008), EDS and T.L. 〖(R)〗_xy=0.4664). The variable significant at the 1% significance level in the input version of the estimated model were all variables (ICIT, IPIT, IRET, I.P., C.S., G.S., PE, and E.S.) outside the variable EDS at the 5% significance level. The coefficient of determination equaled $R^2 = 0.999978$. The F-Snedecor test performed confirmed the overall suitability of the model as F (9,2)=10240.32> F^*=19.3848 The Durbin-Watson autocorrelation test DW=3.040414, for d_L=0.6291 and d_U=1.6993. The initial version of the model is also the final version of the model because the variables presented a high degree of significance (Table 7).

Table 7. *Estimation of TL values for urban-rural municipalities in Poland by the CLRM for the period 2005-2017 (final data, dependent variable: ld_TL)*

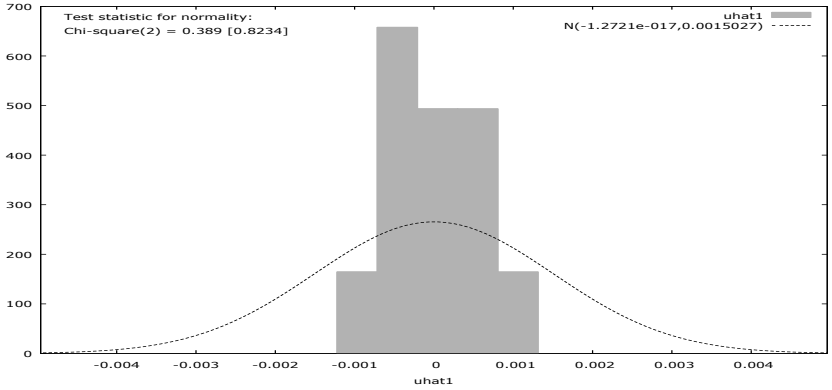
	Coefficient	*Std. Error*	*t-ratio*	*p-value*	α
const	0.236566	0.00715468	33.06	0.0009	***
ld_ICIT	0.242841	0.00662478	36.66	0.0007	***
ld_IPIT	−2.48039	0.0204946	−121.0	<0.0001	***
ld_IRET	−2.53666	0.0699264	−36.28	0.0008	***
ld_IPT	0.743782	0.00859848	86.50	0.0001	***
ld_CS	−0.239384	0.00457397	−52.34	0.0004	***
ld_GS	−2.73433	0.0250417	−109.2	<0.0001	***
ld_PE	−0.0666605	0.00465606	−14.32	0.0048	***
ld_ES	5.45444	0.0599508	90.98	0.0001	***
ld_EDS	−0.0481881	0.00542730	−8.879	0.0124	**
R-squared	0.999978	Adjusted R-squared		0.999881	
F(9, 2)	10240.32	P-value(F)		0.000098	
rho	−0.599102	Durbin-Watson		3.040414	

Note: *α = 0.01 (***), where α = 0.05 (**).*
Source: *Own calculations on the basis of MF, GRETL program.*

Normality of the distribution of residuals was assessed with the use of the Doornik–Hansen test, which confirmed that the distribution of residuals had the features of normal distribution: $Chi - square(2) = 0.389$ with p-value= 0.82342 > α=0.10; $JB = 0.389 < \chi^2\,(2) = 4.606$) (Figure 4). Subsequent tests verifying the correctness of the model showed that: acccording to Breusch-Pagan test for heteroskedasticity test statistic: Test statistic: LM = 4.536713,with p-value = P(Chi-square(9) > 4.536713) = 0.872683.

Results of VIF_j were also lower than values < 10.0, because: ld_ICIT= 4.217, ld_IPIT=9.172, ld_IRET=7.256, ld_IP=5.513, ld_CS=3.715, ld_GS=3.486, ld_PE=4.610, ld_ES=9.507 and ld_EDS=7.811. Test for ARCH of order 1 estimated the test statistic: LM = 0.798984, with p-value = P(Chi-square(1) > 0.798984) = 0.371397; that $LM = (T - p)R^2 = 0.798984 < \chi^2(p = 1) = 2.70554$ and no ARCH effect is present.

Figure 4. *Jargue`a Bery test statistic for normality*



Source: *Own calculations on the basis of MF, GRETL program.*

4.3 Final Empirical Results

On the basis of the results of econometric modeling, equations of functions describing variables that affect changes in total liabilities have been developed. The equitation for the final model estimated TL for urban municipalities (MODEL I) in the years 2005-2017 (Table 2) was as follows:

$$Id\_TL_{MODEL\ I} = 0.00582965 - 1.32636\ \text{ld\_IPIT} + 0.373505\ ld\_IPT - 2.12252\ Id\_GS + 4.10328\ \text{ld\_ES} \quad (5)$$

This equitation could be interpreted as:

1) a 1% increase in IPIT would lead on average to a 1.33% decrease TL.
2) a 1% increase in IPT would lead on average to a 0.37% increase TL.
3) a 1% increase in GS would lead on average to a 2.12% decrease TL.
4) a 1% increase in ES would lead on average to a 4.10% increase TL.

The results of the OLS model confirmed that four variables were statistically significant and had the largest share in the explanation of the TL changes. Three variables represent sources of income and one source of expenditures. The highest value of the directional coefficient (4.10328) at the explanatory variable of the ES (expenditures in salaries) indicates that this variable had the most decisive influence on the TL changes.

The equitation for the final model estimated TL for rural municipalities (MODEL II) in the years 2005-2017 (Table 5) was as follows:

$$Id\_TL_{MODEL\ II} = 0.484117 + 0.716629\ ld\_ICIT - 3.40575\ ld\_\text{IPIT} - 2.72114\ ld\_IRET + 1.21327\ ld\_IPT - 0.0961569\ ld\_CS + 0.538223\ ld\_EDS \quad (6)$$

This equitation could be interpreted as:

1) a 1% increase in ICIT would lead on average to a 0.72% increase TL.

2) a 1% increase in IPIT would lead on average to a 3.40% decrease TL.
3) a 1% increase in IRET would lead on average to a 2.72% decrease TL.
4) a 1% increase in IPT would lead on average to a 1.21% increase TL.
5) a 1% increase in CS would lead on average to a 0.10% decrease TL.
6) a 1% increase in EDS would lead on average to a 0.54% increase TL.

The results of the OLS model confirmed that six of the nine analyzed variables were statistically significant. There are mainly incomes variables. The highest value of the directional coefficient (3.40575) at the explanatory variable of the IPIT (income from PIT) indicates that this variable had the strongest influence on the TL changes.

The equitation for the final model estimated TL for urban-rural municipalities (MODEL III) in the years 2005-2017 (Table 6) was as follows:

$$Id\_TL_{MODEL\ III} = 0.236566 + 0.242841\ ld_{ICIT} - 2.48039\ ld_{IPIT} - 2.53666\ ld_{IRET} + 0.743782\ ld_{IPT} - 0.239384\ ld_{CS} - 2.73433\ ld_{GS} - 0.0666605\ ld_{PE} + 5.45444\ ld_{ES} - 0.0481881\ ld_{EDS}. \quad (7)$$

This equitation could be interpreted as:

1) a 1% increase in ICIT would lead on average to a 0.24% increase TL.
2) a 1% increase in IPIT would lead on average to a 2.48% decrease TL.
3) a 1% increase in IRET would lead on average to a 2.53% decrease TL.
4) a 1% increase in IPT would lead on average to a 0.74% increase TL.
5) a 1% increase in CS would lead on average to a 0.24% decrease TL.
6) a 1% increase in GS would lead on average to a 2.73% decrease TL.
7) a 1% increase in PE would lead on average to a 0.07% decrease TL.
8) a 1% increase in ES would lead on average to a 5.45% increase TL.
9) a 1% increase in EDS would lead on average to a 0.05% decrease TL.

The results of the OLS model confirmed that the nine analyzed variables were statistically significant. There are six income variables and three expenditure variables. The highest value of the directional coefficient (5.45444) at the explanatory variable of the ES (expenditures in salaries) indicates that this variable had the most decisive influence on the TL changes.

5. Conclusions

The obtained results are in line with the previous research results and extend the knowledge in the stability and indebtedness of local government units. Also, their practical aspect means that they can be used to manage local government units or assess their stability by external agencies.

In all three types of territorial units (urban, rural, and urban-rural), the increase in PIT revenues causes a decrease in public debt. It should be emphasized that an increase

in the personal income of the population is usually caused by a higher quality of social capital or a higher willingness to accept risk. The positive correlation between debt and the quality of human capital was already pointed out by other researchers discussed earlier (Rodríguez-Bolívar et al., 2016b). Notably, the growth of human capital does not usually require higher expenditures from local budgets, as it is determined by many endogenous factors, utterly independent of local governments (Davidsson and Honig, 2003). Thus, it can be concluded that an increase in direct tax revenues from individuals does not burden public budgets with additional expenditures.

However, it is different for CIT taxes. This change was statistically significant in two models (rural municipalities and urban-rural municipalities). The increase of this indicator by 1% is accompanied by the increase of debt in the range of 0.24 to 0.72%. This means that it has a debilitating effect on the sustainability of the public finance system. This is due to the need for earlier expenditures from local budgets to create or develop an entrepreneurship support ecosystem. For companies to develop and consequently pay higher CIT from the budgets of local government units, expenditures must first be incurred on developing investment areas, providing necessary infrastructure, or building or repairing roads. Similar motives are also indicated by other studies (Kemmerling, 2002).

In the case of the remaining variables, it was possible to identify those income factors of local budgets that are statistically significant and influence positively or negatively the size of the public debt of local government units. It should be recalled that the literature stresses that in the context of sustainability, in addition to the size of the debt, its structure is also essential (IMF, 1998). Thus, the study carried out allows to extend this knowledge and proves that the indebtedness of local government units is also affected by the structure of income of these units. Thus, it is not only the debt structure that is important and should be analyzed in sustainability but also the revenue structure that affects debt.

The conducted research certainly does not exhaust the subject, but it may be considered a starting point for further detailed analyses in other countries. Identifying the factors that determine instability on the local government unit level is particularly important nowadays when we know how serious the consequences of destabilizing public finance may be for society. Linking stability to revenue-related factors is certainly a direction that requires further, in-depth studies to improve the understanding of financial recessions and public financial stability.

Public debt sustainability and the sustainability of public finances overall are primarily determined by investor confidence and the confidence of citizens at large, who in many cases directly own bonds from their government. As noted, though, central banks – the lenders of last resort – are increasingly holding government bonds on their balance sheets. All these actors are ultimately dependent on the financial health of the underlying entities emitting bonds, upon which confidence is either built or lost. Confidence can be seen as a somewhat nebulous factor – as indeed can money

itself when considered in light of the functioning of international financial markets. Financial transactions in a context of confidence are based on an expectation of a return in an agreed timeframe; when confidence is low or shattered, the mostimmediate cash in hand concept of money prevails. In short, a liquidity crisis shows.

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