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The Impact of Regional Transformation on Tax Revenue of Municipalities in the Silesian Voivodeship: Developing a Model

Keywords: regional transformation; factors describing regional transformation; revenue of local government units; tax revenue of communes

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Abstract

Theoretical background: Numerous theoretical analyses have examined the issue of municipalities' capacity to generate their own revenue (referred to as revenue potential or financial independence) or, more broadly, the assessment of municipal financial management (understood as financial autonomy or fiscal stability). However, empirical studies focusing on the impact of specific factors on these processes are relatively rare.

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Purpose of the article: The purpose of the article is to identify factors describing regional transformation and to develop a model explaining their impact on the tax revenue of municipalities in the Silesian Voivodeship, using personal income tax revenue as an example.
Research methods: An in-depth literature review was conducted to identify and systematize factors describing regional transformation. The research employed panel regression with random effects to determine the impact of selected factors describing regional transformation on personal income tax revenue in the municipalities of the Silesian Voivodeship. The factors describing regional transformation were categorized into social, economic, and environmental-spatial dimensions. The study ultimately utilized indicators representing the influence of selected factors, considering their data availability and quality, as well as the need to maintain their independence as explanatory variables in the model. As a result, a model was developed to explain the relationship between changes in personal income tax revenue and changes in population size, as well as the number of unemployed individuals. The study covered 49 urban municipalities (including cities with county rights) in the Silesian Voivodeship from 2012 to 2022.
Main findings: The developed model made it possible to assess the sensitivity of changes in personal income tax revenue to changes in population size and the number of unemployed individuals in the Silesian Voivodeship. Additionally, the model provided insights into the extent to which these factors explain changes in personal income tax revenue, offering a foundation for further research on the impact of regional transformation on the tax revenue of local government units. The model thus developed also led to recommendations for improving data collection, facilitating more effective monitoring of regional transformation.

Introduction

Transformation processes affect all local government units (LGUs) in Poland. However, due to the specific nature of the changes taking place, they have the most significant impact on industrialized and urbanized regions. Against this backdrop, the Silesian Voivodeship stands out on the map of Poland, as it has a high proportion of cities that emerged as a result of 19th- and 20th-century industrialization. Consequently, the region is home to numerous highly specialized industrial towns (Suchacka, 2014, p. 103). The Silesian Voivodeship hosts numerous industrial facilities, particularly in the mining, energy, and metallurgy sectors. Therefore, the requirements for achieving climate neutrality pose significant challenges for the region.

Local government is crucial in providing public goods and exercising public authority. The effectiveness and quality of its operations significantly depend on the size and stability of public revenue (i.e. the quality of funding sources). The socio-economic transformation of a region no doubt affects the fiscal stability of LGUs. Regional transformation leads not only to changes in the level of revenue (and expenditures) but also impacts their structure. Public finance management requires the development and use of tools that enable the measurement and evaluation of the effects of these changes.

This article aims to identify factors describing regional transformation and develop a model explaining their impact on tax revenue (specifically, the sensitivity of tax revenue to these factors) in municipalities of the Silesian Voivodeship. This is exemplified by analysing revenue from personal income tax.

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Literature review

Regional transformation is the result of numerous processes, some of which merit particular attention:

– climate change and efforts to mitigate it,
– deindustrialization,
– development of digital technologies,
– social changes, such as depopulationl and population aging.

The consequence of these changes is often a shift in the economic profile of the region, as the economic success of a local government unit depends on the quality of its economic base. Moreover, specialization in competitive industrial sectors and market services – particularly knowledge-intensive and high-tech industries – indicates the strength of the economic base, whereas the dominance of declining industrial sectors and public services reflects its weakness (Sobala-Gwosdz, 2024, p. 19).

In the context of striving for climate neutrality, a key challenge for the Silesian Voivodeship is decarbonisation, as it is home to the last major coal mining region in the European Union. The departure from coal in energy production and its replacement with less carbon-intensive energy sources means a reduced role for the mining industry in the region. It necessitates the development of an economic base centred on high-efficiency, low-emission sectors, such as machinery, electrotechnical, and electronic industries, as well as chemical, pharmaceutical, and automotive industries. Decarbonisation also significantly impacts the structure of the regional labour market.

The region's transformation affects the fiscal stability of LGUs. Transformational processes substantially alter the conditions under which local governments operate – not only in terms of the tasks they perform and, consequently, the structure and level of expenditures, but also the conditions for collecting public revenue, particularly tax-related revenue. As Wójtowicz notes, maintaining fiscal stability is not an end in itself but rather one of the conditions necessary for the sustainable and balanced development of a local government community in economic, socio-demographic, environmental-spatial, and institutional dimensions (Wójtowicz, 2019, p. 12). Recent studies address the importance and impacts of the green transition on local government finances (Miszczuk et al., 2023) while recognizing the issue of digital transformation in LGUs (Kaczyńska et al., 2021).

Studies on the subject limit their scope to issues related to the financial management of LGUs, particularly in the area of financial independence (Dziemianowicz et al., 2018; Kańduła, 2003; Milewska, 2017; Rechul, 2013; Surówka, 2013; Żołądkiewicz, 2014), financial situation (Kluza, 2017) or fiscal stability (Marczakowska-Proczka, 2015; Wójtowicz, 2019). Authors also undertake to identify factors of fiscal stability (Głowicka-Wołoszyn & Wysocki, 2014, p. 35; Jastrzębska, 2023; Navarro-Galera et al., 2019; Rodríguez Bolívar et al., 2016; Santis, 2020; Zawora, 2010).

In a narrower sense, fiscal stability is understood as a consistent and stable inflow of tax revenue to municipal budgets (Marczakowska-Proczka, 2015). This justifies

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the search for tax factors of financial potential (Filipiak, 2016) as well as the analysis of revenue, taking into account the most important changes in the structure of taxes (Felis et al., 2024). The literature on the subject even discusses the fiscal autonomy of LGUs and its determinants (Poniatowicz, 2015). As Śmiechowicz notes, the stability of municipal revenue determines their ability to properly carry out public tasks entrusted to them due to decentralization (Śmiechowicz, 2016). Therefore, it is not surprising that numerous studies are dedicated to the revenue potential (Kozera, 2018; Lubińska et al., 2007; Satoła, 2019) or financial independence (Czarny, 2016; Kalisiak-Mędelska, 2013; Szołno-Koguc, 2021; Uryszek, 2012; Wyszkowska, 2017; Wyszkowska & Wyszkowski, 2015).

The ability of LGUs to generate their own revenue is primarily conditioned by internal factors. The transforming reality leads to changes in these factors. The transformation of the region is complex. This raises the following questions: How should regional transformation be measured? How should transformation be measured in the context of the ability of LGUs, including municipalities, to collect tax revenue? Table l presents examples of factors describing the transformation of a region, particularly an industrialized region, along with their indicators. Among the factors describing the transformation of a region, the following are distinguished: social, economic, and environmental-spatial factors.

Table 1. Classification of factors describing regional transformation significant for the fiscal stability of local government finances and examples of indicators

Type of factor	Sample factors	Sample indicators
social factors	– demographic structure – depopulation – aging of the population – migration of the population – regional identity – asymmetry in the age structure of women and men – migration (of youth) from rural areas to the cities – migration of people of post-working age from cities to rural areas – emigration abroad – level of education	– population (in thousands) – number of women (in thousands) – number of men (in thousands) – population in the pre-working age – population in the working age – population in the post-working age – population density (population per l km²) – number of people with higher education
economic factors	– economic structure – deindustrialization – digital transformation – decarbonisation – energy consumption of industry – labour market – energy transformation – number of business entities – size of business entities	– unemployment rate overall – unemployment rate for women – unemployment rate for men – employment by sector – wage levels – employed, by gender – financial results by PKD (Statistical Classification of Economic Activities) – number of business entities – electricity consumption per capita

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Type of factor	Sample factors	Sample indicators
environmental-spatial factors	– afforestation – concrete cover – climate change adaptation – urban sprawl / concentration of cities / urban densification – energy efficiency of buildings – need for revitalization and reclamation of post-industrial areas – infrastructure capital – road density – transport hub – communication routes	– land area – usable floor area of buildings – total area of privately owned forest land – total area of privately owned agricultural land – value of construction – size of impermeable surfaces in cities (in hectares) and their percentage of total surface area

Source: own elaboration.

The first step in studying the impact (sensitivity) of factors describing regional transformation on tax revenue (overall or revenue from a specific tax) is assessing the significance of individual factors that describe the region's transformation. A key issue in this context is the selection of appropriate indicators and the availability of these data. Similar to the assessment of financial autonomy, objective indicators are crucial and should be considered comprehensively due to the lack of one universal indicator (Rechul, 2013).

Research methods

In general, the article aims to develop a model explaining the impact of factors describing regional transformation on PIT tax revenue in municipalities of the Silesian Voivodeship. Specifically, the goal of the research is to determine the sensitivity of PIT tax revenue in urban municipalities (a measure of fiscal stability – y_{it}) to regional transformation factors: population size (a measure of the social factor – $x1_{it-2}$) and the number of unemployed individuals (a measure of the economic factor – $x2_{it-2}$). The main hypothesis (H1) assumes that regional transformation affects the fiscal stability of municipalities. Additionally, two auxiliary hypotheses were formulated. The first (H1.1) assumes that an increase in population leads to increased PIT tax revenue in municipalities. The second (H1.2) posits that an increase in the number of unemployed individuals leads to decreased PIT tax revenue in municipalities. The structure of the personal income tax determined the selection of relevant factors, while the availability and quality of data influenced the choice of indicators. Environmental and spatial factors were excluded, as they were deemed unsuitable for the analysis of the examined tax.

The subject of the study, concerning the impact of regional transformation on municipal tax revenue in the Silesian Voivodeship, focuses on PIT tax revenue

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because it makes up the largest share in the structure of local government revenue in Poland (Główny Urząd Statystyczny [GUS], 2023, p. 69). As a result, changes in PIT revenue most strongly influence the fiscal stability of municipalities.

The research sample includes annual data from 49 urban municipalities (including cities with county rights) in the Silesian Voivodeship from 2011 to 2022, obtained from the Local Data Bank of the Central Statistical Office (GUS). Rural municipalities were excluded from the study, as they typically have an agricultural character, and their revenue potential from personal income tax is of a completely different nature. This is due to the distinct taxation rules for income derived from agricultural activities. Consequently, rural municipalities show the highest income inequality (Głowicka-Wołoszyn et al., 2017; Kańduła & Śmiechowicz, 2016).

Due to the method of calculating tax revenue from PIT (in period *t*), tax revenue was moved relative to the social and economic indicators by two years back (t–2). The rules for determining and transferring PIT tax revenue to municipalities during the period covered by the study were regulated by the Act on the Revenue of Local Government Units (Dz.U. of 2024, item 356). In the period analyzed (2012–2022), the amount of PIT tax revenue for the budget year was determined based on data from two years prior to the budget year. The algorithm for determining the amount of PIT tax revenue for individual municipalities underwent significant changes starting in 2023. From this point, PIT tax revenue was calculated as a weighted average of three years, covering the year preceding the budget year by two, three, and four years. Due to these changes, the year 2023 was excluded from the research process.

$$\Delta y_{pct,it} = \beta_0 + \beta_1 \Delta x1_{pct,it-2} - \beta_2 \Delta x1_{pct,it-2} + \nu_i + \varepsilon_{it-2} \qquad (1)$$

A panel regression (1) with random effects (v_i) was used in the research process. The Hausman test was performed to confirm the choice. The obtained Hausman test statistic was 1.5985 with a $p = 0.4497$. Since the difference between the fixed and random effects estimates was not statistically significant, the random effects model was considered the more appropriate choice. The values of the dependent variable (y_{it}) and explanatory variables ($x1_{it-2}$, $x2_{it-2}$) were transformed into simple changes (Δy_{it}, $\Delta x1_{pct,it-2}$, $\Delta x2_{pct,it-2}$). The use of simple changes is justified, on the one hand, by the aim to achieve stationarity of the variables and exclude the effect of the size of the studied entity, and on the other hand, it has a practical aspect, making it easier to interpret the results of the models (interpreting the coefficients that indicate the sensitivity of the dependent variable to each explanatory variable, namely β_1 and β_2, and the constant term β_0). Due to the shift in the calculation of tax revenue from PIT (t–2), the study ultimately considered 9 annual changes in explanatory variables (2012–2020) and the dependent variable (2014–2022). The calculations were performed in Python using the linear models 6.0 library.

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Results

Using data for 49 urban municipalities in the Silesian Voivodeship, a panel regression model (2) was obtained, explaining changes in tax revenue from PIT resulting from changes in population and changes in the number of unemployed persons.

$$\Delta y_{pct,it} = 0.662 + 0.6609\Delta x1_{pct,it-2} - 0.0577\Delta x1_{pct,it-2} + \nu_i + \varepsilon_{it-2} \quad (2)$$

The coefficient β_1, indicating the direction and scale of the response of PIT tax revenue to changes in population, amounted to 0.6609, which would mean that a 1.0000% increase in population would be associated with a 0.6609% increase in PIT tax revenue. The coefficient β_1 has p at 0.0503, which means that, although it is not formally statistically significant, it is on the borderline of statistical significance. At the same time, the coefficient β_2, indicating the direction and scale of the response of PIT tax revenue to changes in the number of unemployed persons, amounted to −0.0577, which would mean that a 1.0000% increase in the number of unemployed individuals would be linked to a 0.0577% decrease in PIT tax revenue. In the case of changes in the number of unemployed persons, the sensitivity coefficient proved to be statistically significant (p = 0.0012). The panel regression model (2) for 49 municipalities explains approximately 6% of the changes in tax revenue (R^2) (Table 2).

It should, therefore, be concluded that the research procedure let us confirm the main hypothesis (H1), the first auxiliary hypothesis (H1.1) (subject to the statistical significance of the coefficient), and the second auxiliary hypothesis (H1.2). The positive (0.0662) and statistically significant (p = 0.0000) constant term β_0 implies that even in the absence of changes in population or unemployment, a growth in PIT tax revenue of approximately 6.62% is expected. The R^2 value of 5.97% indicates that the model explains only a fraction of the variability in changes in PIT tax revenue. The explanatory power of the model is relatively low, which means that these variables explain only a very small part of the variation in the dynamics of PIT tax revenue. Nevertheless, both variables exert a statistically significant impact, which should be important for local policies.

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Table 2. Panel regression results for 49 urban municipalities in the Silesian Voivodeship from 2012 to 2022

Random effects estimation summary			
Dependent variable	$\Delta y1_{pct,it}$	R^2	0.0597
Estimator	Random effects	R-squared (between)	0.1142
No. of observations	441	R-squared (within)	0.0557
Date	Wed, December 11, 2024	R-squared (overall)	0.0597
Time	12:07:31	Log-likelihood	582.45
Covariance estimator	Unadjusted		
		F	13.898
Entities	49	p	0.0000
Average observations	9.0000	Distribution	$F(2,438)$
Min. Obs:	9.0000		
Max. Obs:	9.0000	F (robust):	13.898
		p	0.0000
Time periods:	9	Distribution	$F(2,438)$
Average Obs:	49.000		
Min. Obs:	49.000		
Max. Obs:	49.000		

Parameter estimates						
	Parameter	*SD*	*t*	*p*	Lower CI	Upper CI
$\Delta x1_{pct,it-2}$	0.6609	0.3367	1.9628	0.0503	−0.0009	1.3228
$\Delta x2_{pct,it-2}$	−0.0577	0.0177	−3.2636	0.0012	−0.0924	−0.0229
const.	0.0662	0.0040	16.605	0.0000	0.0583	0.0740

Source: own elaboration.

Discussion

Empirical studies on the fiscal stability of LGUs typically focus on the issue of their debt (Banaszewska, 2023; Budzeń & Głębski, 2021; Filipiak, 2017; Kluza, 2017; Owsiak, 2023). On the other hand, studies on the fiscal stability of LGUs in the context of their revenue potential mainly involve the assessment of the revenue structure (e.g. Sygut, 2018; Śmiechowicz, 2016; Zawora, 2014). The research results indicate that between 2002 and 2013, the share of own revenues in the total income of Polish municipalities and cities with county rights increased, whereas, at the same time, there were evident regional development disparities (Jegorow, 2015). Additionally, the studies showed variability in the level of revenue potential depending on the size of the urban municipality (Standar & Kozera, 2023). Municipalities located in the

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Silesia-Zagłębie urban agglomeration are an example of one of the most stable clusters of municipalities in Poland over time, with high own revenue per capita, based on research covering the period 1995–2019 (Kossowski & Motek, 2021, pp. 17–18).

While the literature identifies factors of revenue potential, empirical studies focusing on specific factors describing the transformation of a region are relatively infrequent. Among the economic factors, the literature particularly highlights the phenomenon of unemployment in the context of the financial independence of LGUs (Jędrzejewski, 2015; Rodríguez Bolívar et al., 2015). Unemployment directly leads to a reduction in the income of the population, which translates into lower PIT tax revenue in municipalities. The economic transformation of the Silesian Voivodeship, especially in the context of the decline of heavy industry and mining, has had a significant impact on the regional labour market. The scale and pace of reducing employment in coal mining over the next decades will pose a challenge for the labour market, as even after accounting for the natural workforce turnover due to the retirement of older employees, mining will be able to retain only half of the current workforce by 2030 (Bukowski et al., 2018, p. 38).

Additionally, high unemployment may lead to labour migration (especially among young people), which reduces the number of taxpayers and deepens the financial problems of local governments. Therefore, studying the transformation of regions requires taking local demographic conditions into account for the fiscal stability of individual LGUs. Moreover, the population size, age structure, and migration dynamics are crucial for the economic development of regions (Zygmunt, 2018). In the future, demographic factors will be a significant determinant of a local government's ability to continue local development policies, primarily since a large portion of the revenue of LGUs depends on them (Kluza, 2015, p. 97). The consequence of declining local revenue due to depopulation is lower fiscal stability (leading to a reduced ability to invest in regional development and social infrastructure) and the increased dependence of local governments on external transfers (Wójtowicz, 2018). The relationships between demographic processes and the stability of the tax system are even referred to in the literature as fiscal demography (Walasik, 2023). The importance of demographic changes such as depopulation, the aging of society, and the high level of emigration of Poles abroad (Cichy, 2020; Jędrzejewski, 2015) for the fiscal stability of LGUs is recognized. Similarly, a multicriteria assessment of regional transformation is conducted in the context of their alignment with sustainable development goals and reducing regional disparities (Drabarczyk, 2017; Stec et al., 2024), but a comprehensive, multicriteria analysis and evaluation of the impact of these changes on tax revenue (or more broadly, on budget revenues) is not undertaken. There is also no sensitivity analysis of tax revenue considering various factors describing regional transformation, including social factors, such as demographic factors.

Wyszkowska and Wyszkowski (2023) examined the impact of the population age structure on PIT tax revenue (using correlation) and on the own revenue of

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municipalities in Poland (using multiple regression), considering, in particular, the following variables: population size, the share of individuals in post-working age, and the share of individuals in working age.

The study of the correlation between PIT tax revenue of municipalities in Poland (separately for urban, urban-rural, urban and cities with county rights) and the share of the population in pre-working, working, and post-working ages showed that for each type of municipality, there is a negative correlation between the share of the population in post-working age and PIT tax revenue (Wyszkowska & Wyszkowski, 2023, p. 46).

The multiple linear regression model was also used by Wichowska (2021) to assess the significance of demographic factors for the income autonomy of municipalities (understood as the share of own revenue in total revenue). Wichowska (2021) focused her study exclusively on rural municipalities in the Warmia and Masuria region during the years 2014–2018. The results of the study revealed that demographic burden (understood as the ratio of the post-working-age population to the working-age population) and internal migration were key demographic factors determining the revenue autonomy of the studied municipalities. The author also notes that one of the limitations of using regression analysis as a research method is the inability to directly infer cause-and-effect relationships from the analysed parameters (Wichowska, 2021, p. 50).

In the study of fiscal stability, the use of panel regression allows for the consideration of relationships occurring at the individual municipality level while accounting for changes over time. It should be stated that the use of panel regression in this article is an attempt to fill a research gap.

Considering the results of the research conducted by the authors of this article, a 1% decrease (increase) in the population would be associated with a decrease (increase) in PIT tax revenue by slightly over 0.6609%. In this context, the declining population of the Silesian Voivodeship poses a significant challenge, as demographic forecasts by the Central Statistical Office indicate that these trends will persist in the long term. Moreover, the population decline in the region during 2017–2030 is projected to be significantly more pronounced than during the 2000–2015 period, also in comparison to the national average (Bukowski et al., 2018, p. 29). It is worth noting that the Central Statistical Office's forecast reveals a considerable disparity between mining and non-mining areas. In mining municipalities, a population decline of as much as 8.5% is anticipated, while in non-mining municipalities, the decrease is projected to be only 2.7%, roughly in line with the national average (Bukowski et al., 2018, p. 29).

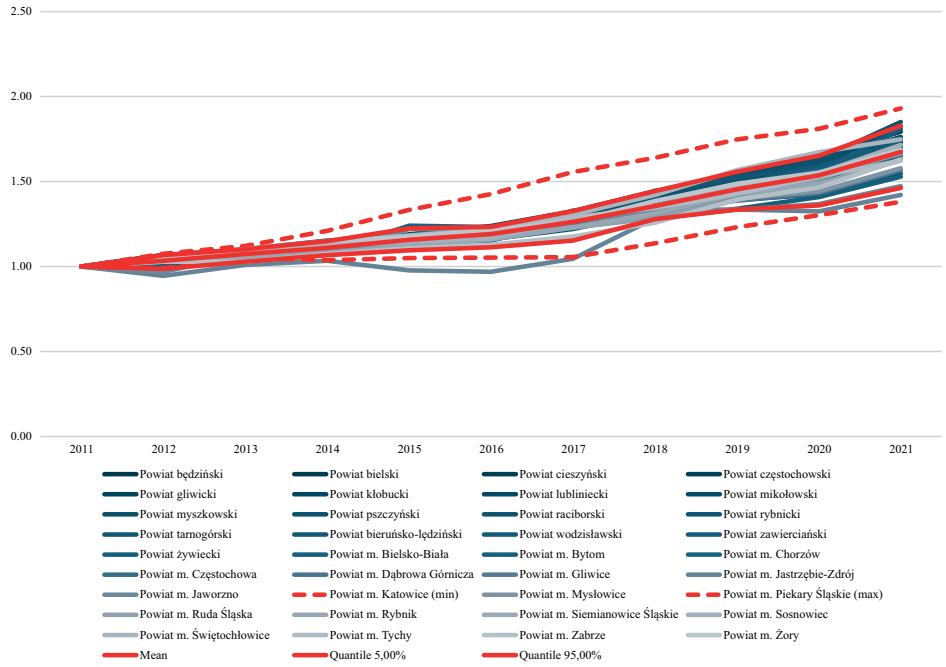
In the light of the conducted research, a 1% increase in the number of the unemployed would result in a decrease in PIT tax revenue by 0.0577%. The positive impact of population growth and the negative impact of an increase in unemployment on tax revenue align with expectations. The sensitivity of PIT tax revenue to population changes (0.66) is more than ten times greater than to changes in unemployment (−0.06).

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At this point, it is important to highlight the issue of wage growth. The study did not account for one of the most significant economic factors describing the region's transformation, which is crucial for the accumulation of tax revenue – the wages level. This omission resulted from the unavailability of data at the municipal level, which put a significant limitation on the research. The problem of data unavailability and the need for its collection is even addressed in the literature (Szczuciński, 2021, p. 13). Data on overall wages are available in the Local Data Bank of the Central Statistical Office only at the county level.

Nevertheless, considering changes in overall wages at the county level between 2012 and 2021, it was found that the geometric mean annual growth rate for counties in the Silesian Voivodeship ranged from 3.28% to 6.80%, with an average of 5.26% (Figure 1). It can be presumed that a similar scale of this phenomenon applies to urban municipalities, which could explain the value of the intercept in the model. However, confirming this assumption requires access to wage data at the urban municipality level.

Figure 1. Standardized wages for the counties of the Silesian Voivodeship from 2011 to 2021 (cumulative dynamics for an initial value of 1.00)



The literature also contains arguments questioning the significance of economic and social factors for the fiscal stability of urban municipalities in Poland, justifying this by their strong dependence on transfer revenue from the state budget, the

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high share of legally determined expenditures in the structure of municipal budget expenditures, as well as the existence of so-called soft budget constraints, which guarantee financial support from central authorities in case of financial difficulties (Wójtowicz, 2018, pp. 230–231). The above circumstances rigidify, while also stabilizing, the financial economy of LGUs, making it relatively immune to other factors.

Conclusions

The socio-economic transformation of regions affects the fiscal stability of municipalities, both in terms of income structure and amount. This is especially evident in industrial regions such as the Silesian Voivodeship, where changes are driven by processes like decarbonisation, deindustrialization, digital transformation, and demographic shifts. The literature lacks comprehensive studies on the changes in tax revenue in the context of regional transformation. This publication aims to fill the research gap regarding studies focused on examining the sensitivity of tax revenue to changes in the socio-economic environment during regional transformations. Using panel regression, a model was developed to explain the impact of factors describing regional transformation on municipal tax revenue in the Silesian Voivodeship, explicitly focusing on PIT tax revenue. The purpose of the study was not to determine whether but rather *how* regional transformation affects PIT tax revenue. The reason is that panel regression allows for the assessment of changes over time for multiple units.

The research showed that a 1.000% decrease in population over a year could be associated with a 0.6609% decline in PIT tax revenue, emphasizing the importance of counteracting depopulation and supporting policies that attract new residents. The aging of the population and migration (both internal and international) pose significant challenges to the financial stability of municipalities. In the case of the Silesian Voivodeship, depopulation processes will lead to further declines in local revenue. Similarly, a 1.000% increase in unemployment could result in a 0.0577% decrease in PIT tax revenue. The low sensitivity of PIT tax revenue to increased unemployment highlights the specifics of the regional labour market, where the high wage growth compensates for the loss of employed individuals. The positive value of the intercept in the model suggests an increase in PIT tax revenue even without changes in the social and economic factors considered in the research, likely related to the rise in wages.

The proposed panel regression model explains only 5.97% of the variability in PIT tax revenue, suggesting that other factors are of significant importance. These conclusions highlight the complexity of the impact of regional transformation on municipal tax revenue and the need to continue research and modify policies that support local development. It is necessary to include additional economic factors in the analyses. Unfortunately, the lack of complete and consistent data at the local

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level limits research opportunities. The data collection system should be improved, which would allow for better monitoring of the impact of the region's transformation on the finances of LGUs.

Furthermore, the transformation of industrial regions, such as the Silesian Voivodeship, requires reconsideration and possibly redesigning the financing system for LGU to address better the challenges associated with economic and social transformation. Changing the country's administrative division may even be necessary, as smaller units will become unable to bear the higher unit costs of public goods provided (Wyszkowska & Wyszkowski, 2023, pp. 34–35).

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