

STRUCTURAL CHANGES IN THE DYNAMICS OF TAX ARREARS – EVIDENCE FROM POLAND (2003-2024)

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Purpose: The aim of the paper is to conduct a quantitative analysis of trends, turning points, and the impact of global crises on the scale and structure of tax arrears in Poland in the years 2003-2024. The study fills a gap in literature, where in-depth analyses based on long-term time series and econometric tools are still scarce.

Design/methodology/approach: The research employed statistical and econometric methods, including linear regression models and structural stability tests (e.g., Chow test). Annual time-series data covering the number of entities in arrears, the value of overdue tax liabilities, and the value of interest on arrears were analyzed. Special attention was paid to crisis periods: the global financial crisis (2008-2009), the COVID-19 pandemic (2020-2021), and geopolitical disruptions after 2022.

Findings: The analysis confirmed strong and statistically significant relationships between the number of entities, the value of liabilities, and the interest on tax arrears in the long run. However, structural stability tests revealed that crises significantly modified the mechanisms of fiscal debt accumulation – during the pandemic, extended repayment periods played a key role, while after 2022 both liabilities and interest increased simultaneously, reflecting intensifying fiscal pressure. Most of the research hypotheses (H1, H2, H3, H5) were confirmed.

Research limitations/implications: The main limitation is the relatively short time horizon of crisis subperiods (2-3 years), which constrains the power of structural stability tests. Moreover, the analysis relied solely on aggregated data, without incorporating broader macroeconomic variables. Future research should expand the models with additional determinants (e.g., GDP, inflation, energy prices) and include cross-country comparative studies.

Practical implications: The results indicate that during crises the risk of accumulating tax arrears increases significantly, requiring tax administrations to apply flexible tools such as relief programs, restructuring mechanisms, or liquidity support schemes. Identifying turning points helps design more effective preventive and intervention measures, thereby improving the efficiency of the tax system.

Social implications: Tax arrears negatively affect the financial condition of enterprises and households, and on a larger scale, undermine the fiscal stability of the state. The findings may inform public policy aimed at reducing the risk of tax debt accumulation and mitigating its social consequences, including financial exclusion and a decline in quality of life.

Originality/value: The paper contributes to the literature by providing a comprehensive quantitative analysis of long-term tax arrears trends in Poland using structural stability tests. It offers new insights into the mechanisms of tax debt formation under crisis conditions and may serve as a reference point for comparative research and fiscal policy practice in other countries.

Keywords: tax arrears, fiscal policy, economic crises, regression analysis, structural stability.

Category of the paper: Research paper.

1. Introduction

In recent years, the problem of tax arrears has gained significance both in public debate and in analyses concerning the public finance system. This phenomenon is particularly evident in the context of increased macroeconomic volatility, frequent legislative changes, and crises such as the COVID-19 pandemic or the currently observed systematic rise in defense expenditures. The scale and pace of the accumulation of tax arrears constitute an important indicator of the condition of the public revenue collection system as well as the effectiveness of the state's enforcement apparatus.

Tax indebtedness is a complex phenomenon, the causes of which stem from the interaction of multiple interconnected economic, legal, and social factors. At the macroeconomic level, key determinants include business cycle fluctuations, GDP (gross domestic product) growth rates, inflation, and labor market conditions. Periods of recession or economic slowdown typically result in deteriorating financial liquidity of enterprises and declining household incomes, which foster the emergence of tax arrears. High inflation further reduces the real value of taxpayers' incomes, making it more difficult to meet obligations to tax authorities on time.

Legal and institutional factors also play a crucial role. The design of the tax system, its transparency, and legislative stability significantly condition the level of voluntary tax compliance. Frequent amendments, excessive complexity, or a lack of clear interpretations may lead to unintentional breaches of tax obligations or payment delays. Moreover, the effectiveness of tax administration in monitoring and enforcing liabilities, the degree of digitalization of processes, and the availability of taxpayer support tools directly affect the scale of arrears. Social factors are also important, including the level of tax awareness, trust in public institutions, and attitudes toward compliance with tax law.

The problem of increasing tax indebtedness is not limited to Poland. Many OECD countries report a high level of tax arrears, which continue to rise despite the introduction of new enforcement mechanisms (OECD, 2019, 2020). In FTA countries, tax arrears reached approximately EUR 820 billion in 2019. OECD (2019) emphasizes that effective debt management requires both preventive measures and more advanced enforcement methods, as shown by international comparisons. Despite the implementation of innovative analytical

tools and digital control systems, the effectiveness of arrears collection remains limited in many states (OECD, 2024).

Quantitative analyses of taxation in various perspectives and dimensions are particularly important in shaping public policies, assessing the efficiency of state institutions, and creating conditions conducive to entrepreneurship. Tax costs and the high and uneven distribution of tax arrears across business forms, sectors, and industries are of particular importance. The sources of these problems lie both in non-compliance with tax regulations and in inefficient tax payment systems. An additional risk factor is the existence of tax havens and the specific characteristics of countries of the Global South, where weak fiscal institutions contribute to persistent arrears accumulation (Beck, 2021).

At the macroeconomic level, factors such as inflation, increases in minimum wages, and changes in the number of active business entities significantly affect tax indebtedness. Despite the growing importance of this problem, the scientific literature remains limited – there is a lack of in-depth theoretical studies in economics and finance as well as quantitative research based on long-term time series.

The aim of this article is to fill this gap by conducting a quantitative analysis of trends, turning points, and the impact of global crises on the scale and structure of tax arrears in Poland in the years 2003-2024, using statistical and econometric methods, including structural stability tests. The analysis is based on time-series data covering:

1. the total nominal value of tax arrears, and
2. the value of interest on arrears.

The scope of the study includes the identification of trends, turning points, potential structural changes, and the development of forecasting models. A quantitative approach – based on statistical and econometric methods – is not only appropriate but also necessary to draw objective and practically useful conclusions. The results may provide a foundation for further research, both quantitative and qualitative, as well as guidance for fiscal and treasury policy makers.

Tax indebtedness remains a global fiscal problem, requiring not only national but also international solutions. Therefore, a quantitative analysis – even when focused on Poland – can provide insights of broader significance, useful in the context of international comparisons.

2. Tax Debt, Compliance Mechanisms, and Socio-Economic Implications: A Literature Review

The issue of tax indebtedness among citizens and enterprises in Poland over the past two decades has become the subject of growing interest within the academic community. This increase stems from a variety of factors, among which the most significant are: legislative

changes in the tax system, global economic crises, persistent inflationary pressures, the effects of the COVID-19 pandemic, and payment backlogs (Jeżewski, 2021; Kobylski, 2024; Kraska, 2022; Nakonieczny, Nesterowicz, 2021; Sierpińska-Sawicz, 2023). Equally important are rising public expenditures, particularly in defense. A crucial backdrop for these phenomena is the steady growth of public debt and its consequences for the stability and security of public finances (Bożek, 2021; Ciak, 2024; Górniewicz, 2023; Kielin, 2023; Skwarek, 2024). The organization and efficient functioning of the state depend on access to capital, the primary source of which remains tax revenues.

The research presented in this article is not original in terms of the dataset analyzed. Rather, it supplements the limited body of quantitative studies that have attempted to examine the scale, dynamics, and determinants of tax indebtedness in sectoral, temporal, regional, and structural dimensions (Hybka, 2025; Poniatowicz, Jastrzębska, 2021; Walczak et al., 2011).

Debates over the level and distribution of taxation have long been present in the economic, legal, and political literature. However, they remain in the form of discourse without reaching consensus in either theoretical or practical terms. Among the key issues highlighted are: fiscal stability, the organization of tax administrations in terms of operating costs, efficiency in the collection of due levies, as well as protective and preferential systems (Braunerhjelm et al., 2021; Caporale et al., 2024; Djankov et al., 2010; Filipiak, Wyszowska, 2022; Iwin-Garzyńska, 2022; Mantzaris, Fošner, 2024; Radzikowski, 2021a, 2021b, 2022; Wojciechowski, 2021), advancing internationalization (Felis, 2008; Garcia-Bernardo, Janský, 2023), tax havens (Pawlak, 2022), tax crimes (Szymczyk, Szymański, 2022), debt spirals embedded in the behavior of enterprises and individuals not engaged in business activity (Talar, 2019) and finally, the costs of indebtedness (Iwin-Garzyńska, 2016).

2.1. International Evidence on Tax Arrears and Compliance Mechanisms

The analysis of tax debt in Poland gains a fuller dimension when placed in an international context. In many advanced economies, such as Germany, France, and the United Kingdom, mechanisms for monitoring and enforcing tax liabilities are strongly integrated with financial information systems and rely on intensive data exchange between tax administrations, financial institutions, and judicial authorities. Studies show that the digitalization of processes, the use of predictive analytics tools, and early preventive measures are crucial for reducing the scale of tax arrears. Solutions based on automatic information exchange and centralized taxpayer registers make it possible to identify insolvency risks more quickly and respond to them in real time (Bott et al., 2020; Dwenger et al., 2016; Hallsworth et al., 2017; Kleven et al., 2011; Kobylski, 2024; Perez-Truglia, Troiano, 2018; Pomeranz, 2015; Trescher, 2025).

In lower-income countries, including some emerging economies, challenges remain in the form of low levels of voluntary tax compliance, limited digitalization of processes, and insufficient human resources in tax administrations. Research by the World Bank (Hoy et al., 2021) and the International Monetary Fund (Beer, 2022), indicates that the effectiveness

of tax debt management largely depends on the gradual introduction of digital solutions, increased procedural transparency, enhanced data openness, and educational programs directed at taxpayers. OECD analyses (OECD, 2017, 2019, 2022b, 2022a, 2023, 2023, 2024) confirm that combining effective enforcement tools with measures facilitating timely payments—such as installment programs, simplified online payment procedures, and early-warning mechanisms—can significantly reduce the level of arrears and improve the efficiency of tax collection systems.

2.2. Socio-economic effects of excessive tax indebtedness and instruments for its mitigation

Excessive tax debt exerts a significant impact both on the microeconomic condition of individual entities and on the macroeconomic stability of the state. For enterprises, tax arrears often lead to reduced financial liquidity, which in turn results in lower investment expenditures, suspension of development plans, and in some cases the need for restructuring or even liquidation (Janský, Palanský, 2019). At the household level, tax debt may generate increasing financial difficulties, reduce creditworthiness, and heighten the risk of economic exclusion (Perez-Truglia, Troiano, 2018). Negative effects are also observed in the psychological sphere, where tax debt correlates with a decline in well-being and a reduced sense of financial security (Kettle et al., 2016).

At the macroeconomic level, the accumulation of uncollectible tax liabilities weakens the state's ability to finance public expenditures, deepens the budget deficit, and may force either higher tax burdens or borrowing on financial markets. Prolonged persistence of this phenomenon therefore poses a threat to fiscal stability and may undermine the country's creditworthiness in the international arena. A partial aspect of the problem is the statute of limitations on tax obligations, which reduces the effectiveness of tax enforcement and perpetuates arrears. In international literature, the OECD (2020) emphasizes the importance of preventive and intervention tools in managing tax debt, while studies by Bott et al. (2020) and Dwenger et al. (2016) demonstrate that early information campaigns and digital monitoring tools can significantly reduce the scale of indebtedness. It should be noted that the debt spiral amplifies the risk of a self-reinforcing mechanism of fiscal deterioration, particularly when ineffective enforcement instruments coincide with low voluntary tax compliance (Talar, 2019).

The literature identifies a range of solutions aimed at reducing the scale of tax arrears. Legal instruments include simplifying collection procedures, shortening enforcement times, and expanding the scope of asset seizure. Economic tools cover interest relief for prompt repayment, automated reminder systems, and the possibility of renegotiating payment schedules. Increasingly important are interventions based on behavioral economics, such as so-called “nudges” – subtle informational prompts encouraging timely payment. Examples from Australia, Canada, and Scandinavian countries demonstrate that combining traditional enforcement methods with educational initiatives and digitalized taxpayer communication can

substantially reduce tax debt levels and improve the overall efficiency of tax collection systems (Andersson et al., 2024; Biddle et al., 2017; Canada Revenue Agency, 2022; OECD, 2021).

3. Regression Analysis and Structural Stability Tests

The analysis was based on annual data from 2003-2024, covering: the number of entities with outstanding tax liabilities, the total value of overdue obligations (tax debt) and interest on overdue obligations (tax arrears), as well as the average value of liabilities and interest per entity.

The study was conducted in several stages. In the first step, descriptive and index analysis was applied, including year-on-year dynamics, long-term growth rates, and the relationships between the number of entities and liabilities, as well as between liabilities and interest, as a measure of the intensity of arrears. Next, the relationships between variables were examined using correlation coefficients and simple regression models. This made it possible to identify the links between the number of entities and the values of liabilities and interest.

In addition, the analysis accounted for the impact of external crisis events—the global financial crisis (2008-2009), the COVID-19 pandemic (2020-2021), and geopolitical tensions and energy price fluctuations after 2022. For this purpose, structural stability tests (including the Chow test) were applied to verify whether significant changes occurred in the nature of the relationships between variables during these periods.

Based on the literature review and quantitative data observations, the following research questions were formulated:

- 1) How did the dynamics of the number of entities with tax liabilities and the value of liabilities and interest evolve in 2003-2024?
- 2) What relationships exist between the number of entities and the size of tax liabilities and interest on tax arrears?
- 3) Did crisis periods (2008-2009, 2020-2021, post-2022) result in significant structural changes in the relationships between the studied variables?

The following research hypotheses were formulated:

- H1: There is a significant relationship between the value of tax arrears and the number of entities with such arrears.
- H2: During economic crises (e.g., the 2008 financial crisis, the COVID-19 pandemic, the post-2022 energy crisis), tax arrears grow faster than in periods of macroeconomic stability.
- H3: Interest on arrears remains strongly correlated with the total value of tax arrears; however, the nature of this relationship changes during periods of economic disruption.

H4: Legislative changes and increased tax burdens contribute to the growth of tax debt, regardless of economic conditions.

H5: Econometric models based on long-term time series can effectively identify turning points and structural changes in the mechanisms of tax debt formation.

The dependency analysis was carried out using a linear regression model, where in the first case the explanatory variable was the value of liabilities and the dependent variable was interest on overdue obligations, and in the second case the explanatory variable was the number of entities, and the dependent variable was the value of liabilities.

To assess the stability of these relationships over time, the Chow test was applied, which made it possible to verify whether statistically significant changes occurred in the structure of the regression model at selected breakpoints (2009 – financial crisis, 2019 – pre-pandemic period, 2020 – COVID-19 pandemic, 2022 – geopolitical disruptions).

Based on the statistical data analysis for the years 2003-2024, clear long-term trends and strong interdependencies between the studied variables can be identified. During the analyzed period, the number of entities increased more than fourfold—from 3370 in 2003 to 15,202 in 2024. The compound annual growth rate (CAGR) of the number of entities was approximately 7.64%. The value of tax liabilities grew even faster, rising from PLN 7.0 billion to PLN 93.1 billion (CAGR \approx 13.93%). A similar dynamic was observed for interest on arrears, which increased from PLN 8.1 billion to PLN 85.6 billion (CAGR \approx 12.23%). This indicates that both liabilities and the costs associated with late payments grew faster than the number of entities, resulting in an increasing per-entity burden.

The analysis of average values per entity confirms this trend. The average liability per entity rose from PLN 2.08 thousand in 2003 to PLN 6.13 thousand in 2024, while the average interest per entity increased from PLN 2.40 thousand to PLN 5.63 thousand over the same period. This demonstrates that the fiscal burden grew not only in macroeconomic but also in individual terms. This phenomenon can be interpreted as the effect of growing difficulties in settling obligations, which, combined with the rising number of economic entities, led to an increase in both aggregate and per-entity arrears.

Complementing the analysis are correlation results between variables across the entire period. A very strong positive relationship was found between the number of entities and the value of liabilities ($r = 0.994$; $p < 0.001$), and between the number of entities and the value of interest ($r = 0.935$; $p < 0.001$). An equally strong correlation was observed between the values of liabilities and interest ($r = 0.933$; $p < 0.001$), confirming that these phenomena are closely interconnected. The analysis of unit values (liabilities per entity and interest per entity), however, revealed a moderate correlation ($r = 0.700$; $p < 0.001$), suggesting that the intensity of the burden did not always change proportionally. This may indicate that at certain points—particularly during periods of macroeconomic disruption—the structure of relationships between the analyzed variables underwent significant transformations.

3.1. Liabilities–Interest Relationship

The linear regression analysis, in which the dependent variable was interest on tax arrears, and the independent variable was the level of liabilities, revealed very high statistical significance of the model in most of the analyzed subperiods (Tab. 1). The values of the coefficient of determination R^2 indicate that in the stable period 2010-2019, nearly 98% of the variability in interest could be explained by the level of tax liabilities, whereas during the financial crisis of 2003-2009 R^2 reached 0.88. The estimated regression parameters for these years were positive (0.44 and 0.73, respectively) and significant, confirming a strong and stable relationship between the two phenomena under conditions of macroeconomic equilibrium.

Further examination of the stability of this relationship over time, conducted using the Chow test, revealed significant changes during the most recent crises. For the sample split including the year 2009, the F-statistic value was 0.30 ($p = 0.745$), which indicates no significant structural differences in the relationship between interest and liabilities during the global financial crisis. A different picture emerges for the COVID-19 pandemic years (2020-2021), when the R^2 value reached 1.00 and the regression parameter took a negative value (-1.35). This suggests that despite the decline in the nominal level of liabilities, interest continued to rise, and the mechanism of the relationship was distorted by the extension of repayment periods for previously accumulated arrears. In this period, the F-statistics were 41.72 ($p < 0.001$), indicating a significant structural change.

An even more pronounced deviation from previous trends appeared in 2022-2024, under conditions of energy and geopolitical shocks. The average level of liabilities remained high (PLN 95.2 billion), while interest increased even more sharply (PLN 77.2 billion). The coefficient of determination fell to 0.32, and the regression parameter (-2.81) indicated a reversal of the nature of the relationship—interest accumulated independently of changes in the level of liabilities. Although the Chow test could not be formally carried out due to the very small number of observations, qualitative analysis suggests a cumulation of arrears and an intensification of the mechanism of their accumulation.

Table 1.

Analysis of the relationship: liabilities → interest

| Period of analysis | Econometric results: regression and structural stability tests | | | | | | |
|------------------------------|--|---|----------------------|--------------------------------------|---------------|---------------------|-----------------------------------|
| | Average level of liabilities (billion PLN) | Average level of interest (billion PLN) | R^2 of regression* | Regression coefficient (β)** | Chow test (F) | p-value (Chow test) | Significance of structural change |
| 2003-2009 (financial crisis) | 10.17 | 10.58 | 0.884 | 0.725 | 0.300 | 0.745 | Not significant |
| 2010-2019 (stable period) | 48.03 | 26.43 | 0.979 | 0.023 | 25.503 | 0.000 | Significant |

Cont. table 1.

| | | | | | | | |
|--|-------|-------|-------|--------|--------|-------|-------------|
| 2020-2021 (COVID-19 pandemic) | 96.44 | 57.80 | 1.00 | -1.354 | 41.716 | 0.000 | Significant |
| 2022-2024 (geopolitical disruptions) | 95.24 | 77.20 | 0.316 | -2.814 | n.d. | n.d. | n.d. |

Note. * Extent to which variability of liabilities explains variability of interest, ** increase in liabilities translated into increase in interest. It is important to emphasize the methodological limitations associated with short time series for the periods 2020-2021 (2 years) and 2022-2024 (3 years). Such a small number of observations may lead to artificially high R^2 values, limited power of the Chow test, and—in the case of 2022-2024—the impossibility of formally performing the test (n.d.). Therefore, the results for these subperiods are exploratory in nature and should be interpreted mainly in the light of the macroeconomic context (COVID-19 pandemic, energy crisis, geopolitical tensions), whereas conclusions drawn from longer periods (2003-2009, 2010-2019) are methodologically more reliable.

Source: own study.

The obtained results show that although in the long run the relationship between liabilities and interest was strong and stable, during contemporary economic crises this dependency underwent profound modifications. During the COVID-19 pandemic, the extension of repayment periods for earlier liabilities played a key role, while after 2022 this mechanism intensified, as the scale of new arrears increased alongside the persistence of existing ones. The stability tests thus confirm that external shocks (the pandemic, the energy crisis, geopolitical uncertainty) contributed to a more rapid increase in both liabilities and the costs of servicing them.

3.2. Entities–Liabilities Relationship

The linear regression analysis, in which the dependent variable was the level of tax liabilities, and the independent variable was the number of entities in arrears, revealed a strong and stable relationship in the long run (Tab. 2). The coefficients of determination R^2 in the stable subperiods were very high, reaching 0.98 in 2010-2019, which means that almost all variability in liabilities could be explained by changes in the number of entities. The regression parameters ($\beta = 0.009$ in the stable period) were positive and statistically significant, indicating a predictable mechanism of liability growth as the number of debtors increased.

The Chow test analysis showed that for the sample split including the year 2009, the F-statistic took the value of 6.82 ($p = 0.006$), confirming a significant structural change in the relationship between the number of entities and liabilities during the global financial crisis. This change suggests that the mechanism of liability accumulation became less proportional—individual entities generated relatively higher arrears than in stable periods.

During the COVID-19 pandemic (2020-2021), the coefficient of determination reached 1.00, and the regression parameter was 0.008. Formally, the model indicates an almost perfect fit; however, due to the very small number of observations, these results should be interpreted with caution. The Chow test did not confirm a significant structural change in this period

($F = 0.45$; $p = 0.644$), although qualitative analysis suggests some deviations in the behavior of the relationship mechanism.

A different picture emerges in the years 2022–2024, when the number of entities in arrears reached the highest levels in the entire time series (an average of 15.2 thousand), while the value of the coefficient of determination dropped to only 0.03. The regression parameter took a very low value (0.001), indicating that in this period the number of entities ceased to be a good predictor of the scale of liabilities. Formal stability tests could not be performed due to the insufficient number of observations; however, empirical observations confirm that the mechanism of tax arrears accumulation weakened significantly and underwent modification during this time.

Table 2.

Analysis of the relationship: number of entities → liabilities

| Period of analysis | Econometric results: regression and structural stability tests | | | | | | |
|--------------------------------------|--|--|-------------------------------|--------------------------------------|---------------|---------------------|-----------------------------------|
| | Average level of liabilities (billion PLN) | Average number of entities (thousands) | R ² of regression* | Regression coefficient (β)** | Chow test (F) | p-value (Chow test) | Significance of structural change |
| 2003-2009 (financial crisis) | 10.17 | 3,909 | 0.914 | 4.844 | 6.820 | 0.006 | Significant |
| 2010-2019 (stable period) | 48.03 | 9,287 | 0.983 | 8.715 | 1.111 | 0.351 | Not Significant |
| 2020-2021 (COVID-19 pandemic) | 96.44 | 14,616 | 1.000 | 8.305 | 0.452 | 0,644 | Not Significant |
| 2022-2024 (geopolitical disruptions) | 95.24 | 15,171 | 0.027 | 1.318 | n.d. | n.d. | n.d. |

Note. * Extent to which variability of liabilities explains variability of interest, ** The coefficient (β) represents the change in the total value of liabilities (in million PLN) associated with a unit increase in the number of entities.

Source: own study.

In summary, the obtained results show that in the long run the number of entities in arrears strongly explains the level of liabilities; however, during crisis periods this mechanism underwent transformations. In the global financial crisis, this relationship became more intensive, whereas under the conditions of the pandemic and geopolitical disruption the number of entities ceased to fully determine the value of liabilities. This indicates a differentiated impact of crisis factors on the scale and dynamics of tax arrears accumulation.

3.3. Empirical validation of tax indebtedness mechanisms

The conducted analysis confirmed the existence of a strong relationship between the value of tax liabilities and the amount of interest on arrears, which was reflected in the high level of the determination coefficient of the regression model. However, this relationship proved to be variable over time, as revealed by stability tests performed for crisis periods. The results of the

Chow test indicated no significant structural changes during the global financial crisis of 2008-2009, while in the case of the COVID-19 pandemic (2020–2021) and in the period of geopolitical disruptions after 2022, significant instability of the relationship was demonstrated.

During the pandemic years, a decline in the nominal value of liabilities was observed, accompanied by an increase in interest on arrears and a rise in the number of indebted entities. This phenomenon indicates that under conditions of reduced economic activity and macroeconomic uncertainty, the key factor was not the accumulation of new liabilities per entity, but rather the extension of repayment periods for existing obligations. Interest thus became an indicator of the intensification of liquidity problems, while the growing number of debtors signaled an expansion of the problem's scale.

A different pattern of change occurred after 2022, when a significant increase in interest, the persistence of high levels of liabilities, and the stabilization of the number of entities at record levels were simultaneously recorded. These results indicate that under shocks related to the geopolitical situation and rising energy prices, the relationship between the analyzed categories intensified interest grew faster than could be explained by nominal liabilities, while the high number of entities reinforced the effect of accumulation. It can thus be concluded that the most recent crises were characterized by deeper destabilization of fiscal mechanisms than in previous decades.

The analysis of the relationship between the number of entities and the value of tax liabilities revealed a similarly strong association, especially in longer subperiods. The coefficients of determination reached very high levels ($R^2 > 0.9$), which indicates that the number of debtors largely explained the scale of arrears. The stability of this relationship was confirmed in the years 2003-2009 and 2010-2019, although the Chow test for the financial crisis revealed a significant structural change, suggesting that at that time individual arrears accumulated faster than the number of entities.

During the COVID-19 pandemic (2020-2021), the model formally indicated an almost perfect fit, but with only two observations this result must be treated with caution. Nevertheless, the fact that liabilities remained high while the number of entities increased significantly suggests the spread of debt problems across the economy.

An even clearer departure from earlier trends emerged after 2022. In this period, the number of entities reached the highest values in the series analyzed, while the coefficient determination of the regression dropped sharply. This means that the number of debtors ceased to be a good predictor of the sum of liabilities—besides the quantitative factor, qualitative aspects such as the heterogeneity of arrears and deepening liquidity problems of specific groups of enterprises became increasingly important. This relationship indicates that in the context of contemporary crises, the number of entities did not always reflect the real burden of fiscal debt.

Taken together, the results demonstrate that both the liabilities–interest relationship and the entities–liabilities relationship are characterized by strong and statistically significant links in the long run, yet their mechanisms underwent substantial modifications in times of crisis.

This highlights the need for analyses that simultaneously consider the number of debtors, the volume of arrears, and the costs of servicing them in order to capture the full picture of fiscal system destabilization under external shocks. The conducted study does not address the causes, including the motivations for tax debt, but focuses solely on the scale of the phenomenon. Nevertheless, it constitutes an important contribution to literature, as an accurate diagnosis of the scale of tax arrears is a prerequisite for designing effective preventive and intervention measures. Defining the size of the problem makes it possible to better assess its fiscal consequences, identify the groups most at risk of debt accumulation, and indicate areas requiring more in-depth research into taxpayer motivations. In this way, the study creates a foundation for further qualitative and quantitative analyses that may in the future explain the sources of debt and shape appropriate fiscal policy.

In summary, most of the research hypotheses (H1, H2, H3, H5) were confirmed, which demonstrates the strong influence of macroeconomic and crisis-related factors on the scale and dynamics of tax debt. Only the hypothesis concerning the impact of legislative changes (H4) was not unequivocally confirmed—although the literature points to the important role of tax law stability, in the analyzed period it was difficult to distinguish the effects of legal changes from the influence of economic factors, which prevented full verification of this relationship. Thus, the obtained results suggest that macroeconomic factors and external crises have a more direct and measurable impact on tax debt than legislative changes themselves, which require further, in-depth qualitative research. Furthermore, our inability to isolate the distinct effect of legislative changes (H4) underscores the complexity of tax debt dynamics and suggests that future policy evaluations require more nuanced, qualitative approaches to disentangle the impact of legal reforms from concurrent economic shocks.

4. Discussion of results

Tax burdens reduce the incomes of enterprises, limiting their ability to satisfy needs, pursue development, and remain competitive, and in extreme cases leading to the erosion of assets. It is therefore not surprising that taxpayers attempt to counteract them (Klonowska, 2008). The phenomenon of non-payment of taxes includes both actions contrary to the law and situations arising from internal problems of enterprises, which are often the consequence of external macroeconomic or even global factors. The first category includes deliberate tax avoidance, income concealment, or operating in the shadow economy. The second category involves cases where failure to fulfill tax obligations results from loss of liquidity, declining demand, exchange rate fluctuations, rising input costs, or disruptions in supply chains. According to many studies, global economic crises and geopolitical tensions have a significant impact on the emergence of tax arrears (Alm et al., 2014; Brondolo, 2009; Caldara, Iacoviello,

2022; Haque et al., 2023) and in recent years also energy price volatility (Mousavi et al., 2024) and the COVID-19 pandemic (Athira, Ramesh, 2023; European Parliament. Directorate General for Internal Policies of the Union., 2023; Hartmann et al., 2022; Kobbi-Fakhfakh, Bougacha, 2023; Țibulcă, 2022; Zhu et al., 2023), which directly affected market stability and the capacity to settle fiscal liabilities on time.

The empirical analysis confirmed the existence of strong relationships between overdue tax liabilities, interest on arrears, and the number of entities in arrears. However, these relationships were not stable over time, as evidenced by structural stability tests. In the long-term perspective, regression models showed high explanatory power, with R^2 values exceeding 0.9 in stable periods. Nevertheless, crisis episodes such as the global financial crisis, the COVID-19 pandemic, and post-2022 geopolitical disruptions revealed significant modifications in these mechanisms.

During the COVID-19 pandemic, liabilities decreased while interest levels increased, suggesting that the key mechanism was not the accumulation of new arrears but the extension of repayment periods for existing ones. This finding aligns with international studies (e.g., OECD reports, IMF working papers) that highlight liquidity constraints and payment delays during pandemic-related restrictions. Conversely, after 2022, both liabilities and interest rose simultaneously, reflecting cumulative effects of geopolitical instability and rising energy prices. This observation corresponds with broader literature emphasizing fiscal stress during external shocks.

The relationship between the number of entities and total liabilities was also strong but more sensitive to crisis periods. In stable times, the number of entities was a reliable predictor of total arrears. However, in the most recent crises this link weakened, as liabilities grew faster or slower than the number of entities, indicating a decoupling between the scale of debtors and the value of arrears. This is consistent with empirical evidence from other economies, where shocks altered both the extent and intensity of fiscal burdens. Importantly, the results confirm theoretical findings that arrears should not be seen solely as intentional non-compliance but also as systemic shocks that constrain taxpayers' financial capacity.

From a policy perspective, these findings imply that effective countermeasures should go beyond stricter enforcement and address systemic vulnerabilities—such as liquidity shortages, energy price volatility, or disrupted supply chains—that directly affect taxpayers' ability to meet obligations. Structural breaks identified in the models clearly show that crises not only increase the scale of arrears but also alter the very mechanisms that link liabilities, interest, and the number of indebted entities. As highlighted by comparative studies (Alm et al., 2014; Hartmann et al., 2022), the resilience of the tax system depends not only on enforcement capacity but also on the flexibility of instruments that mitigate the impact of crises on taxpayers. Designing adaptive fiscal tools, including temporary tax reliefs, restructuring schemes, or targeted support measures, could therefore reduce the risk of long-term arrears accumulation and protect both public revenues and enterprise viability. An equally important element is the

early monitoring of liquidity indicators and fiscal pressures in the business sector, enabling authorities to react quickly to emerging risks. Finally, experiences such as the COVID-19 relief packages demonstrate that temporary, targeted interventions at the national and EU levels can play a crucial role in sustaining both compliance and economic stability during systemic shocks.

This study provides insights into the dynamics of tax arrears in Poland, but its limitations should be acknowledged. The analysis relies on aggregated national data, which masks sectoral, regional, and firm-size heterogeneity. Furthermore, the models do not incorporate broader macroeconomic variables (e.g., GDP growth, unemployment, inflation), limiting the ability to fully explain the drivers behind the observed structural changes. Finally, the short time span of the recent crisis sub-periods (2020-2021 and 2022-2024) constrains the statistical power of the stability tests, making these results more indicative.

These limitations suggest fruitful directions for future research. Studies utilizing disaggregated data could identify high-risk sectors and regions. Expanding the models to include macroeconomic determinants would offer a more robust explanation of arrears formation. Finally, comparative cross-country analyses could determine whether the observed structural changes are specific to Poland or part of a broader regional pattern.

5. Conclusions

The results demonstrate that in the long run, relationships between overdue liabilities, interest on arrears, and the number of entities in arrears are strong and statistically significant. However, economic crises trigger structural changes that reshape these dependencies. During the pandemic, the persistence of arrears rather than their volume became the main driver of interest accumulation. After 2022, the simultaneous rise in liabilities and interest revealed intensified fiscal stress.

Research limitations should be emphasized. Short subperiods (2020-2021, 2022-2024) reduce the reliability of statistical inference, particularly in structural stability tests (Chow test). Moreover, the analysis is based solely on aggregated data, without incorporating broader macroeconomic determinants. These constraints suggest that findings for the most recent years should be treated as exploratory.

Practical implications arise for fiscal authorities, who should account for the heightened risk of arrears accumulation during crises, especially due to extended repayment periods and increased unit burdens. Scientific implications include the need to integrate crisis-sensitive factors into models of tax arrears and to test structural stability more systematically.

Future research directions should include expanding the model by introducing additional macroeconomic variables such as GDP dynamics, unemployment, or energy prices. Comparative studies across countries would also allow verification of whether the observed structural changes are specific to Poland or represent a broader pattern of fiscal dynamics under external shocks.

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