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Estimating the Relationship Between Inflation and Tax Revenues in Selected European Countries: Austria, Germany, France, United Kingdom and Italy

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Abstract: *The state as a special subject of economic relations is constantly in the sphere of influence of various internal and external factors. Among such attributes of doing business, inflation and tax revenues can be distinguished. These metrics are under constant scrutiny. Since it is these attributes that determine the policy of the state in the field of economic relations, and the state can regulate them through its powers and a number of institutional institutions. Thus, the analysis of the dynamics of inflation and tax revenues is an important element in the development of appropriate public policy. The more important point is the study of the relationship between inflation and tax revenues. To solve this problem, we consider a retrospective change in the values of indicators for selected attributes. We also take into account the regional aspect of such interdependence, which is revealed through the analysis of data for different countries. As a research apparatus, we use various statistical methods. We consider the comparative aspect of the obtained results. The paper presents a lot of empirical material in the form of separate graphs and diagrams. This allows a better understanding of the presented analysis. The results obtained can be used to substantiate the strategy of the state's behavior in the sphere of regulation of economic relations.*

Keywords—inflation; relationship; tax revenues; dynamics; statistical analysis; regional aspect; retrospective; economic development; economic relations

1. INTRODUCTION

Inflation and taxes are integral parts of economic development [1]-[5]. Such attributes always accompany various economic processes, act as a kind of intermediary in relations between economic agents and state institutional institutions. At the same time, the influence of such attributes can be considered, at first glance, as opposite forces in their actions. In a sense, we can also talk about a kind of co-directional influence of inflation and taxes. At the same time, differences in the dynamics of the impact on financial flows and production processes necessitate a closer examination of them [6]-[9]. This explains the relevance of this research topic.

Inflation, first of all, is considered as a factor in the manifestation of certain unfavorable processes in economic development [10], [11]. Rising prices have a negative impact on economic relations, the functioning of business entities. This can lead to a decrease in demand and, as a result, to a drop in the growth rate of production of goods and services. In some cases, such influence may lead to the suspension of production. Excessive inflation adversely affects the corresponding financial flows [6], [12], [13]. These streams can be subject to various kinds of influences, which break their continuity in time, changes in the direction of their movement. This makes the study of inflation indicators an important element of such an analysis.

Taxes are one of the sources of financial resources of the state [14]-[16]. This makes it possible to ensure the development of not only the state as a special subject of economic relations, but also other business entities. However, a significant increase in taxes can lead to the opposite effect, which will lead to a decrease in revenues, to a decrease in the ability of the state to carry out its functions, to support business entities in their development. Thus, questions of taxation are as central as questions of inflation.

We can also note the fact that moderate inflation contributes to the growth of tax revenues. In turn, this allows us to develop production, maintain the financial resources of the state at the necessary and sufficient level. Therefore, an important point is the analysis of the relationship between inflation and taxes. For this, various approaches can be used to understand and explain this relationship [17]-[24]. At the same time, it is important to consider the dynamics of inflation and taxes, both in retrospective terms and taking into account the regional aspect.

Thus, the main goal of this study is a joint analysis of inflation and taxation indicators. To achieve this goal, we will consider various and estimates of such values, taking into account regional differences, as a generalizing factor in this study. But first, we will review relevant related studies by other authors.

2. Related Works

In their study, M. A. Musarat, W. S. Alaloul and M. S. Liew consider the impact of inflation on the cost of construction projects [25]. The importance of such an analysis is based on the fact that the construction industry multiplies the transfer of contracts to a number of business entities. In turn, inflation has a wider impact than just the budget of construction companies. The authors consider the dynamics of the relationship between inflation and income in construction. This helps to better understand the formation of the respective budgets. Based on this, the paper proposes a methodology for budgeting taking into account inflationary expectations. This contributes to the growth of the company's income, reducing the risks of impact on estimates as a result of unpredictable inflation.

C. W. Su, K. Khan, R. Tao and M Umar review the impact of inflation on economic processes in Venezuela [26]. Given the specifics of the economy, the authors pay attention to oil prices (OP) and their impact on inflation (INF). The paper shows a close relationship between such parameters and concludes that it is necessary to take into account the geopolitical risk [26]. This is important because the correlation between OP and INF is sustainable in the long run and Venezuela is dependent on oil. The issues of stability of the local currency in the light of inflationary expectations are also considered [26]. The role of reforms in supporting an acceptable level of INF is noted. In their study, the authors use the methods of statistical analysis, generalization and inference.

N. H. Tien analyzes in detail the impact of price changes on the economy of Vietnam [27]. The author believes that the main goal of the government's economic policy is to curb inflation. It is important to determine the threshold of such influence. This is done taking into account the dynamics of GDP values. Therefore, N. H. Tien estimates the relationship between inflation and GDP. This estimate reflects the optimal possibility of keeping inflation at the level of 6% [27]. The non-linearity of the process of price changes is also taken into account. Methods of correlation analysis are used in the work, building statistical dependencies and obtaining appropriate estimates.

F. Dharma, S. Shabrina, A. Noviana, M. Tahir, N. Hendrastuty and W. Wahyono build a predictive model to study inflation [28]. This model is based on data from Indonesia. For analysis, the authors use various regression models. Genetic algorithms are used to optimize these models. The constructed model was tested on real data. The effectiveness of such a model is shown. This is important for the development of state policy in the field of consumer price changes. At the same time, the authors note the need to take into account historical data in their retrospective. This is necessary in order to prevent the conditions for the development of uncontrolled price changes.

Similar studies can be found in the works of I. Khan, D. Tan, W. Azam, S. T. Hassan [29], C. A. E. Goodhart and M. Pradhan [30], T. Rudelius [31] and other authors.

G. Oz-Yalaman reveals the issues of access to finance in terms of negative and positive dynamics of tax revenues [32]. The author analyzes the relationship between financial affordability and the amount of taxes paid. This conclusion is based on the fact that as income increases, so do tax deductions. In his work, the author examines data for 137 countries in the period 2011-2017 based on the methodology of panel data. It is noted that there is a positive relationship between income growth and tax revenues. However, there are periods of time when such a relationship is not significantly significant. In this aspect, it is important to distinguish between types of taxes and their relationship with the growth of income of companies and business entities.

J. Mawejje and R. K. Sebudde analyze the possibilities of increasing tax revenues [33]. To do this, the authors give the values of the corresponding estimates. This is important for determining the capabilities of the state, implementing its policies and strategies, and developing individual business entities and the population. The paper considers data from 150 countries. For the study, the method of analysis by stochastic boundaries was chosen. Here it is necessary to have sufficient dynamics of the initial data. The results are heterogeneous, where different groups of countries are distinguished. But the key is the development of human capital.

H. Fang, Y.Su and W. Lu explore the relationship between corporate income and tax revenues in the context of tax incentives [34]. The authors review data from China, based on income tax (EIT). For analysis, a regression gap plan is used. The main goal is to identify the growth in the activities of business entities and, as a result, an increase in tax deductions. As a result, it is shown that with a decrease in the EIT rate, the return on assets increases, which leads to an increase in the volume of economic activity. Therefore, it should be noted the positive effect in the use of tax incentives. But such benefits must be weighed and applied at certain time intervals.

D. Prammer and L. Reiss reveal measures to prevent inflationary influences on monetary policy in the EU countries [35]. Particular attention is paid to Austria and the growth of tax revenues. A comparative analysis is carried out for different European countries. Various statistical methods are used for the study.

L. Ferrara, L. Metelli F. Natoli and D. Siena directly explore the relationship between fiscal policy and price changes [36]. The authors use data from the USA. The SVAR model is used for analysis. The paper notes that such a model most reflects the totality of empirical data and is resistant to changes in fiscal policy. Various scenarios of the relationship between inflation and tax revenues are considered.

This review shows the possibility of using different methods for the respective analysis. In doing so, it is important to consider a meaningful data set and its retrospective.

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3. The Values of Inflation and Tax Revenues as Data for the Study

For further analysis, let's consider inflation and tax deductions for a number of European countries. We will consider data for Austria, Germany, France, United Kingdom and Italy. Tax revenues are presented as a percentage of GDP for each country. We are examining the time period from 1972 to 2020. All data from worldbank.org.

The figure below shows the data for Austria.

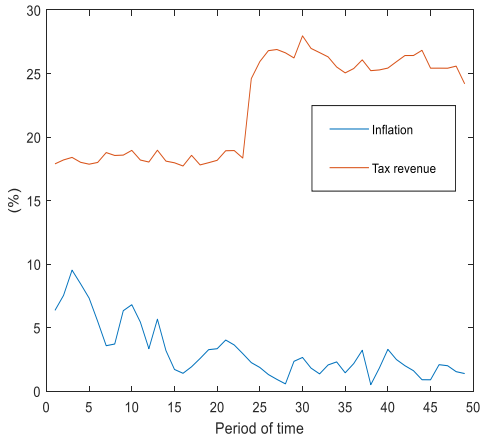

Figure 1: Inflation and tax revenues in Austria

We see that, shown in Fig. 1 indicators have a significant difference, both in dynamics and in their values. INF data for 1972-2020 is declining. Although such a change has a certain volatility. But in general, inflation has not exceeded 5% since 1985.

From 1972 to 1994, the dynamics of tax revenues is approximately the same. Then there is a sharp jump in such values as a percentage of GDP. During this period, there is a sharp change in the values between the INF and tax deductions. Further, from 1995 to 2020, we again have approximately the same dynamics of tax revenues in their percentage ratio.

A somewhat different dynamics is presented for data from Germany. These data, first of all, have a smaller range of changes in their values.

In the second figure, we see the values of INF and tax revenues (NR) for Germany. As in the case of Austria, we can also note a decrease in inflation for Germany. The highest value of inflation was observed in 1974, the lowest in 1986 (see Fig. 2).

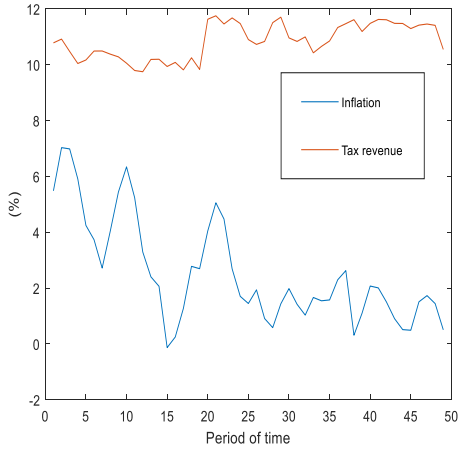

Figure 2: INF and NR data in Germany

Tax revenues in Germany are also characterized by leaps and bounds. This can be seen at the end of 1991, when the volume of receipts increased by 2% of GDP. It should also be emphasized that the volatility of inflation values for Germany is higher than for NR values.

The following figure shows the data for France.

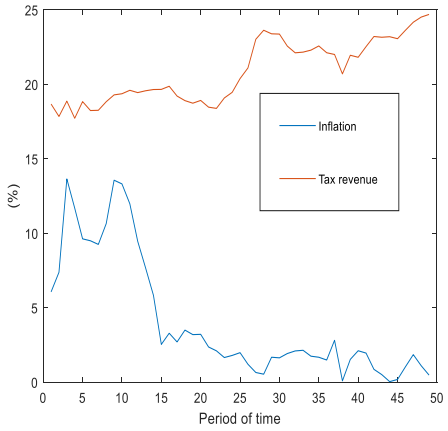

Figure 3: Data for France (inflation and tax revenues)

Since 1981, the dynamics of inflation in France has been constantly declining, and subsequently does not exceed 4%. The volatility of such changes is insignificant. In general, the dynamics of INF values for France is decreasing.

The values of the NR indicator are constantly increasing. At the same time, since 1982, the gap in inflation and tax revenues for France has been constantly increasing. Thus, we can talk about the effectiveness of state policy in the sphere of economic relations.

Consider another country of the European Union – Italy.

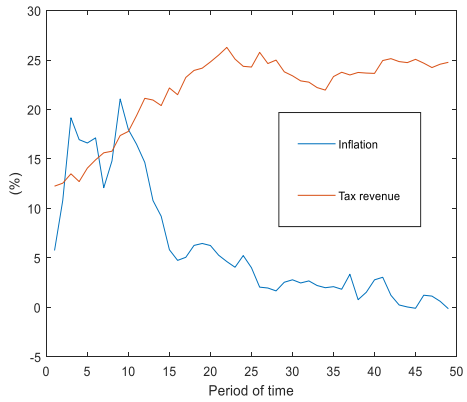

Figure 4: Empirical data from Italy

In the period from 1974 to 1981, inflation in Italy exceeded the values of tax revenues. This is a distinguishing feature of the data for Italy compared to Austria, Germany and France. Further, the situation stabilizes and the dynamics of NR values exceeds INF. In addition, the gap between these data is growing.

Since 1982, inflation in Italy has been steadily declining and has recently been in the region of 1%. In 1994, there is a slight decrease in NR in Italy. But since 2011, this figure has increased again.

The dynamics of inflation values and the indicator of tax revenues to GDP for the United Kingdom are displayed in Fig. 5.

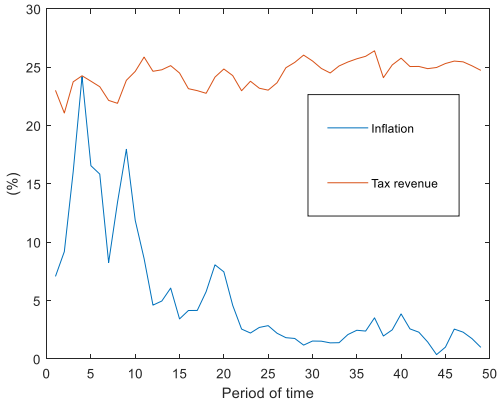

Figure 5: Inflation and NR for the UK

We note a significant inflationary surge in the UK in 1975, which was at the level of tax revenues. Further, since 1976, there has been a constant decline in INF.

The value of the indicator of tax revenues in the UK is approximately at the same level - in the region of 24-25 percent of GDP.

In general, we see different dynamics in the studied data from the point of view of each country. At the same time, the same trend should be noted. This is a decrease in INF. Therefore, let's take a closer look at the relationship between inflation and tax revenues.

4. Analysis of the Ratio of Inflation and Tax Revenues

To carry out such an analysis, we will consider changes in NR depending on inflation. At the same time, all data is pre-sorted by INF in ascending order for each country separately.

On Fig. 6 shows the dependence of the dynamics of tax revenues on inflation for data from Austria.

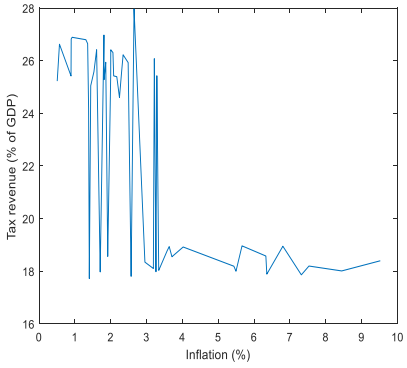

Figure 6: INF to NR ratio for Austria

In the seventh figure, the data is for Germany.

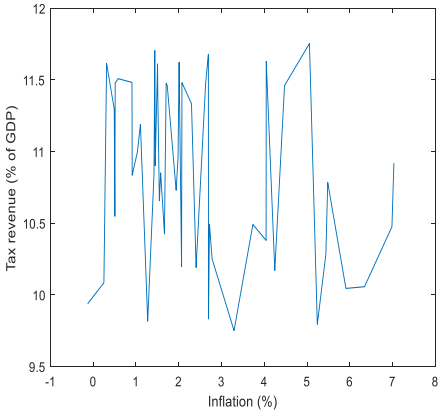

Figure 7: Relationship between inflation and tax revenues in Germany

We see that the presented dependences for Austria and Germany differ from each other. For the Austrian data, NR is stabilizing with rising inflation. This stabilization (about 19% of GDP) appears after inflation rates of 4% or more. If the inflation rate was less than 4%, the values of tax revenues were significantly higher and ranged from 18 to 28 percent of GDP.

For data from Germany, there is no stable relationship between the values of INF and NR.

The dynamics of the ratio between INF and NR for France is similar to the data from Austria.

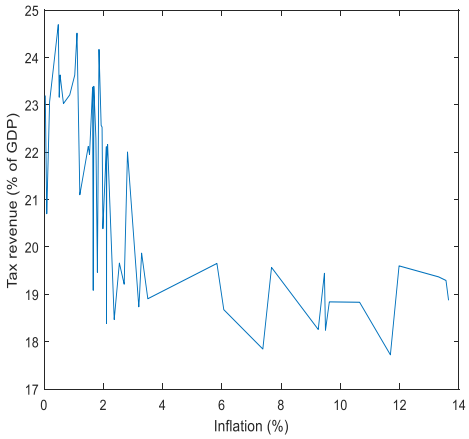

Figure 8: Ratio between inflation and taxes in France

Starting from an inflation rate of 4%, there is some stabilization of NR values in France. However, in this case, the values of tax revenues are much less than they were before the level of INF values of 4%. Thus, rising inflation has a negative impact on the relative performance of tax revenues.

For data from Italy, it should be noted ambiguous dynamics.

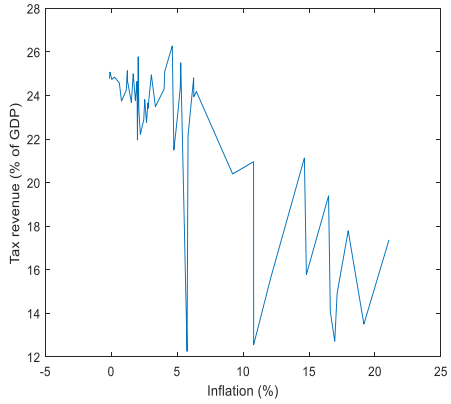

Figure 9: Ratio data from Italy

We see significant volatility in the relationship between tax revenue and inflation for Italy. At the same time, in general, we note a decrease in the NR indicator with an increase in values for inflation.

Data for the UK is shown in Fig. 10.

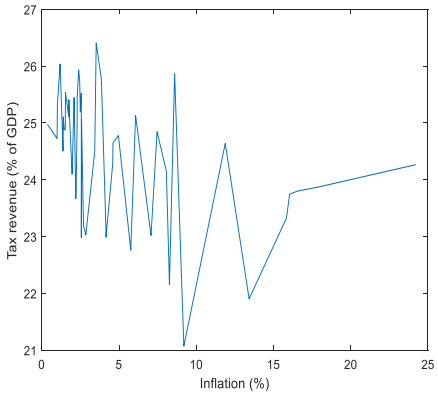

Figure 10: Link between INF and NR from UK

Here, too, there is significant volatility in estimates of the relationship between inflation and taxes. And although we have a certain trend towards a decrease in NR values with an increase in INF indicators, it is premature to talk about its stability. We see the need to consider the mutual dynamics between inflation and tax revenues. This will be done in the next section.

5. Wavelet Coherence Estimates as an Analysis Tool

One of the methods for analyzing the mutual evaluation of data dynamics is the methodology of wavelet coherence [37], [38]. This methodology has found its proper place in the study of economic data [39]-[41]. This is based on the fact that such an analysis makes it possible to evaluate the mutual dynamics at different time horizons, taking into account the depth of possible connections. On Fig. 11 shows wavelet coherence estimates for data from Austria.

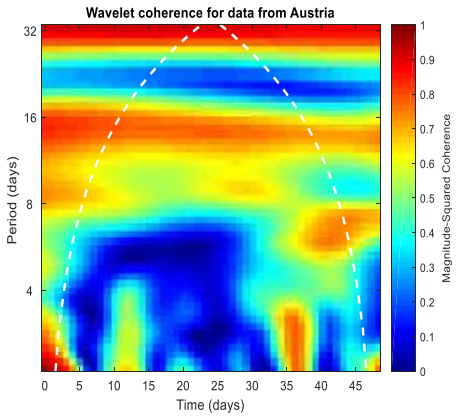

Figure 11: Coherence of INF and NR for Austria

We note that the estimates obtained are in full agreement with the data in Fig. 1. We have an opposite dynamic between inflation and tax revenues.

We observe a similar result for data from Germany.

At the same time, we can identify time periods where there are similar trends in dynamics between inflation and tax revenues. This corresponds to the data in Fig. 7.

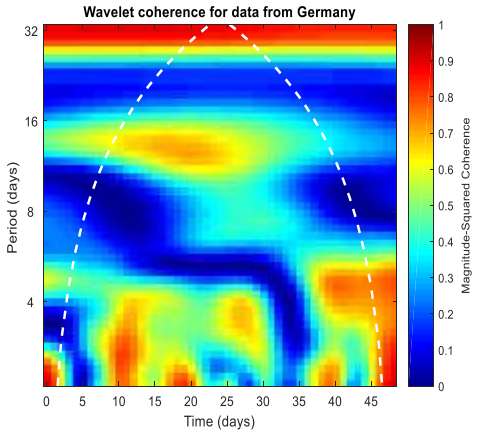

Figure 12: Consistency score for data from Germany

The consistency score for data from France also highlights the difference in dynamics between inflation and tax data. Although there are periods when the trends of such dynamics are the same (see Fig. 3 and Fig. 8).

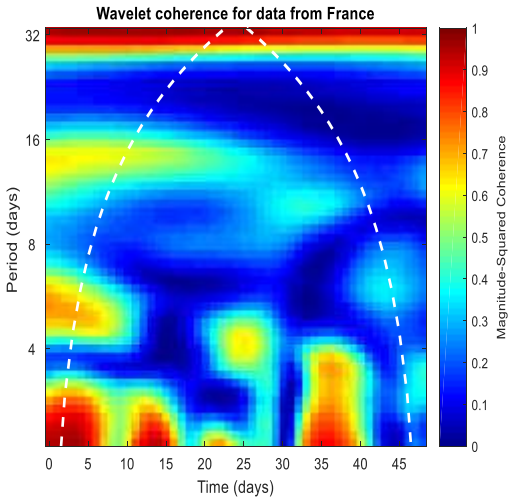

Figure 13: Estimates for France

We obtained similar estimates for data from Italy. We can say that the dynamics of inflation and tax revenues in general is opposite in its trends.

Minor overlaps between inflation and taxes can be observed between 1991 and 1998. This is the period of time when there was a simultaneous decrease in INF and NR (see data in Fig. 4).

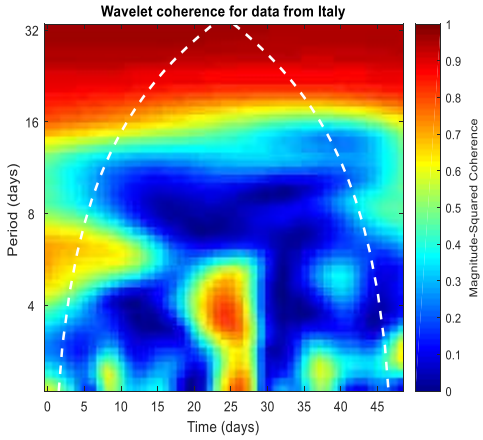

Figure 14: Wavelet coherence for data from Italy

Thus, the estimates of wavelet coherence help to argue the conclusions that we obtained earlier.

6. Conclusion

The article considers such attributes of economic relations as inflation and tax revenues. The importance of such indicators in the development of the state is shown. A brief review of related work by other authors is provided, which shows the importance of retrospective analysis for the relevant study.

On the example of a number of European countries, estimates of the relationship between the level of price changes and tax revenues were obtained. Various methods of statistical analysis were used for the analysis. It is shown that with the growth of inflation, the dynamics of the values of tax revenues (as a percentage of GDP) decreases. Also, for all countries, there is a downward trend in the price level.

The obtained results can be used to substantiate the policy in the field of state regulation of economic relations.

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