



Alexey Leontyev

Integrated Approach to Taxation Optimisation in Latvia

Summary of the Doctoral Thesis for obtaining a doctoral
degree “Doctor of Science (*PhD*)”

Sector – Economics and Business
Sub-Sector – Regional Economics

Riga, 2023



RĪGA STRADIŅŠ
UNIVERSITY

Alexey Leontyev

ORCID 0000-0002-6345-9500

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Supervisor of the Doctoral Thesis:

Dr. oec., Professor **Kārlis Ketners**,

BA School of Business and Finance, Riga, Latvia (2016–2022)

Official Reviewers:

Dr. oec., Professor **Tatjana Muravska**,

Rīga Stradiņš University, Latvia

Dr. oec., Professor **Biruta Sloka**,

University of Latvia

Dr. oec., Professor **Ewa Latoszek**,

SGH Warsaw School of Economics, Poland

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Secretary of the Promotion Council:

Dr. oec., Assistant Professor, **Anželika Berķe-Berga**

Table of contents

List of Abbreviations	4
Introduction	5
1 Theoretical aspects of tax policy	15
1.1 Evolution of tax concepts	15
1.2 Tax system requirements	17
1.3 Critical analysis of the Laffer's concept	21
2 Analysis of the tax policy of Latvia as the EU member state.....	27
2.1 Tax policy in the European Union	27
2.2 The tax system of Latvia in relation to the regional aspects	33
2.3 Analysis of the tax policy evolution in Latvia	35
3 Tools for analysing and evaluating taxes and the tax system.....	42
3.1 Approaches for analysing taxes and the tax system.....	42
3.2 Reliability as an evaluative characteristic of the tax system life cycle	48
3.3 Tax prism method.....	51
3.4 The method of relative single indexes	55
3.5 Tax system as a composite system	57
4 Improvement of the tax system of Latvia by applying integrated optimisation tools	59
4.1 Reliability assessment of the tax system.....	60
4.2 Statistical analysis of tax revenues to the budget.....	64
4.3 Application of the tax prism method	66
4.4 Application of the relative single indexes and the successive concessions method in the analysis of the Vehicle Operation Tax and tax costs related to the vehicle operation	70
4.5 Application of expert evaluation for the elimination of requirements incompatibility.....	79
Conclusions and recommendations.....	82
Information about author's publications and conferences	90
Bibliography	94

List of Abbreviations

ARIMA	Autoregressive integrated moving average
ATR	Administrative-territorial reform
CSDD	Road Traffic Safety Directorate (<i>Ceļu Satiksmes Drošības Direkcija (CSDD)</i>)
EC	European Commission
EDS	Electronic declaration system
EEC	Equity – Efficiency combination
EU	European Union
GDP	Gross Domestic Product
ITCI	International Tax Competitiveness Index
MAPE	Mean absolute percentage error
OECD	Organisation for Economic Co-operation and Development
SARIMA	Seasonal autoregressive integrated moving average
SARIMAX	Seasonal autoregressive integrated moving average extended
SIA	Limited liability company (<i>Sabiedrība ar ierobežotu atbildību (SIA)</i>)
SRS	State Revenue Service
VAT	Value added tax

Introduction

Relevance of the research topic

The economic development of the state is directly related to tax revenues to the budget and, accordingly, to the optimal structure of the tax system. Moreover, these issues became relevant simultaneously with the emergence of the state and much earlier than the emergence of economic science in the modern sense of this definition.

The main challenge for the tax system is the need to be consistent with these processes. At the same time, its efficiency and fairness must be preserved and maintained at the required level. Traditionally, the state is interested in increasing the revenue part of the budget formed from taxes (hereinafter referred to as the tax part of the budget) and is forced to seek additional reserves if tax collections are not received in full. In the latter case, it is difficult for the state to fulfil the functions assigned to it. Individuals and legal entities, on the other hand, often criticise tax policy, pointing out an excessive and sometimes unbearable tax burden.

All this suggests that the tax policy of the state at any time is the main criterion for its viability and makes the study of issues and problems of tax policy extremely **relevant**.

The level of scientific development of the problem

The evolution of taxation is closely related to the social and economic development of society and the state. The history of the development and improvement of tax systems from ancient times to the present is well-studied.

The research of J. Mirrlees¹ published 1971 can be considered as the beginning of the modern theory of optimal taxation. However, a number of

¹ Mirrlees, J. 1971. An Exploration in the Theory of Optimum Income Taxation. *The Review of Economic Studies*. 38(2), 175–208.

aspects of optimal taxation were studied earlier by other authors, for example, by F. Ramsey.²

The scientists saw the task of optimal taxation in the search for a tax system that maximises social welfare under any restrictions. However, they did not use an integrated approach to solve the problem. Yet, decisions to improve the tax system, including by correcting its fiscal function, which are taken on the basis of the analysis and change of any discrete parameter (a group of parameters of the same type) that do not involve the use of an integrated approach, often do not give the desired result.

The necessity of application of the integrated approach was mentioned by Ē. Žubule, I. Sproģe and others in the doctoral theses related to the tax system of Latvia.^{3, 4} However, these researchers are only limited to corresponding recommendations. One of the major reasons for the necessity of the integrated approach for improving and enhancing the tax system is its objective process of constant adaptation to the ever-changing internal and external environments in which the tax system functions.

The stimulus for the integrated approach is the growing uncertainty, in which professionals involved in the development of reforms or corrective measures have to make decisions. The higher the level of uncertainty is, the more factors must be taken into account simultaneously.

At the same time, an analysis of both Latvian and foreign works and methods shows that so far the researchers have demonstrated a rather narrow approach, and only recommended replacing it with an integrated one. In the

² Ramsey F. 1927. Contribution to the Theory of Taxation. *Economic Journal*. 145(37), 47–61.

³ Žubule, E. 2012. *Valsts budžeta procesa analīze un pilnveidošana: promocijas darbs: specialitāte – ekonomika*. Rīga: Latvijas Universitāte, 219.

⁴ Sproģe, I. 2010. *Nodokļu politika ekonomikas attīstības mainīgajos apstākļos: promocijas darbs: specialitāte – ekonomika*. Rīga: Latvijas Universitāte, 213.

studied doctoral theses, researchers usually confine themselves to small, narrow questions, in some cases only indicating that the result can be achieved by applying an integrated approach.

Based on the aforementioned, it was decided to use an integrated approach, which implies that decisions on assessing the current tax system and recommendations for changing (modernising) it are made based not on the analysis of any one indicator or criterion, but on the basis of a number of conditions (criteria).

To select the most appropriate solution, it is proposed to use the optimisation process, which herein refers to the application of scientific methods, united under the name “operations research”, i.e., application of mathematical, quantitative methods to justify and develop decisions related to changes in the tax system.

As an optimal solution will be considered a solution, not being absolutely the best in the literal sense of the Latin term “optimum” (from Latin – the best), yet being for one reason or another, is more preferable in relation to others. In the case of the absence of suitable solutions, (that is, relatively speaking, in the presence of only “bad” solutions), the approach proposed by operations research allows choosing the most preferable of them.

The important role in the problem of tax system optimisation using an integrated approach is related to the dependence of tax revenues on tax rate described by the Laffer curve. The Laffer curve has been thoroughly studied by various researchers, it has been severely criticised from a practical point of view, and there have been made numerous attempts to improve it. However, the analysis of studies has shown that modernisation attempts did not allow to create a universal tool for tax system analysis and the results are operating either on a theoretical dimension, or a very narrow practical one, not providing sufficient results.

The integrated approach to the tax optimisation is also very important factor of a regional development, as the tax system operates on a specific territory, establishing corresponding tax regime, that directly affects the wellbeing and standards of living of the population. Inter-country regional division and its specificities could be used as a one of the criteria for tax system optimisation using the integrated approach.

Hypothesis

The use of the integrated approach for substantiation of tax policy measures permits rational decision making.

Aim of the Doctoral Thesis

The aim of the doctoral research is to develop tools for improving the tax system of Latvia and increasing its reliability, taking into account the multidirectional interests of the state and business.

Tasks of the Doctoral Thesis

To achieve the aim, the following tasks were formulated:

1. To analyse the evolution of approaches to taxes and taxation and definitions, as well as the criteria for tax systems and the stages of implementing tax reforms.
2. To study specific aspects of the tax policy of the EU, and the EU requirements for taxation, changes in the tax system to reduce social stratification.
3. To analyse the evolution of Latvian tax policy within the framework of the tax system.

4. To develop a set of tools that will allow a comprehensive assessment of the tax situation in Latvia, regarding the interests of the state and business.
5. To develop proposals for the modernisation of the Latvian tax system in order to build a more reliable and optimal tax system.
6. To assess the impact of the proposed changes on the tax system of Latvia on the example of Vehicle Operation Tax (including other tax factors, affecting the cost of vehicle usage), by applying the integrated approach instruments.

Object of the Doctoral Thesis

The object of the research is the process of reform and improvement of the tax system.

Subject of the Doctoral Thesis

The subject of the research is the tax system of Latvia.

Theses for the defence

1. The tax system of Latvia after the reforms introduced since January 1, 2018 does not fully meet the criteria of equity⁵ and efficiency and is not reliable.
2. Assessment of the reliability of tax reforms at the stage of their development contributes to the creation of a tax system that meets all the necessary criteria to the maximum extent.
3. One of the most important criteria of the tax system are the principles of efficiency and equity. The joint use of state-oriented and business-oriented aspects in the analysis, construction and change (reform) of

⁵ Term “equity” also is referenced as “fairness”.

the tax system allows to take into account these criteria of taxation for tax system improvement.

4. Tax policy instruments can give the maximum effect if the principle of an integrated approach is applied when all types of activities are mutually coordinated and subordinated to the implementation of national development priorities.
5. The application of the tax prism method, relative single indexes, reliability assessment, statistical analysis, as well as analysis of the composite system is defining possibilities to have of comprehensive assessment of the tax system for its rational reform.

Research methods, data collection tools and techniques

In the Doctoral Thesis, the following research methods are used: analysis of primary and secondary data; method of graphical differentiation and integration; time series analysis methods (ARIMA, SARIMA); method of expert assessments; method for analysing the consistency of opinions in subgroups of experts using the Kendall's coefficient of concordance; method of mathematical modelling; methods of geometric similarity, mathematical analysis (including functional analysis); scenario analysis method; deterministic, probabilistic and quantum modelling of composite systems; variational calculus method; methods of determining reliability and methods of operations research (including decision theory).

Calculations were carried out using software (SPSS Statistics, Gretl, Python programming language).

Research limitations

Within the framework of the study, the economy and tax system of Latvia, including in particular as a member state of the European Union, was considered.

In addition, six main regions of Latvia were studied, and the country's administrative-territorial division was considered, which was in effect until July 1, 2021, as well as after that date.

To study the tax system, the period was chosen from the beginning of 1991 until the beginning of 2022.

For the analysis of time series according to the available statistics of the State Revenue Service of Latvia was determined and studied the frame from 2016 to 2020 inclusive, when major tax changes were entered into force, and the COVID-19 pandemic started to affect taxation.

Scientific novelty

1. The systematisation of approaches to the analysis of the Laffer curve and preparation of grounding for creating a new tool that would allow to describe the relationship between the parameters proposed by Laffer more effectively and clearly, as well as additionally qualitatively and quantitatively consider their relationship with the tax base.
2. The analysis of the changes in the definition of “tax” in the legislation of Latvia, from 1995 to the present.
3. Newly introduced advanced definitions:
 - state-oriented aspect of tax optimisation (approach to taxation);
 - business-oriented aspect of tax optimisation (approach to taxation).
4. The concept of reliability of the tax system has been introduced and the reliability criterion has been developed for assessing the tax reforms and the tax system as a whole.
5. For economic interpretation of the formation of the tax (revenue) part of the budget, for its assessment and research, the concept of a tax prism has been introduced.

6. The concept of static and dynamic tax prism has been introduced and a methodology for their calculation has been developed, allowing to consider the decrease in the volume of collected taxes due to the use of legal tax optimisation schemes by taxpayers.
7. Relative single indexes are formed to determine the rational combination in the system “equity – efficiency”. Possible equity – efficiency combination (EEC) scenarios are identified and their interpretation is described. For cases of fatal incompatibility of requirements, it is proposed to use the method of successive concessions (with the use of expert judgment).
8. The tax system modelling in form of a composite system, where each of the taxes represents its element, is proposed to assess the specified criteria in the “equity – efficiency” system and the relationship between taxes.

Practical significance

The implementation of the author’s proposals and recommendations will improve the reliability of the tax reforms under development and other adjustments made to the tax system of the state. This will increase the efficiency of the functioning of the tax system and its balance, and at the same time will allow taking into account the interests of the state and the taxpayer in conditions of economic instability and the ongoing pandemic.

The implementation of the proposed measures will ensure activation of business and the stable development of the country by reducing and subsequently eliminating the budget deficit and will make it possible to create a more stable tax system that meets all the requirements (criteria) imposed on it and fully implement the recommendations of the European Commission, developed by it as a result of the tax reform 2018 and subsequent adjustments.

The results obtained can be used by state and regional (municipal) authorities to develop concepts, strategies and programs for sustainable development of regions by improving the tax system in Latvia as part of the implementation of the recommendations of the European Commission.

The results of the conducted economic analysis to assess the impact of external socio-economic indicators on total tax collections (including social payments) have practical importance.

The main provisions of the Doctoral Thesis expand and supplement the existing research on theoretical and practical problems of improving the tax system, assessing its reliability, and also contain a new approach to the relationship between the volume of tax revenues and tax rates (the author's method of tax prism). The tools proposed by the author can also be used in the field of higher and specialised professional education, in particular, in the process of teaching the disciplines "Macroeconomics", "Regional Economics", "Regional Finance", "Taxes and Taxation" and a number of other specialised disciplines.

Practical approbation of developed tools is done on various fields of economy and economic activity in Latvia, including variant optimisation of Vehicle Operation Tax and tax costs related to the vehicle operation, as well as their scenario analysis.

Evaluation of the research results

The main provisions of the study were presented by the author to a wide range of interested parties and set out:

- in 22 scientific articles prepared and published in Latvian and foreign scientific journals and collections, including 5 publications indexed in databases (4 publications indexed in SCOPUS, 2 publications indexed

in Web of Science; see the Section *Information about publications and conferences*);

- in presentations and reports at 15 international scientific and research-to-practice conferences and forums (in the Section *Information about publications and conferences*);
- in the educational process when giving lectures and conducting seminars with master's degree students of economic specialties.

The research within the framework of this Doctoral Thesis was carried out:

- during development of computer programs for the improvement and business-oriented tax optimisation and analysis of financial activities of the annual International Congress “Person and Medicine”;
- during development of computer programs for the improvement and business-oriented tax optimisation and analysis of financial activities of the company “Leon News Agency spol. s.r.o.”;
- during development of computer programs for the improvement and business-oriented optimisation of the financial activities of the company “Magistral”;
- during creation of a strategy for improving the financial performance of the SIA “Trade Hub Productions” company.

The structure of the Doctoral Thesis

The Doctoral Thesis consists of an introduction, 4 chapters, conclusions and recommendations, a bibliography, a list of abbreviations, and 11 annexes. The volume and structure of the Thesis are determined by the aim, tasks and logic of the research.

1 Theoretical aspects of tax policy

1.1 Evolution of tax concepts

Taxes, being the main tool for mobilising state budget revenues, simultaneously play the role of a regulator of economic activity and the activities of tax subjects.

Many taxpayers for various reasons negatively perceive the need for tax confiscation of part of the income received.

In a number of works, the institution of taxation is seriously criticised.

Francis Ysidro Edgeworth, developing issues of social justice in taxation, pointed out that in order to achieve social justice, the principle of least aggregate sacrifice should be the main principle of taxation.⁶ Edgeworth's taxation paradox is being considered in the scope of excise taxation, where unit excise tax can affect the price – to reduce it, as well as to increase output.⁷

The same principle was developed by the English economist Arthur Cecil Pigou, who was one of the founders of the economic theory of welfare. He pointed out that the market system, despite all its effectiveness, can contribute to the uneven distribution of income.

In modern society the green economy and the reduction of the greenhouse gases is one of the major areas where Pigouvian taxation may be naturally appealing. In addition to corrective taxes, Pigou studied progressive taxation issues, pointing out its negative consequences.

In the 70s of the XX century, the Keynesian concept of redistribution of income through taxes was widely discussed. It was noted that the progressive tax plays an important role in the redistribution of income, but at the same time it

⁶ Vitaliano, D. 2018. The Hedonic Theory of Taxation: An Application to the U.S. Income Tax. *Public Finance and Management*. 18(3), 251–264.

⁷ Ritz, R. 2014. A new version of Edgeworth's taxation paradox. *Oxford Economic Papers*, Oxford University Press. 66(1), 209–226.

can be destabilising in nature, since in a number of cases it turned out to be unprofitable to work a lot and receive large incomes. It was concluded that the stronger the progression of taxation, the weaker the differentiation of incomes, but the lower the efficiency of the economy.

During this period, the “economic theory of supply” arose, the representatives of which were J. Wanniski, A. Laffer, R. Mundell, M. Feldstein, J. Gilder, who considered the problems of the impact of taxation on the economy. The supporters of this theory believed that high taxes lead to a decrease in business activity, since they reduce the share of savings, weaken the main incentives for economic activity (private initiative), without which economic success is impossible.

Modern assessments of the current policy in the field of taxation are different.

The reduction in taxes limiting the growth of personal consumption (income from the sale of property in the form of securities, real estate, precious metals, the abolition of the tax on the inheritance of real estate) led to an increase in personal consumption, and not to an increase in investments. As a matter of fact, major tax cuts for the rich are said to increase income inequality and social stratification but do not stimulate economic performance.⁸

To assess the impact of taxes on efficiency and equity, it must be borne in mind that in modern conditions this part is constantly increasing.

The gap between tax payments and the provision of public services is serious shortcoming of the tax system. No matter how the problems of efficiency and equity are interpreted (a serious contradiction between them is noted by many economists), the main goal of economic policy is to find the optimal

⁸ Hope, D. and Limberg, J. 2022. The economic consequences of major tax cuts for the rich. *Socio-Economic Review*, 20(2), 539–559.

combination. There is a problem of public choice of various priorities of the state's economic policy, the problem of combining economic efficiency and public interests.

The state uses tax policy as a tool for the redistribution of national income in order to improve the economic development of the regions and increase the well-being of the population as a whole. Analysing the aforesaid, the author comes to the conclusion about the need for an integrated approach to theoretical and practical issues of tax policy, including during the preparation and implementation of tax reforms.

1.2 Tax system requirements

The basis for the existence of the state is its competent tax policy, which determines the economic development of the country and the level of well-being of its citizens. Tax policy must comply with certain requirements.

The processes of global economic regulation in the field of taxation have a historical and institutional continuity. The Organisation for Economic Cooperation and Development (OECD) pointed out the need to comply with the criteria of taxation.⁹

Researchers also state that one of the important tax policy design requirements is the fairness of the taxation,¹⁰ which is crucial for both for tax system design and allocation of tax rights.

⁹ OECD. 2015. *Addressing the Tax Challenges of the Digital Economy*. Paris: OECD Publishing. 1(2), 29–50.

¹⁰ Lubis, A. and Rahay, N. 2021. Emphasizing Inter-Nation Equity in the New Digital Economy's Taxing Rights Allocation Scheme. *International Journal of Scientific and Research Publications*. 11, 402–408.

In “Tax policies in the European Union. 2020 survey” four channels are highlighted through which taxation can influence social welfare.¹¹ The researchers are pinpointing key features to be taken into account (and how well the government handles them) when assessing the fairness and efficiency of a tax system.

One of the approaches to assessing the fairness of tax policy was graphically illustrated by M. Lorenz in the form of an uneven distribution of income¹² and is applied for European household wealth assessment. Lorenz curve is also used for linking various indicators, including Gini index and the Pietra index (a counterpart of the Kolmogorov–Smirnov statistic), which is considered as an analogous to Gini index.¹³

The requirements of taxation and good tax policy are also reflected in research devoted to finding optimal taxes. So, for example Mike Brewer, Emmanuel Saez, and Andrew Shephard¹⁴ defined the main trade-off of the problem.

The application of this or that type of taxation system is individual for each state and depends on many socio-economic factors. Also, the choice of the type of taxation system is often a political tool. Thus, I. Spröge has pointed out that despite the fact that the choice of the taxation system is a subject of wide discussion between economists and politicians, the practical choice of the system

¹¹ European Commission, Secretariat-General. 2020. Tax policies in the European Union. 2020 survey. SWD (2020) 14 final. 30.01.2020. <https://data.consilium.europa.eu/doc/document/ST-5695-2020-INIT/en/>, 124.

¹² Costa, R. and Pérez-Duarte, S. 2019. *Not all inequality measures were created equal. The measurement of wealth inequality, its decompositions, and an application to European household wealth*. European Central Bank: Statistics Paper Series. 31(12), 57.

¹³ Eliazar, I. and Sokolov, I. 2010. Measuring statistical heterogeneity: The Pietra index. *Physica A: Statistical Mechanics and its Applications*. 389(1), 117–125.

¹⁴ Mirrlees, J. 2017. *Dimensions of Tax Design*. Adam, S., Besley, T., Blundell, R., Bond, S. et al. (eds.). Oxford: Oxford University Press for Institute for Fiscal Studies, 1346.

remains with the ruling party (coalition).¹⁵ The author believes that with such an approach, there is a danger of making ineffective decisions, in some cases populist, especially during pre-election periods. One such example is the speculative use of the Laffer curve.

Because of its simplicity and clarity, a number of American politicians demonstrated the need to reduce taxes with its help, in some cases unreasonably appealing to the fact that tax rates are located to the right of the optimal point (i.e., they are too high, and tax revenues to the budget in the same amount can be provided at lower tax rates). At the same time, other arguments were not taken into account. Throughout the years, the reasoning behind it remains the same – tax cuts should lead to a larger-scaled economy.¹⁶

One of the important directions in the analysis of taxes is the determination of the parties who will be charged with the tax burden.

The author considers the importance of taking elasticity into account when developing tax reforms and making adjustments to tax legislation.

Depending on the complexity and the number of goals set, the reform can be planned in one or several successive stages with a corresponding breakdown by goals, means and methods. The algorithm for implementing the tax reform is shown in Figure 1.1.

¹⁵ Sproģe, I. 2010. *Nodokļu politika ekonomikas attīstības mainīgajos apstākļos: promocijas darbs: specialitāte – ekonomika*. Rīga: Latvijas Universitāte, 213.

¹⁶ Gale, W. and Samwick, A. 2014. Effects of Income Tax Changes on Economic Growth. *Economic studies at Brookings. The Brookings Institution*. (9), 1–15.

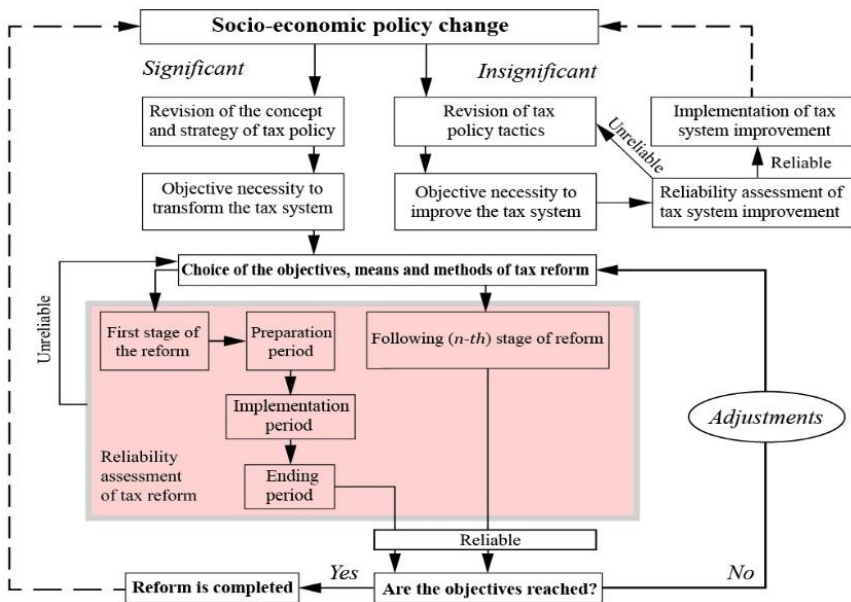


Figure 1.1 Algorithm for the implementation of tax reform

Source: created by the author.

The reliability assessment should be carried out at all stages of the preparation and implementation of the tax reform.

The author proposes his own approach to the algorithm for the preparation and implementation of the tax reform, taking into account the assessment of its reliability at various stages.

The main tax contradiction is the antagonism of efficiency and fairness (equity), which is the main problem of creating the architecture of a rational tax system, taking into account the interests of both the state and the taxpayer.

1.3 Critical analysis of the Laffer's concept

To describe the correlation between the tax burden and tax revenues to the budget the “Laffer curve” is quite often used, named after the economist who visualised the idea that the volume of tax revenues is not always an increasing function of the tax rate.^{17, 18} More than 50 works of researchers from different countries devoted to the Laffer curve were selected for analysis.

Classification of works devoted to the application of the Laffer curve

The analysis has shown that recently there has been an intense flow of publications concerning the negation or confirmation of the Laffer curve concept, as well as studying the problems of its practical application.

Research sources that mention the Laffer curve in one way or another were divided into three main groups.

The **first** group includes studies by scientists who agree with Laffer's interpretation. The **second** one includes those in which Laffer's approach is considered erroneous and the existence of his curve and the validity of the economic research carried out on its basis are called into question. The **third** group includes studies in which scientists agree with Laffer's concept, but show its limited suitability and make attempts to improve and modernise the curve in question. Separately, is distinguished the **fourth group**, which includes educational literature.

The analysis of the theoretical justification of the Laffer curve shows that it quite accurately illustrates the application of a progressive scale of tax rates. It is when a progressive scale is used that there are negative incentives in the supply of labour associated with the fact that additional income is taxed at a higher rate.

¹⁷ Mach, P. 2019. On the Origin of the Laffer Curve. *ACTA VŠFS*. 13(2), 186–191.

¹⁸ Wanniski, J. 1978. Taxes, Revenues, and the «Laffer Curve». *The Public Interest*. 3–16.

It should be noted that the Laffer curve does reflect the dependence of the budget revenue on the tax rate, implying a tax base, without which this function is not viable. However, this curve cannot account for changes in the tax base under the impact of any influences.

Limitations of the Laffer concept

The modern stage of research into the relationship between tax revenues and the optimal structure of taxes and economic activity is marked by the influence of American economist A. Laffer and the curve of the same name, even if researchers do not agree with him and do not share his political-economic position.

The author does not share the position of researchers who completely deny the validity of the Laffer curve.

The author shares the viewpoint of T. Merkulova,¹⁹ who showed the most common misconceptions about the Laffer curve. In particular, she pointed out that Laffer did not argue that tax revenues will always increase when the rate is reduced.

Many economists have noted the difficulty and had disagreements in identifying the part of the curve that corresponds to the time of the study.

In regard to this, the author shares the position of those specialists who agree that the dependence illustrated by Laffer does exist. At the same time, the author agrees with many critics who point to the impossibility of using this approach for practical purposes in a number of cases.

¹⁹ Merkulova, T. 2007. Snizhenie nalogovoi nagruzki i effekt Laffera: argumenti I zabluzhdenija. *Nalogooblozhenie: problem nauki I praktiki* [Tax burden lowering and Laffer's effect: arguments and delusions]. *Kharkiv (Ukraine): ID „INZHEK”*. 28–42.

The Laffer curve is not a universal tool. Using it in the form proposed by Laffer can be difficult and not always giving reliable results, which is confirmed by numerous works in which the Laffer curve is criticised and modernised in an attempt to adapt it to specific conditions.

For example, Kakaulina provided graphs of Volobuev, Balatsky and Mayburov, which show the qualitative relationship between the tax base and the tax burden.²⁰ At the same time, the dependence shown by Volobuev is most often cited in various works (e.g. Sproģe and a number of other researchers also referred to it in their studies²¹). The analysis of this theoretical dependence shows that the tax base decreases with an increase in the tax burden, yet Mayburov and Balatsky suggested that this dependence is a parabola similar to the Laffer curve.

The assumption of Mayburov and Balatsky that both dependencies depicted by them have a parabolic shape, according to the author's opinion, is sufficiently artificial, and is proposed since analytical research is more convenient in this case. However, significant assumptions lead to the fact that the determination of the maxima of parabolas has turned, rather not into an economic, but a mathematical analysis. At the same time, this analysis demonstrated only theoretical relation between the tax base and the tax burden, as well as tax revenues and the tax burden. It is difficult to establish a reliable correlation between the tax base and the tax burden in this way due to the large number of assumptions made by researchers in the model.

The attention to this is also drawn by Shcherbakov, who pointed out that “Balatsky’s assumption about the existence of a Laffer point of the second kind – the maximum of the Laffer tax curve – for a quadratic function defining the Laffer tax curve is fulfilled only when the coefficient in front of the squared

²⁰ Kakaulina, M. 2017. Visual Representation of Laffer Curve Factoring in Implications of Capital Outflow. *Journal of Tax Reform*. 3(2), 103–114.

²¹ Sproģe, I. 2010. Nodokļu politika ekonomikas attīstības mainīgajos apstākļos: *promocijas darbs*: specialitāte – ekonomika. Rīga: Latvijas Universitāte, 213.

variable is negative.”²² Analysing the dependencies proposed by Balatsky, Shcherbakov has drawn attention to the difficulties of economic interpretation of the obtained results and has shown that in some cases it is impossible to do such an interpretation.

Balatsky, evaluating the results of calculations using his methodology, pointed out that with the three-parameter method, Laffer points “are either absent or have unrealistic values”, and with the two-parameter method, they “improbably jump over the years.”²³

E. Balatsky and N. Ekimova, analysing similar approaches of I. Ananiashvili, V. Papava²⁴ and G. Loladze²⁵ concluded that all their approaches were based on the methodology of static functions, which led to serious computational difficulties and very questionable estimates, which results in either overestimated or underestimated fiscal parameters.²⁶

Kakaulina also referred to the works of Mayburov, in which he, analysing his own approach to the relationship of the tax burden – tax collection – tax base, and a similar approach of Balatsky, concluded that “the theory cannot give a reasonable multifactorial dependence and a satisfactory quantitative assessment of the optimal level of the tax burden yet.”^{27, 28}

²² Shcherbakov, G. 2019. Laffer points, area of fiscal contradictions and taxpayers’ acceptance power. *RUDN Journal of Economics*, 27(1), 49–62.

²³ Balatsky, E. 2003. Invariance of Laffer fiscal points. *World economics and international relations*. (6), 62–71.

²⁴ Ananiashvili, I. and Papava, V. 2010. Macroeconomic equilibrium under the Laffer-Keynesian synthesis (in Georgian). *Journal Economist*. 5(10), 5–23.

²⁵ Loladze, G. 2002. About certain aspects of the Laffer curve (in Georgian). *Macro and microeconomics*. 9, 1–14.

²⁶ Balatsky, E. and Ekimova, N. 2011. Fiscal policy and economic growth. *Society and economics*. (4–5), 197–214.

²⁷ Kakaulina, M. 2017. Visual Representation of Laffer Curve Factoring in Implications of Capital Outflow. *Journal of Tax Reform*. 3(2), 103–114.

²⁸ Mayburov, I. 2012. The Problem of Tax Expenditures Identification and Evaluation: Methodological Approach. *Problems of economics. Finance in banking*. (4), 187–193.

It should be noted that, as already mentioned, many researchers, realising the importance of considering the connection of the three above parameters, depicted their theoretical dependence.

The author certainly agrees with the need to take into account the connections of these three parameters, but has to state that at the moment, there are no reliable methods implemented in the form of algorithms for computing these values. At the same time, attempts to establish a connection with the tax base were carried out on the basis of the curve proposed by Laffer, and not by developing other tools.

The studies associated with the modernisation of the Laffer curve and the methods proposed on their basis to assess the impact of the tax burden on tax collection, in the author's opinion, should be considered as independent tools based on dependencies known long before the appearance of the Laffer curve.

The concept of the Laffer curve cannot be universal for all types of taxes. Depending on the specificities of the studied tax (direct or indirect), the significance of the tax for the budget, the purpose of tax collection (fiscal or corrective), the subject of taxation (legal person or individual), the subject (object) of taxation, the type of the applied rate (progressive, regressive, proportional) significantly depends on the Laffer curve and even on the fact of its existence. The use of this curve is largely hampered by the fact that it actually takes into account the correlation of only two known parameters, while the tax base is not explicitly taken into account in the Laffer approach.

Studies and attempts to improve the Laffer curve, which were conducted for almost four and a half decades, showed that one of the drawbacks of the visualisation proposed by A. Laffer is that this approach initially involves only two variables – independent (the tax rate) and dependent (tax revenues).

That's why it's possible to conclude that the visualisation proposed by Laffer has been sufficiently studied and has largely exhausted its possibilities.

Many works formally related to modernisation of this curve are in fact independent, but solve a limited range of questions due to the fact that they are initially based on the approach proposed by Laffer and Wanniski. All this confirms the need for a different tool, allowing for taking into account more parameters in an explicit way.

In this case, the abovementioned disadvantages and limitations of the Laffer curve should be taken into account, or a better tool should be developed that allows to perform more precise assessment.

2 Analysis of the tax policy of Latvia as the EU member state

2.1 Tax policy in the European Union

The establishment of the European Union took place on February 7, 1992.²⁹

In the tax policy, the main focus was on direct taxation (until Denmark and United Kingdom joined European Community). Harmonisation of direct taxation was suggested for the first time by the Neumark committee.³⁰ Later, European Economic Community abandoned the idea of direct taxation harmonisation and moved to indirect taxation.

Only a part of the national law resulting from the implementation of integration legislation into the national legislation of the EU member states can, in a limited aspect, be recognised as part of EU tax law and only in the part that without distortions duplicates the provisions of integration tax law and is similar to them.³¹

Of all the international unions, the EU is currently the most established and mature union in the world. In the process of convergence of the EU countries the tax policy at the EU level has been consistently changing.

The supreme executive body of the EU is the European Commission (EC). Its functions include preparing draft laws, implementing decisions of the

²⁹ Office for Official Publications of the European Communities. 1992. Treaty on European Union. *Official Journal of the European Communities*. <https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:11992M/TXT>, 253.

³⁰ Menéndez, A. 2015. *Neumark Vindicated the Europeanisation of National Tax Systems and the Future of the Social and Democratic Rechtsstaat*. Oslo: ARENA, Centre for European Studies University of Oslo, 57.

³¹ Wattel, P., Marres, O. and Vermeulen, H. 2018. *European Tax Law*. 7th edition. Alphen aan den Rijn: Wolters Kluwer, Kluwer Law International, 1012.

European Parliament and the Council, monitoring compliance with EU treaties and other legal acts, as well as other current affairs of the Union.³²

From the moment of its creation to the present, the EU has been paying significant attention to tax policy issues in its activities.

The creation of a common tax policy was confirmed by the Treaty on the establishment of the EU³³ and European single market (providing the freedom for movement of goods, persons, services and capital).

The measures taken by the EU institutions, as well as by its member countries, have contributed to the elimination of tax barriers within the internal market, ensuring the freedom of movement of goods, persons, services and capital, the rejection of the use of unfair tax competition regimes of jurisdictions, the elimination of double taxation and the successful fight against tax offenses.

The transformation of taxation in the EU has its certain specifics. It should be taken into consideration that there are certain differences in the regulation of direct and indirect taxation of member countries. In the field of indirect taxation of the EU countries, a policy aimed at harmonisation is being carried out, and in the field of direct taxation, a coordination process is underway.

The opinions of economists of various schools that study the impact of fiscal policy of the member states economies differ significantly.

³² European Commission. EU INSTITUTION European Commission. Retrieved: https://europa.eu/european-union/about-eu/institutions-bodies/european-commission_en.

³³ Office for Official Publications of the European Communities. 1992. Treaty on European Union. *Official Journal of the European Communities*. <https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:11992M/TXT>, 253.

The author believes that during the formation of Common Market, special attention should be paid to the harmonisation of legislation on indirect taxes, because it is these taxes that have a significant impact on the formation of prices in mutual trade and make up a considerable part of the revenues to the budgets of member countries. At the same time, maintaining a certain independence in the field of direct taxation provides an opportunity at the state level to take measures necessary to maintain balance in national economies.

According to the author's opinion, the restriction of national sovereignty in the field of currency regulation can be partially offset by a competent tax policy. In this regard, in order to stabilise national economies and neutralise the negative impact of the external environment at the level of state governments, the instruments of fiscal regulation will acquire special significance.

Of course, it should be taken into account that the adjustment of the ongoing fiscal policy takes time, since the approval of the national budget is a rather lengthy process.

As practice shows, the results of the impact of fiscal policy on the country's economy are noticeable already 6–12 months after the changes made. Meanwhile, a positive result from the application of monetary measures can be expected not earlier than in 12–14 months.³⁴ This is the main advantage of fiscal regulation. At present, the budget system of the European Union is the most developed of all existing ones.

It should be noted that the reallocation of EU budget funds is often carried out in favour of countries with a serious level of problems, as well as new members of the European Union. Countries whose economies are in a state of recession will cover their costs from the general budget,³⁵ which is previously

³⁴ Baldwin, R. and Wyplosz, Ch. 2012. *The Economics of European Integration*. New York: McGraw-Hill Education, 584.

³⁵ Steinbach, A. 2014. *Economic Policy Coordination in the Euro Area*. 1st edition. London and New York: Routledge studies in the European economy, 212.

studied by M. Obstfeld and G. Peri. Moreover, it may promote competition between the countries of the Union for budgetary resources to finance public spending.

The most important task in the formation of economic unions is the thoughtful distribution of fiscal powers between national and supranational regulatory bodies, which ensures the coordination of fiscal policy, taking into account the interests of all member states of the association.

The tax policy strategy of the EC was explained in the message of May 23, 2001 “Tax policy in the European Union – priorities for the coming years”.³⁶

Moreover, according to the European Economic and Social Committee it is necessary to strengthen the coordination of tax policy.³⁷ The most important goal of tax regulation in the EU is the desire of the member states to ensure that business entities are taxed in one of the countries, and double taxation is avoided.

In the period from 2012 to 2017, a clear trend in taxation in the EU was an increase in the VAT rate, as well as in corporate and income tax rates.³⁸

One of the important tasks that European countries are facing is to reduce greenhouse gas emissions and transfer to green economy. At the same time, it is necessary that the transition is socially fair, and the costs of it are fairly distributed among taxpayers.

³⁶ Communication from the Commission to the Council, the European Parliament and the Economic and Social Committee - Tax policy in the European Union – Priorities for the years ahead. 2001. COM (2001) 0260 final. 10.10.2001. <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex%3A52001DC0260>.

³⁷ Communication from the commission to the Council, the European Parliament and the European Economic and Social Committee - Coordinating Member States' direct tax systems in the Internal Market – Commission of the European Communities. 2006. COM (2006) 823 final. 15.01.2008. <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A52007AE1264%2803%29>.

³⁸ An official website of the European Union. VAT rules and rates. VAT. Retrieved: https://europa.eu/youreurope/business/taxation/vat/vat-rules-rates/index_en.htm.

However, today the EU legal framework used in the area of taxation related to various types of energy still contradicts the EU objectives in the field of environment and climate change.³⁹

As stated in “Reflection Paper Towards a Sustainable Europe by 2030”, the EU is eager to create a stronger, more sustainable and inclusive economy.

However, the fact that productivity growth is increasingly unevenly distributed across regions creates risks of loss of cohesion. Meanwhile, social inequality and regional disparities are a growing concern.

Various tax reforms are tending to stack on one another, leading to much more complicated tax system, its regulations and administrative processes of tax gathering and redistribution. It led to separate studies of the concept of tax system complexity. On the example from Greece and its tax system,⁴⁰ three major directions of simplification were found out, namely technology, information systems and tax legislation. Improvement in these areas is the way to simplify the tax system, make it more understandable to the taxpayer – both for citizens and business. The tax awareness was determined not impactful on the complexity in general, yet it is related to the digitisation and information systems, thus providing an indirect impact.

The author thinks that complexity of the tax system should be taking into account on each of the levels related to the tax system functioning – international, state and local.

³⁹ European Commission. 2019. Reflection paper towards a sustainable Europe by 2030. COM (2019) 220. 30.01.2019. https://ec.europa.eu/info/publications/reflection-paper-towards-sustainable-europe-2030_en, 132.

⁴⁰ Karagiorgos, A., Lazos, G., Lois, P., Katsifas, D. and Kasiouli, M. 2022. Simplification factors addressing tax systemic complexity during tax reform periods: Evidence from the Greek tax system. *Journal of Accounting and Taxation*. 14(2), 161–169.

The optimal structure of the tax system involves certain trade-offs and prioritisation according to national specifics and political choices. Also, it should be noted that public support is critical to the “legitimacy” of tax reforms.

In recent years EU pursuing the goal of a green economy – as part of the initiative to achieve the goal of reducing greenhouse gas emissions by 55% by 2030 and reaching their zero level by 2050, on July 14, 2021, the European Commission presented a draft package of climate legislation,^{41, 42} including both new proposals and amendments to existing laws.

At the moment, Latvia has not yet developed a precise plan that would allow the implementation of the tasks set by the European Commission in accordance with this project. However, options are already being considered, including such as a possible increase in the Vehicle Operation Tax and even a ban on the purchase of cars with certain types of engines, as well as reorientation of the country’s residents to the priority use of public transport and electric vehicles.^{43 44} At the same time, already during 2021, a number of reduced excise rates on fuel were cancelled, and increased rates were also introduced on it.⁴⁵

⁴¹ European Commission, Secretariat-General. 2021. Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions. 'Fit for 55': delivering the EU's 2030 Climate Target on the way to climate neutrality. COM (2021) 550 final. 14.07.2021. <https://eur-lex.europa.eu/legal-content/EN/ALL/?uri=CELEX:52021DC0550>.

⁴² European Commission. 2021. Delivering the European Green Deal. https://ec.europa.eu/info/strategy/priorities-2019-2024/european-green-deal/delivering-european-green-deal_en#documents.

⁴³ Ministru kabineta 21.12.2021 noteikumi Nr. 896 “Emisijas kvotu izsolišanas instrumenta finansēto projektu atklāta konkursa “Siltumnīcefekta gāzu emisijas samazināšana transporta sektorā – atbalsts bezemisiju un mazemisiju transportlīdzekļu iegādei” nolikums”. *Latvijas Vēstnesis*, 249, 27.12.2021. Pieņemts: 21.12.2021.

⁴⁴ Latvijas Republikas Vides aizsardzības un reģionālās attīstības ministrija. 2021. Vides politikas pamatnostādnes 2021.–2027. gadam. *VPP2027*. <https://www.varam.gov.lv/media/download>, 123.

⁴⁵ Latvijas Republikas likums. Likums “Par akcīzes nodokli”. *Latvijas Vēstnesis*, 161, 14.11.2003. Pieņemts: 30.10.2003.

In addition, in 2021, changes were introduced in the Vehicle Operation Tax rates.⁴⁶

2.2 The tax system of Latvia in relation to the regional aspects

The term “region” nowadays is continuing to be a subject of the discussions and debates among researchers focused on regionalism. Despite the globalisation processes, clearly emerging since the XX century, the term “region” is widely used at the various levels of the academic community.^{47, 48, 49} Anssi Paasi and Jonathan Metzger showed, that: “Thus, regions appear to have persistent relevance and allure, both for academics and policy practitioners alike. Then again, understandings of what a region is and does have shifted considerably in the course of decades. The region is today generally conceptualised as a flexible, malleable and mutable object of analysis.”⁵⁰ The author shares the position of these scientists, that the region could be various objects (e.g. territories), segregated by specific criteria, depending on the aim of the research and set tasks.

Latvia, after joining the EU in 2004 following the requirements and rules related to the Regional and Cohesion policies of the EU and directives, related to the EU Regional policy, is currently revising the principles of territorial administration.

⁴⁶ Latvijas Republikas Valsts ieņēmumu dienests. 2021. Vehicle Operation Tax. VID. <https://www.vid.gov.lv/en/node/57244>.

⁴⁷ Entrikin, J. (Ed.). 2008. *Regions: Critical essays in human geography*. London: Ashgate, 636.

⁴⁸ Fawn, R. 2009. ‘Regions’ and their study: Wherefrom, what for and whereto? *Review of International Studies*. 35 (S1), 5–34.

⁴⁹ Harrison, J. 2008. The region in political economy. *Geography Compass*. 2(3), 814–830.

⁵⁰ Paasi, A. and Metzger, J. 2017. Foregrounding the region. *Regional Studies Association*. 51(1), 19–30.

In November 2019, a council meeting dedicated to the country's upcoming ATR was held at the Latvian Academy of Sciences.

The council prepared a conclusion, which indicated that despite a lot of work on the preparation of the proposed reform of the administrative-territorial division, its advantages, disadvantages, as well as its impact on the socio-economic development of the country are poorly substantiated. In addition, this reform has not been sufficiently explained to the public and therefore remains unclear to it.

Most of the experts came to the conclusion that the administrative-territorial reform in the form in which it was proposed will not be able to achieve the set goals and the promised results, since their formulations are vague and approximate.

In the Council's conclusion, it was stated that in Latvia there was still no understanding of the desired administrative division of the country's territory and the management structure, therefore it could be assumed that this ATR would not be the last one.

An effective tax system can be built only taking into account the administrative and territorial features of any country. For Latvia, this is especially important due to the fact that in addition to the centralised state budget, a number of taxes (for example, Real Estate Tax) and their parts (for example, Personal Income Tax) remain directly in the budgets of local governments. When preparing for tax reforms, it is necessary to consider the peculiarities of territorial division, as well as the economic potential of the regions. And when preparing and conducting the ATR, it is necessary to take into account the economic characteristics of the regions, changes in tax flows and, if and only if these factors are considered – proceed with its implementation. Otherwise, various unfavourable situations are possible, for example, with increased costs for tax administration and refinancing of certain regions, as well as other situations that

reduce the efficiency of the tax system. The administrative-territorial division is unique for each country due to economic, social and other national characteristics. That is also why it is impossible to automatically transfer a “good” tax system of one country to another country. In Latvia, already at the stage of the ATR preparation, it was repeatedly criticised, and despite the fact that it was adopted, the Council, argued that it was insufficiently elaborated and justified.

2.3 Analysis of the tax policy evolution in Latvia

After Latvia became a member state of the European Union in 2004, new promising markets appeared, and provisions were introduced into the legislation aimed at adapting the national business laws to the European ones.

Studies have shown that simultaneously with this process, a number of accompanying negative factors arose – the opening of internal European borders entailed an outflow of labour, simplified the transition of business to other jurisdictions, increased intercountry competition, both external and domestic. At the same time, the sector of the shadow economy from 2004 to the beginning of the economic crisis of 2008–2009 officially continued to decline.⁵¹

During the development of the tax reform of 1995, with the aim of stimulating of the economic development, the main attention was focused on consumption, and not on the income taxation, to stimulate savings and encourage investment growth of the country.⁵²

At the time the Supreme Council of Latvia very quickly adopted the entire package of laws on business activities regulating the tax system, Latvian economist Evgeniya Zaitseva claimed: “This package of laws was donated by

⁵¹ Schneider, F. 2010. Size and Development of the Shadow Economy of 31 European Countries from 2003 to 2010. *Revised version*. 1–4.

⁵² Ministru kabineta 10.06.2003 rīkojums Nr.380 “Par Pamatnostādnēm nodokļu un nodevu sistēmas attīstībā”. *Latvijas Vēstnesis*, 88, 12.06.2003. Pieņemts: 10.06.2003.

Denmark, it was simply translated into Latvian, approved, published as a brochure – and everything went on.”⁵³

Ainis Dābols, Chairman of the Board of Tax Advisers of Latvia, also points out that “copying the tax system from developed countries with established economies was not the best solution for Latvia as a new state with its transitional economy”.⁵⁴

The author does not believe that there was a complete copying, since his research showed that the package of tax laws was developed at the Latvian Academy of Sciences in the period from 1989 to early 1990. At that time, 14 bills were initially prepared, which were considered by the working group of the Supreme Council of the country (in the summer of 1990). Then, discussions were held directly in the Supreme Council of the Republic of Latvia, which is confirmed by the corresponding transcripts.^{55, 56}

The taxes themselves and their values during the historical period under consideration have repeatedly changed both in essence and in size. This process continues at the present time. Thus, on January 1, 2018, a tax reform came into effect in Latvia, which was being prepared over the past several years. One of its goals was to reduce inequality in the distribution of incomes of various groups of the population. Changes to certain taxes were studied by researchers for some time before the major reform.⁵⁷

⁵³ Odina, T. 2018. Ekonimika, prosto o slozhnom: SGD, nalogi i “navoznie zhuki”. Ekonomika. <https://rus.tvnet.lv/6469130/ekonomika-prosto-o-slozhnom-sgd-nalogi-i-navoznye-zhuki>.

⁵⁴ Dābols, A. 2014. Nalogovie proverki v Latvii, presentation. *Latvijas Nodokļu konsultantu asociācija*. <http://www.myshared.ru/slide/666327/>.

⁵⁵ Latvijas Republikas Saeima. 1990. gada 28. decembra sēdes stenogramma. Rīta sēde. *Latvijas Republikas Saeima*. https://www.saeima.lv/steno/AP_steno/1990/st_901228.htm.

⁵⁶ Latvijas Republikas Saeima. 1991. gada 7. augusta sēdes stenogramma. Vakara sēde. *Latvijas Republikas Saeima*. https://www.saeima.lv/steno/AP_steno/1991/st_910807v.htm.

⁵⁷ Ketners, K. and Pētersone, M. 2014. Corporate income Tax reform possibilities for Latvia. *Economics and Rural Development*. (10), 14–22.

The high level of income inequality in Latvia was blamed for insufficient tax-benefit redistribution system, thus it was assumed, that tax system should be changed to improve the redistribution, and the only valid measure for that would be a tax reform. The prepared reform had to introduce long-awaited progressivity to personal income tax, replacing the flat rate with 3 brackets based on the annual income, as well as introducing some other changes.

Changes in the tax system of the country took place in subsequent years. Unfortunately, this goal has not yet been achieved. Before the reform of 2018 entered into force, specialists of Baltic International Centre for Economic Policy Studies have studied possible consequences of the tax reform on income inequality distribution using EUROMOD – tax-benefit microsimulation model.⁵⁸ They made a set of insightful conclusions: first of all, only a slight decrease of the Gini coefficient, but at maximum by 0.6 percentage points compared to prognosed values without a tax reform. Secondly, the reduction of the Gini coefficient is not fully related to the introduction of the 3 income brackets (on the contrary, they're assumed to be acting as a mean of increasing inequality, not decreasing it), but is mostly dependent on the non-taxable allowance changes.

As of 2020, Latvia ranks second in inequality, as measured by the Gini coefficient in the EU, behind only Bulgaria.

At the same time, the data in Table 2.1 indicates that there are regions in Latvia (Zemgale region and Latgale region) with the Gini coefficient values close to the EU average. However, in most regions and in Latvia as a whole, there is a tendency towards an increase in the Gini coefficient values.

⁵⁸ Pluta, A. and Zasova, A. 2017. Latvia Stumbling Towards Progressive Income Taxation. *FREE Network Policy Brief Series*. 1–6.

Table 2.1

Latvia – Gini coefficient (2011–2020, scale from 0 to 100)

Region	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Latvia	35.7	35.2	35.5	35.4	34.5	34.5	35.6	35.2	34.5	35.7
Rīga region	34.2	33.7	34.3	33.7	33.6	32.2	34.1	33.9	33.8	35.8
Pierīga region	38.1	36.9	37.1	35.9	34.5	34.8	35.9	35.0	35.4	34.1
Vidzeme region	33.6	35.2	33.7	34.0	32.4	31.6	31.8	33.1	30.8	34.5
Kurzeme region	34.9	33.2	33.6	32.6	31.5	32.7	31.8	31.9	32.2	33.6
Zemgale region	34.8	32.1	32.0	34.2	31.5	33.2	32.7	32.0	30.4	31.8
Latgale region	31.6	31.9	31.9	31.0	31.5	32.3	36.4	33.3	31.3	30.6

Source: Eurostat⁵⁹ and Official statistics portal⁶⁰.

To date, it is impossible to reliably assess the impact of tax system adjustments in 2020 – 2021 on the economic state of the country due to the lack of the necessary statistical material, as well as the distortions introduced by the Covid-19 pandemic.

The European Commission document on taxes shows the forecast trend for tax revenues as a percentage of GDP in 27 EU countries until 2022. According to it, Latvia is one of the four countries where an increase in tax revenues is projected.⁶¹

⁵⁹ Eurostat. 2022. Gini coefficient of equivalised disposable income - EU-SILC survey. EU. https://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=ilc_di12.

⁶⁰ Oficiālās statistikas portāls. Džini koeficients (procentos) 2004–2020. Ienākumu nevienlīdzība (EU-SILC). https://data.stat.gov.lv/pxweb/lv/OSP_PUB/START_POP_NN_NNI/NNI030/.

⁶¹ European Commission. 2021. Taxation Trends in the European Union. *Directorate-General for Taxation and Customs Union, European Commission, Publications Office of the European Union*. <https://op.europa.eu/en/publication-detail/-/publication/d5b94e4e-d4f1-11eb-895a-01aa75ed71a1>, 302.

When developing measures to change and (or) improve the tax system, the time factor is of great importance. For each newly created or modernised element of the tax system, new requirements are imposed, aimed at improving its fairness and efficiency. Each subsequent option should have a number of specific advantages over the previous one.

The territorial policy of the state is a complex set of measures aimed at the maximum possible development of all territories, while contributing to the equalisation of the standard of living, balanced settlement of people and the distribution of economic activity. Increasing investment attractiveness and creating such living conditions that could cause an influx of population into the region can be called one of the main tasks of territorial administration.⁶²

As it was already mentioned, in the conclusion of the European Commission, which studied at the end of 2019 the results of the tax reform launched in Latvia on January 1, 2018, the need to reduce the tax burden on low-paid workers, large families and pensioners in order to reduce social inequality was noted.

Strong evidence is showing⁶³ that corporate tax cuts are actually promoting the inequality – top income inequality increases as the result of such measures. Corporate tax cuts can be used as a mean to increase economic activity, but with a cost of top income inequality increment. Thus, it is making corporate tax cuts an inappropriate tool for both inequality reducing and boosting the economic activity at the same time. In this case, other approaches may be used, e.g. tax cuts to low-income earners,⁶⁴ which may increase the economic

⁶² European Commission. 2011. Territorial Agenda of the European Union 2020. Towards an Inclusive, Smart and Sustainable Europe of Diverse Regions. *EU 2011 HU*. https://ec.europa.eu/regional_policy/sources/policy/what/territorial-cohesion/territorial_agenda_2020.pdf, 11.

⁶³ Nallareddy, S., Rouen, E. and Serrato, J. 2022. Do corporate tax cuts increase income inequality? *Tax Policy and the Economy*. (36), 35–91.

⁶⁴ Zidar, O. 2019. Tax Cuts for Whom? Heterogeneous Effects of Income Tax Changes on Growth and Employment. *Journal of Political Economy*. 127(3), 1437–1472.

activity and at the same time help to reduce inequality and social-economic stratification.

This could be one of the reasons for not achieving the goal of reducing the inequality after the tax reform of 2018.

Discussing the problem of optimising the tax part of the budget, one should take into account the stimulating nature of the tax system. Excessively high tax withdrawals, on the one hand, oppress the economy, and on the other, they question the formation of an adequate income base.

When solving the issue of the sources of filling the budgets, one should start with the goals and objectives that face one or another of their levels. Since 1990, the formation and improvement of the national tax system has been taking place, and a rational tax system is a task that not only Latvia, but most countries of the world are trying to solve. To accomplish this task, the author has proposed a set of tools (Figure 2.1).

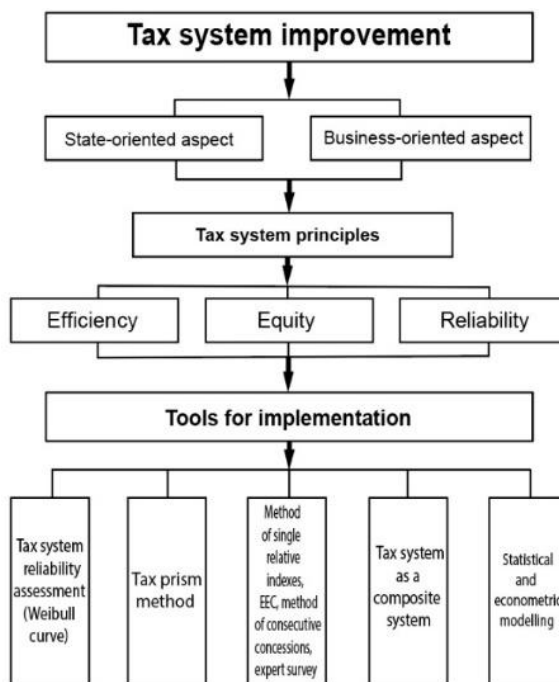


Figure 2.1 **Integrated approach to improving the tax system**

Source: created by the author.

The author holds to the opinion that it is possible to solve the problem of constructing an optimal tax system that meets the necessary criteria only by using an integrated approach. Meanwhile, borrowing any successfully functioning tax system of another state is futile in view of intercountry differences. The Thesis proposes an integrated approach to solving the task, including an assessment of the reliability of tax reforms and the tax system as a whole, a methodology for determining a rational combination of criteria for equity and efficiency, as well as a methodology that allows to consider the mutual influence of tax collection, the tax base and the amount of taxes, and a number of other aspects (Figure 2.1).

3 Tools for analysing and evaluating taxes and the tax system

3.1 Approaches for analysing taxes and the tax system

The role of taxes in modern economic systems is exceptionally great. Since 2014, Latvia has had the Fiscal Discipline Council,⁶⁵ whose main task is to ensure that the government's fiscal policy guarantees sustainable and balanced economic growth.

The tax burden is a generalised characteristic of the tax system, determining, among other things, the level of responsiveness of the taxpayer. Enterprises are interested in determining the level of tax burden for tax planning and financial optimisation purposes. The size of the tax burden can have a significant weight in the costs of the company and forecasting the tax burden for the future period is a necessary component of financial management. The process of preparing investment projects in certain areas of the company activity also includes consideration of the values of the tax burden for each of the activities.

The comparison of the tax burden of a particular company with the average tax burden of the industry or region helps companies navigate the tax landscape and look for ways to optimise taxes by applying all available tax incentives or by reorganising the company.

An effectively functioning tax system should not allow the oppressive impact of the tax burden on businesses. On the contrary, it should stimulate the development of those activities that are most promising and in demand.

⁶⁵ Latvijas Republikas Fiskālās disciplīnas padome. 2021. Padome. *Sākums*. <https://www.fdp.gov.lv/lv/nozares-politika/padome>.

Modern macroeconomic theory deals with this problem using the example of the Laffer curve (graphically depicts the dependence of tax collections on tax rates) and the tax multiplier (shows that reducing the tax burden frees up additional funds from taxpayers, which are directed to consumption or investment, which stimulates economic development and leads to its growth). Besides the reduction of investment in the case of an excessively high tax burden, there is also the problem of enterprises leaving for the shadow sector of the economy.

In Section 1.2 the main criteria of tax systems were reviewed, where it was emphasised that among them, most often, the criteria of equity and efficiency are of utmost importance.

Contradictions between equity and efficiency in tax policy have been repeatedly noted.^{66, 67} At the same time, the emphasis was placed on the fact that even in the most advanced tax systems, contradictions between these criteria take place and have a significant impact on both tax system and society.⁶⁸

Experts also drew attention that most studies on tax reforms focus only on the aspect of tax efficiency and do not include the aspect of equity in the analysis.⁶⁹

The author, having studied these scientific publications devoted to the study of the formation, development and reform of tax systems in different countries of the world, came to a similar conclusion. After studying these works, it can be concluded that the concepts of equity and efficiency are variable

⁶⁶ Toader, S., Ungureanu, M., Predescu, I. and Predescu, A. 2011. Tax Efficiency vs. Tax Equity – Points of View regarding Tax Optimum. *Oeconomica*. 7(5), 44–51.

⁶⁷ Bejakovic, P. 2020. How to Achieve Efficiency and Equity in the Tax System? *Revija za socijalnu politiku*. 27(2), 137–150.

⁶⁸ Brendon, C. 2013. Efficiency, Equity, and Optimal Income Taxation. *European University Institute*. 22, 1–50.

⁶⁹ Saez, E. 2001. Using Elasticities to Derive Optimal Income Tax Rates. *Review of Economic Studies*. 68, 205–229.

(variant) concepts that depend on many economic and political factors (both external and internal).

Effective taxation can be ensured by a rational combination of the chosen tax mechanism with the goals and objectives that the state sets. The efficiency of taxation, from one point of view can be determined by the ratio of tax revenues to budgets with the total costs of tax collection (including in relation to each specific tax). However, in general, the efficiency of taxation and tax system for the state can be defined as increasing budget revenues via tax revenues and growth of the tax base (the latter in many cases is not properly considered, forcing the tax system to be efficient only at a small period of the time).

From the point of view of the taxpayer, equity criterion means:

- for business entities – obtaining the maximum possible income (profit) while minimising tax payments;
- for the population – in obtaining sufficient income for satisfying needs after paying established taxes, through which the state provides the necessary social services.

In practice, equity can be vertical, horizontal, and also in some cases be associated with the shifting of the tax burden between the groups of taxpayers.

Changes in the economy of the country, and in the financial policy of the state, require appropriate transformations in the tax system. In other words, the tax system cannot be brought to any final form. It is only possible to adapt it to the economic development of the country and to the choice of ways to develop the economy in the future.

In order to take into account their impact in a particular situation most fully, later in this chapter, a method of relative single indexes will be proposed for the application. During the formation of the relative single indexes, the most characteristic factors for a particular country and corresponding to a specific economic situation etc., can already be considered at a preliminary stage.

The efficiency and equity of taxes and tax policy can be characterised through the business-oriented optimisation aspect of taxation (equity) and the state-oriented aspect (efficiency).

Business-oriented aspect of tax optimisation

The business-oriented aspect of tax optimisation is defined as a set of measures used by the taxpayer (most often by an enterprise or an individual) or by an outsourcing firm serving them in order to reduce the tax burden in the short or long term or to postpone tax payments.⁷⁰ The beneficiary of such actions are the taxpayers themselves.

These activities can include legal and illegal tax optimisation, as well as leaving to other jurisdictions to reduce the tax burden, as well as in extreme cases – the complete cessation of activities due to the high value of the tax burden.

Competently conducted business-oriented tax optimisation involves reducing the relative and absolute tax burden on the taxpayer, *ceteris paribus*. In this case, the state receives less tax payments to the budget compared to the period before optimisation.

These activities must be carried out within the legal framework, but in some cases, intentionally or unintentionally may violate the law in force.

The business-oriented aspect of tax optimisation related to the criterion of equity, the numerical values of which can be obtained depending on the aim of the study and the available statistics.

⁷⁰ Term “taxpayer” in Latvia is defined in the law «On Taxes and Fees», Section 1. <https://likumi.lv/ta/en/en/id/33946>.

There are not many research publications in Latvia, which quantitatively and qualitatively assess these activities in relation to the state under-receiving funds to the budget as a result of legal tax optimisation so far. At the same time, assessment of damage to the country's budget as a result of illegal actions to reduce the tax burden or complete tax evasion is carried out on a regular basis.⁷¹

The author surveyed a number of firms providing financial services in Latvia regarding their interpretation of the concept of “tax optimisation”.

Analysing the results of this study, it is possible to conclude that the vast majority of firms offering the above services interpret tax optimisation solely as a process of minimising tax payments. In all cases, representatives of the firms emphasised that they will conduct these activities only within the legal framework.

As mentioned above, the business-oriented aspect of tax optimisation, in addition to legal entities, also includes individuals. In the broad sense of the proposed term, any taxpayer can be considered from the point of view of the business-oriented aspect of tax optimisation. The proposed formalisation allows, depending on the purpose of the research, to use tools to study the problem and the degree of multidirectional of interests not only in the enterprise–state system, but also in the taxpayer-individual–state system. Such an approach allows to consider individual elements of the tax system not only in aggregate, but also targeted, and the proposed formalisation in the business-oriented aspect of tax optimisation is possible due to the fact that both companies and individuals, as rational agents, are aimed at maximising their own profit by reducing the amount of taxes paid.

⁷¹ Latvijas Republikas Valsts ieņēmumu dienests. 2018. Nesamaksātās nodokļu summas turpina samazināties. *Aktualitātes, jaunumi*. <https://www.vid.gov.lv/lv/nesamaksatas-nodoklu-summas-turpina-samazinaties>.

State-oriented aspect of tax optimisation

The state-oriented aspect of tax optimisation is defined as the actions of authorities with special powers to regulate the process of taxation. These actions should be aimed at improving the business climate in the country and increasing the competitiveness of national business, as well as stimulating the creation and development of business in general. At the same time, the structure and administration of taxes are being improved, as well as the automation of tax administration.

The state-oriented aspect of tax optimisation related to the criterion of efficiency, the numerical values of which can be obtained depending on the aim of the study and the available statistics.

State-oriented optimisation does not always mean that after its implementation the tax burden and tax revenues to the budget will increase. In addition to the fiscal function, optimisation should affect the other functions of taxes – social, regulatory, and control.

Insufficient consideration of economic prerequisites, politically motivated decisions affecting the sphere of taxation, and the exclusive focus on the performance of exclusively fiscal function leads to the low reliability of the tax system and entails frequent adjustments.

The division of approaches into state-oriented and business-oriented, proposed by the author, allows to consider the contradictions between the state and the taxpayer in order to find the most rational combination of the main problem of taxation – equity and efficiency. At the same time, the redistributive function of taxes as a tool of the state's social policy is not included in the state-oriented aspect, since it is often designed to correct the shortcomings (failures) of the tax system. To ensure proper implementation of the redistributive function, it is necessary to have a rationally structured functioning of the tax system within the state-oriented and business-oriented aspects. A poorly functioning tax system

that has an effective tax collection, but does not meet the criteria of equity, sooner or later will face high administrative costs associated with ensuring the work of the redistributive function.

3.2 Reliability as an evaluative characteristic of the tax system life cycle

Approaches to assessing the reliability of the tax system

In Latvia, during the preparation and implementation of measures to reform the tax system, a set of problems of financial and economic block has arisen, related to the formation of the budget of the country, taking into account the efficiency and economic reliability.

The tax reform enacted in 2018 did not achieve one of the main goals of increasing tax revenues relative to GDP, nor did it grow the tax base fast enough. To reduce inequality, the tax burden for low-wage workers was reduced, but it is still significant and higher than in Lithuania and Estonia. The reform improved capitalisation and profitability of companies, but did not lead to a significant increase in fixed capital accumulation and the corresponding expected economic breakthrough.⁷²

According to the International Tax Competitiveness Index (ITCI),⁷³ Latvia is in second place out of 37 OECD countries in the Index, while Germany, France and Italy are in 16th, 35th and 37th places, respectively.

⁷² Latvijas Republikas Fiskālās disciplīnas padome. 2018. 2018. gada nodokļu reformas rezultāti un kritēriji tālākai nodokļu sistēmas pilnveidošanai. *Fiskālās disciplīnas padomes viedoklis*. <https://www.fdp.gov.lv/en/media/2988/>.

⁷³ Bunn, D. and Asen, E. 2021. International Tax Competitiveness Index (ITCI). *Tax Foundation*. <https://taxfoundation.org/publications/international-tax-competitiveness-index/>.

Various rankings aim to assess the current tax system as one of the conditions for successful business in the country, rather than to assess the effectiveness of the tax system as a source of budget revenue from the point of view of the state. However, they do not allow to assess the reliability of tax reforms and the tax system of the country as a whole.

The reliability of the tax system can be evaluated from different positions. The author proposes to evaluate it in two directions, namely:

- assess the reliability of the functioning of the fiscal system (in fact, the effectiveness of tax collection);
- assess the reliability of the tax reform (in fact, to assess the consistency of the reforms carried out with the goals declared in its design and implementation).

The category of economic reliability is considered as the opposite category of risk and as a systemic characteristic of decision-making and management.

Analytical assessment of the reliability of the tax system

A general analytical approach to assessing the reliability of the tax system has been developed. A graph of the probability of system's failure-free functioning R as a function of time t is shown in Figure 3.1.

The initial assessment of the reliability of the tax system as a fiscal instrument should be made on the basis of the reliability of its constituent elements. As of the beginning of 2022, 14 taxes are applied in Latvia.⁷⁴ When assessing the reliability of functioning of the fiscal system, it is these taxes that will be the parameter under study.

⁷⁴ Latvijas Republikas likums. Likums "Par nodokļiem un nodevām". *Latvijas Vēstnesis*, 7, 13.04.1995. Pieņemts: 02.02.1995.

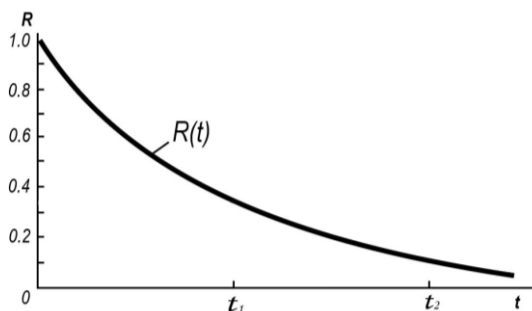


Figure 3.1 **Standardised reliability curve**⁷⁵

A sudden decline in the effectiveness of any tax to the point of having a significant impact on budget revenues is called a “catastrophic failure”. Catastrophic decline in efficiency occurs unexpectedly without preceding symptoms to predict it. Such a situation occurs randomly, i.e., unexpectedly and irregularly.

Reliability assessment as a tool to prepare for tax reform

The notion of “reliability” of the tax system in aggregate is proposed to mean the probability that, during the process of reforms and after their completion, the tax system will fulfil all the requirements imposed on it for a given period of time.

In case of research, the tax system can be considered as a system consisting of the elements represented in the form of taxes stipulated by Article 8 of the Latvian Law “On Taxes and Fees”.⁷⁶

⁷⁵ Bazovsky, I. 1961. *Reliability theory and practice*. London: Prentice-Hall International, 376.

⁷⁶ Latvijas Republikas likums. Likums “Par nodokļiem un nodevām”. *Latvijas Vēstnesis*, 7, 13.04.1995. Pieņemts: 02.02.1995.

The tax system can be considered reliable when the quality of the elements that make it up at the time of their entry into force is about the same. Here it should be noted that the taxes stipulated by the law “On Taxes and Fees” have different weight (rank) in the sense of their influence on the volume of the revenue part of the budget.⁷⁷

In Chapter 4 the reliability of the tax system in Latvia is assessed, where the period of time since 2018 was chosen as the study period.

3.3 Tax prism method

For economic interpretation of the formation of the tax (revenue) part of the budget, for its assessment and research, as well as for analysis and business modelling of financial activities of enterprises, in order to make rational management decisions, the author proposes to introduce the concept of tax prism.

In Section 1.3, an analysis of more than 50 works devoted to the Laffer curve was carried out, they have been systematised and divided into three main groups. It was determined that in a number of works attempts to modernise the Laffer curve, attempts to establish a relationship between the dependence of the tax rate on the volume of taxes collected and the tax base (for example, M. Kakaulina, E. Balatsky and I. Mayburov, etc.) were made, but these attempts, so far, have not led to the creation of any methodology for practical calculations that allow to describe the relationship of the three above parameters quantitatively. As shown in Section 1.3, these researchers indicated that it has not been possible yet to create an appropriate dependency that allows for the necessary quantitative assessment. At the same time, as it was noted that these

⁷⁷ Verovska, L. and Leontyev, A. 2015. Using of Variant Optimization Methods for Determination of Rational Taxation Amount. *XVIII International Scientific and Practical Conference «Taxes: Theory and Practice 2015»*. Brno: Akademie STING, 114–120.

works were carried out by modernisation of the Laffer curve or other analytical actions based on this curve.

The author offers his own tool that is not related to the Laffer curve, while noting that the obtained results do not contradict both the theory of Laffer, Keynes, and other researchers who pointed out the existence of a relationship between the tax burden and the amount of taxes collected, as well as its specific nature. In addition, the author considers the need to take into account not only the qualitative, but also the quantitative relationship of these two parameters (tax rate and volume of tax revenues) with the tax base.

Economic interpretation of the tax prism

The tax prism⁷⁸ is based on the property of a figure (rectangular prism with a square base) – created from a square of fixed (constant) dimension – first, to increase its volume, and upon reaching a certain maximum – to reduce it, similar to the dependence proposed by Laffer and the observations of many other scientists on research that Laffer relied on.

With the proposed approach, the side of the square L , from which the prism is created, corresponds to the tax base, the height of the edge of the prism characterises the size of the tax burden, and the volume of the prism V shows the change in the volume of tax (taxes) revenues.

The proposed tax prism tool eliminates shortcomings of the Laffer curve, since unlike the Laffer curve, which functionally connects only two parameters (the tax rate and the amount of taxes collected), tax prism allows to simultaneously take into account the third parameter (tax base), as well as accurately determine the position on the ascending or descending branch of the dependence.

⁷⁸ The figure is also called a rectangular parallelepiped, at the base of which lies a square.

The general economic and geometric interpretation of the developed tool is shown in Figure 3.2.

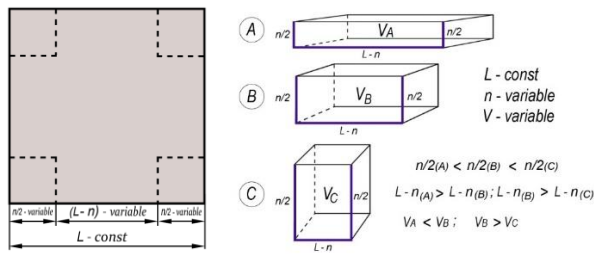


Figure 3.2 Economic interpretation of the “tax prism” tool

L – tax base; n – size of tax (tax burden); V – characteristic of the volume of the tax revenues.

Source: created by the author.

The tax prism is a geometrical figure whose volume V corresponds to dynamics of the amount of the taxes received by the state (depending on the aim of the research could be taxes payable for the enterprise or even for individuals) in the studied period and n corresponds to the cumulative amount of taxes (or separately a tax under study).

From the state-oriented aspect point of view, the tax prism is considered, in its base is a square (Figure 3.3).

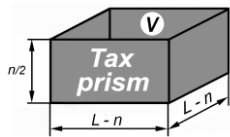


Figure 3.3 General form of the geometric interpretation of the tax prism

Source: created by the author.

On the one hand, the task of the state is to receive a maximum of taxes, from the other – not to put out of business the taxpayer, keeping his or her interest in profit earning by means of this type of activity. Therefore, the state shall also be engaged in taxation optimisation process.

This process can be considered by means of the offered tax prism. The tax prism forming process can be studied both analytically or graphoanalytically, depending on the aim of the study.

Static and dynamic tax prism

It is offered to introduce the concept of a static and dynamic tax prism for assessing the decrease in the amount of the collected taxes due to the use of legal tax optimisation schemes by the taxpayers.

Static tax prism – a prism which volume V_{st} characterises a tax part of the budget without taking into account possible tax optimisation in the business-oriented aspect.

Dynamic tax prism – a prism which volume V_{dyn} characterises a tax part of the budget taking into account possible tax optimisation in the business-oriented aspect.

It is useful for comparative purposes: to evaluate how much optimisation measures can reduce tax collections – a static prism is needed. This will make it possible to establish acceptable limits for measures to reduce the tax burden (including the use of benefits, of which there are currently about 200 in Latvia), i.e. at the state level, to normalise the process of optimising taxation, which is aimed solely at reducing the tax burden from the point of view of the taxpayer.

$$V_{dyn} = k_{to}V_{st}, \quad (3.1)$$

where k_{to} – coefficient of tax optimisation ($k_{to} \leq 1$).

When $k_{to} = 1$ taxpayer didn't take actions directed to tax reduction, while all other conditions are unchanged. When $k_{to} < 1$ – such actions were taken, as always after optimisation, the amount of taxes collected decreases, but never increases.

Therefore, when taxpayers use tax optimisation the dynamic volume of a tax prism will be less than static:

$$V_{dyn} < V_{st}. \quad (3.2)$$

This model takes into consideration not only possible tax optimisation in the business-oriented aspect, but also a number of other factors influencing the tax part size of the budget.

For this purpose, it is necessary to introduce the corresponding raising or decreasing coefficients into a formula (3.1).

These coefficients must also take into account various force majeure circumstances. For example, a decrease in tax revenues in a number of industries due to the coronavirus pandemic.

3.4 The method of relative single indexes

It is appropriate to introduce the concept of the optimal (comfortable) value of equity and efficiency combination (EEC) in tax policy. Because of the above-mentioned tendency of inconsistency between the principles of equity and efficiency, the value of the EEC should be determined taking into account the main links of these criteria with specific taxes.

Choosing a rational EEC is a very complex multi-criteria task.

The assignment of this parameter, carried out intuitively on the basis of practical experience, requires numerous adjustments and does not always yield the desired result.

Assigning EEC based on experience is not optimal and accurate, because the error values can reach significant values.

In studied case it is most expedient to use the method of variant optimisation.^{79 80} It is based on the choice of the best taxation scheme from a number of pre-calculated options with systematically changing elements. This approach makes it possible to obtain graphical dependences characterising different taxes from the optimised element (EEC).

The use of the method of variant optimisation for the problem of selecting the EEC is considered for obtaining a rational solution.

Before carrying out variant optimisation it is necessary for each specific case and time period to determine the numerical values of relative single indexes characterising “equity” and “efficiency” of tax policy of a specific state.

Relative single indexes of “equity” $K_{eq j}$ and “efficiency” $K_{eff j}$ are formed so that their values lying in the range of values less than unity, reflect the unacceptable value of quality (their characteristics), and the acceptable values of K_{ij} are equal to unity or exceed it.

The application of the method of variant optimisation can lead to 3 major possibilities: having multiple suitable solutions, having one suitable solution and having no possible solutions. In the first case, there is an area of suitable solutions, in the second case there is only one suitable solution, located at the intersection of $K_{eq j}$ and $K_{eff j}$.

The greatest difficulty is the situation when solving the problem under consideration for the search of EEC, after rejecting unacceptable solutions, no suitable one remains. This means that the characteristics adopted in the model

⁷⁹ Giannessi, F. and Maugeri, A. 2005. *Variational Analysis and Applications*. NOIA, Springer, (79), 1183.

⁸⁰ Bryson, A. and Yu-Chi, Ho. 2017. *Applied optimal control. Optimization, estimation and control*. New York: Taylor & Francis Group, LLC (1975), Boca Raton, 496.

are incompatible, and it is impossible to determine the value of the EEC, taking into account these constraints.

In such a situation, in order to solve the problem by variant optimisation method, it is advisable to use the method of successive concessions.

It is advisable to carry out the ranking by expert ranking methods (where a group of experts is invited to arrange any values of interest in terms of their significance, importance or rank in ascending or descending order) or, more preferably, by using a probabilistic approach.

The application of the relative single indexes method for determining the area of acceptable EEC values with respect to the Vehicle Operation Tax in force and tax costs related to the vehicle operation in Latvia and the use of the principle of successive concessions related to the ranking of relative single indexes by importance for incompatible requirements is given in Chapter 4.

3.5 Tax system as a composite system

In recent years the usage of the mathematical basics of the quantum mechanics is became a perspective direction of the research in various areas of economics: from economic theory to tools for risk assessment and measuring value of the financial instruments.⁸¹

These questions were additionally studied by the author during the completion of the Global Quantum Programming Workshops.

The tax system is a composite system consisting of various internal and external elements. Even though the tax system is rather complicated – still, abstractly it can be assumed, that such a system as the tax system consists of a number of basic elements (units) having the same type. For the tax system, such a basic unit is a tax itself, thus the tax system at the simplest representation

⁸¹ Hull, I., Sattath, O., Diamanti, E. and Wendin, G. 2020. Quantum Technology for Economists. *SSRN Electronic Journal*. 10.2139/ssrn.3745608, 1–106.

of a composite system can be defined as a composite system consisting of taxes, which are its basic units.

Discrete assessment of a tax system at a certain moment of time can be called a state of the tax system and it depends on combined discrete assessment (state) of the system elements (taxes).

In order to distinguish tax system features, efficient tax is set to state 0 , and tax, that's following the principle of equity is set to state 1 . The terms equity and efficiency are used within the framework of the state-oriented and business-oriented aspects of tax optimisation defined in Section 3.1, including their antagonistic nature.

Within the scope of the composite system representation three approaches are considered: deterministic, probabilistic and quantum. Deterministic approach considers that the state, corresponding to the tax system feature is clearly defined, probabilistic approach extends deterministic to a probability being in state of efficiency or equity. Quantum approach allows conducting a deeper analysis of the tax system, as the states can go to the quadrants (based on unit circle representation of a state) where the values will be negative (probabilities will remain positive). This will give the possibility of a deeper analysis of the relations between taxes in the tax system. A tax that is in the negative quadrant—when any change is implemented—may result in a different equity or efficiency probability distribution than if it is in the positive quadrant.

The quantum approach gives an opportunity to see more explicitly, with bigger sensitivity the changes in separate units and in the whole system, allowing to apply various quantum operators in appropriate situations to the tax system. The data gathered by the quantum approach can be later used in regression modelling and other available statistical tools for additional analysis and prognosis enhancement.

4 Improvement of the tax system of Latvia by applying integrated optimisation tools

The chapter is demonstrating the practical application of several methods (tools) intended for use in the process of tax optimisation during the integrated optimisation of the tax system.

Earlier, in Chapter 3, the theoretical development of the tools was carried out. They are intended both for individual use (in solving discrete problems) and in combination with well-known methods that have proven their universality and applicability in solving economic problems related to the tax system.

The author in the Thesis proposed an integrated approach and developed the following tools:

The method (tool) for determining reliability – for assessing the life cycle of the tax system, as well as forecasting the life cycle of the changes (reforms) being developed.

The method (tool) of the tax prism – for determining the relationships, values, forecast and optimisation of the three-parameter system “tax rate – tax base – volume of collected taxes”, both from the point of view of a business-oriented approach and from the point of view of a state-oriented approach.

The method of relative single indexes in the “equity-efficiency” system – for obtaining zone of the most acceptable solutions when determining rational tax parameters in terms of criteria of equity and efficiency.

The composite system method – for describing and modelling the relationships between taxes and the impact of changes in some taxes on others, taking into account the criteria of equity and efficiency.

Also, in the Thesis were used:

The method of expert evaluation – for elimination of the incompatibility of requirements and for search of concessions in the “equity – efficiency” system.

Classical methods of statistical and econometric analysis are used to describe and forecast existing tax dependencies for scenario analysis in the absence of changes, as well as for indirect assessment of the reliability (predictability) of tax revenues.

In this Chapter the results of studies of the Latvian tax system are presented, obtained with the help of the set of abovementioned tools, based on the analysis of which conclusions are drawn and recommendations are given.

4.1 Reliability assessment of the tax system

The reliability of the tax system is an important element that characterises its functioning and is intended for timely adjustment of the tax system, preparation of tax reforms and assessment of their subsequent life cycle. A tax system that meets the requirements of efficiency and equity, but is not sufficiently reliable, will function in the required mode without adjustments on various levels for a short period of time, and, consequently, will require additional costs. In addition, frequent changes in the tax system affect the trust of taxpayers.

To assess the results of tax reforms reliability, the necessity of constructing a failure rate curve λ as a function of the operation time T of a particular tax system for a fixed number of taxes in force in Latvia was determined. The Weibull distribution (Figure 4.1) that is used in the core of the failure rate curve is allowing to assess the reliability of the tax system, for example, after the major tax overhaul. The resulting curve has shown the change in the reliability of the tax system in the form of the failure rate in the post-reform period.

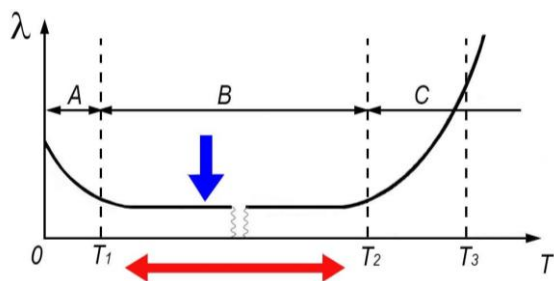


Figure 4.1 Minimisation of failures and increasing the life cycle of the tax system's stable operation

Source: created by the author.

Based on the Weibull curve the analysis of the situation determining the reliability of the Latvian tax system in 2018–2021 has been carried out. The examples of the starting periods of the functioning of the post-reform tax system, characterised by, for example, failures or the EDS and insufficient understanding of the tax debt forming by taxpayers.

When tax reform is introduced, a period of uninterrupted operation of the tax system should be projected ($T_1 - T_2$). Since external conditions are constantly changing, after some time the tax system will no longer meet the objective realities, and another tax reform will be required (section $T_2 - T_3$).

During the preparatory period of the tax reform and its subsequent implementation, it is necessary to strive for the horizontal section of the Weibull curve to be as close to the abscissa axis as possible.

This is symbolised by the blue arrow in Figure. 4.1. In this case, the failure rate λ will be minimal, which will allow to consider the tax system reliable. And, of course, the length of the horizontal section (between points T_1 and T_2) should be long enough for the implemented tax measures to operate efficiently and reliably for a long time. This is shown by the red double-edged arrow.

When the tax system is in the $T_2 - T_3$ area of the Weibull curve and, as mentioned above, it no longer fits the current situation, tax reform is necessary,

which is always associated with significant costs. However, in certain cases, it is possible to do with less costly measures.

The sign that a particular tax system has become obsolete, and at least requires modernisation, is the transition of the horizontal part of the Weibull curve into a hyperbola (Figure 4.1). There is a possibility of several scenarios:

- the creation of a new tax system to replace the current one;
- taking measures to upgrade the existing system and return it to normal operation.

It was shown that in reality, in Latvia, the Weibull curve, also called the Weibull bathtub (or bathtub curve), degenerated into a parabola in the period since the beginning of 2018. It was never possible to reach the horizontal section. It was not possible to create a stably operating fiscal system that would effectively perform its functions for a long time.

Also, the analysis of the situation determining the reliability of the tax system of Latvia from 2021 has been carried out, which has shown that most likely, in the near future, it will be necessary to adjust the tax laws again, because the innovations do not correlate well with the current economic and epidemic situation in the world.

The more time corresponds to the interval $T_1 - T_2$ on the Weibull curve, the more taxpayers trust the current system, the more understandable it is to them.

A survey conducted at the beginning of the year 2021 regarding the level of Latvian residents' awareness of the tax changes introduced on January 1, 2021, has revealed that only 14% of the respondents from 18 to 60 are well aware of the changes affecting them personally. 54% of respondents said they had heard something about the changes, while 25% said they were not aware of them. 3% of residents believed that the tax changes will not affect them personally, and 4% of the population did not know whether they will or will not be affected by these changes.

The author with the assistance of the specialists of the University of Latvia has conducted own research. It has shown the necessity of the further improvement of the tax literacy of the population of Latvia.

For multicriteria assessment of the reliability of the tax system of the Republic of Latvia, the author proposes to use a three-tiered scale to classify the reliability of the tax system (reform, adjustments, changes): high, medium and low degree of reliability.

Factors affecting the reliability of the tax system can be divided into several groups: the reaction of taxpayers, additional changes in tax legislation, recommendations, reports, and requirements of EU structures, as well as the impact of changes on budget revenues.

The criteria for qualitative assessment of the tax system's reliability were developed. Points are awarded both cumulatively and separately in each category. Based on this, it is possible to distinguish two types of reliability: local – when the tax system is reliable in any group of criteria, and global – showing the aggregate reliability of the tax system. Local reliability does not mean stability of the tax system in the long term. Depending on the group of reliability, the tax system may lose local reliability over time, or vice versa.

For the integrated and comprehensive assessment, a of reliability according to the proposed criteria a scale was introduced by the author.

The analysis of the tax system's reliability since the 2018 tax reform took effect was based on the data of the Ministry of Finance on tax changes between 2018 and 2021.

When reforming the tax system, the author recommends that government agencies consider and evaluate the reliability of the resulting tax system to create a reliable functioning fiscal instrument.

The process also requires the development of two-level economic-mathematical models and appropriate software.

Assessment of the reliability of the tax system should be carried out not only at the national level, but also separately at the regional level, since part of the tax revenues are administered and remain directly at the disposal of local governments. Conducting such evaluation activities and analysing their results can serve as one of the decisive factors for conducting the ATR (as mentioned in Section 2.2). The reliability assessment in these cases should also be carried out using an evaluation scale similar to that proposed in this Section for the general assessment of the tax system. Taking into account the regional characteristics of a particular territory, which are signature for assessing tax revenues, will increase the reliability and efficiency of the tax system, as well as stimulate the development of regions to the necessary extent and improve the situation of the population with low incomes.

4.2 Statistical analysis of tax revenues to the budget

It is possible to use statistical models to estimate both total tax revenues and the level of collection of individual taxes. One of the classical options that is widely used in economic modelling is regression analysis. However, in case of analysis of statistical data of the tax system of Latvia it is encountering several important difficulties.

The major of them is a small number of observations for creation of precise and sophisticated models – most of the statistical data is available annually, which leads to approximately 20 valid observations. If to take into account possible structural breaks in the data (e.g. 2004, when Latvia joined EU, 2008–2009, when financial crisis took place and 2020, when Covid-19 pandemic hit the world), the number of observations for specific time interval is becoming dramatically small. It leads only to an opportunity to create assumption models, which can be used to estimate certain relations and trends but cannot be

efficiently used for prognosing. It is not all the problems, that regression modelling would encounter during the corresponding analysis of the tax system.

Thus, the tax revenues of the Latvian budget were studied based on the time series analysis. In this approach, Autoregressive Integrated Moving Average (ARIMA) and Seasonal Autoregressive Integrated Moving Average (SARIMA) models were used for the analysis of the time series.

The advantage of this approach is the absence of additional variables that can introduce noise into the model and also have a high correlation between each other.

Another advantage of the proposed approach is the ability to extract monthly tax revenues data of the Latvian budget for each of the studied taxes, which gives more observations than the analysis of annual tax revenues that are usually used in classical regression models. The data for construction time series was taken from open source and was transformed into time series with monthly step.

Table 4.1

Time series modelling application for all taxes and cumulative tax income data

Indicator	ARIMA			SARIMA			Semi-auto SARIMA		
	Coefficients	MAPE 2019	MAPE 2020	Coefficients	MAPE 2019	MAPE 2020	Coefficients	MAPE 2019	MAPE 2020
Value Added Tax	(1,1,1)	0.063	0.17	(0,1,0)×(1,1,0)	0.099	0.117	(0,1,1)×(0,2,1)	0.054	0.097
Corporate Income Tax	(1,1,1)	1.502	0.898	(1,1,0)×(0,1,1)	3.172	0.691	(0,1,0)×(0,1,1)	3.292	0.769
Excise Duties	(1,0,0)	0.111	0.108	(0,1,0)×(0,1,2)	0.063	0.076	(0,1,0)×(2,1,0)	0.059	0.066
Lottery and Gambling Tax	(2,0,0)	0.141	1.43	(2,0,0)×(0,1,1)	0.181	1.869	(2,1,2)×(0,1,1)	0.25	1.739
Electricity Tax	(0,1,0)	0.107	0.145	(0,1,1)×(2,1,0)	0.632	0.692	(0,1,2)×(3,1,0)	0.608	0.678
Vehicle Operation Tax	(0,0,0)	0.130	0.095	(0,1,2)×(0,1,0)	0.058	0.064	(2,1,3)×(0,1,0)	0.058	0.067
Company Car Tax	(0,0,0)	0.101	0.082	(0,1,2)×(0,1,0)	0.042	0.051	(0,1,2)×(3,1,0)	0.059	0.061
Customs Tax	(0,1,1)	0.217	0.191	(1,0,1)×(0,1,1)	0.104	0.101	(0,1,3)×(0,1,1)	0.188	0.095
Mandatory State Social Insurance Contributions	(0,0,0)	0.427	0.316	(0,0,0)×(0,1,1)	0.396	0.178	(0,1,3)×(0,1,1)	0.439	0.511
Natural Resources Tax	(5,1,1)	Non-stationary	Non-stationary	(0,1,2)×(0,1,0)	0.296	0.467	(2,1,0)×(2,1,1)	0.277	0.205
Personal Income Tax	(2,0,1)	0.17	0.272	(1,2,1)×(0,1,0)	0.436	0.472	(0,1,0)×(0,1,0)	0.106	0.468
Microenterprise Tax	(3,1,1)	0.717	0.703	(3,0,1)×(0,1,1)	0.476	0.352	(2,1,1)×(0,1,1)	0.417	0.288
Cumulative Administered Revenues	(1,0,2)	0.119	0.274	(0,1,0)×(1,1,0)	0.036	0.136	(0,1,0)×(0,1,0)	0.036	0.136

Source: created by the author.

ARIMA and two variations of SARIMA models were analysed for each of the following taxes and aggregations: value-added tax, enterprise income tax, excise duty, lotteries and gambling tax, electricity tax, vehicle operation tax, company car tax, customs duty, state compulsory social security contributions, natural resources tax, personal income tax, micro-enterprise tax, as well as total SRS administrated income. The results are shown in Table 4.1.

For each of them, prediction for the next period was obtained, as well as models were tested out on the previous periods (2019 and 2020). The following classification was used to rate obtained models:

- the results with acceptable accuracy are highlighted in green (MAPE<0.3), i.e. the prediction accuracy is at least 70 %;
- yellow colour marks the results, the accuracy of which lies in the range from 50 to 70 %;
- results with an error of more than 50 % are marked in red;
- cases where it is not possible to apply the model with appropriate parameters for testing on previous periods (due to the identified non-stationarity of the time series) are marked in blue.

Models with both approbation results highlighted in green may be recommended for use.

4.3 Application of the tax prism method

One of the instruments of tax policy analysis, proposed by the author, is the tax prism.

The author proposed to use the concepts of state-oriented tax prism and business-oriented tax prism.

In determining the rational value of taxation, it is necessary to conduct a comprehensive study using data from both the state-oriented tax prism and the business-oriented tax prism. To do this, a combined diagram should be created

with graphs $V = f(n)$, plotted for state-oriented indicators $V_{so} = f(n)$ and for business-oriented indicators $V_{bo} = f(n)$ (Figures 4.2–4.6). Parameters V and n are chosen based on the goal of the study. Combined diagrams can differ significantly from each other, and the most typical variants of such diagrams are considered below.

If the graph of function $V_{so} = f(n)$ coincides completely with the graph of function $V_{bo} = f(n)$ or is close to it (Figure 4.2) or is inside it (Figure 4.3), then the size of tax burden optimal for both parties can be easily determined. In the situation shown in Figure 4.2, the areas of optimal values almost completely coincide. In this figure, the area of the most acceptable options is highlighted in green.

In the case shown in Figure 4.3, despite the fact that the optimal value areas do not overlap, the state imposes even fewer financial requirements on the taxpayer than the amount of taxes that corresponds to their comfortable tax burden. In the situations shown in Figure 4.2 and Figure 4.3, the ranges n set by the state and acceptable to the taxpayer are almost identical.

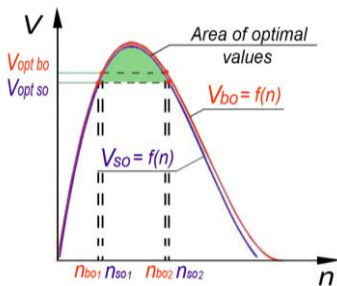


Figure 4.2 Combined diagram with $V_{bo} \approx V_{so}$ and $n_{bo} \approx n_{so}$

Source: created by the author.

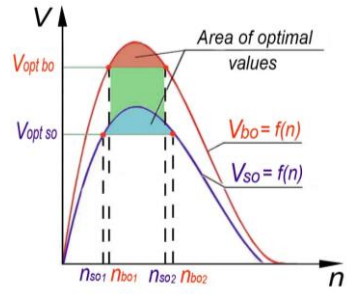


Figure 4.3 Combined diagram with $V_{bo} > V_{so}$ and $n_{bo} \approx n_{so}$

Source: created by the author.

It is somewhat more difficult to make a decision in the situation when both functions are shifted along the abscissa axis relative to each other, but have a significant area of mutual intersection formed by areas of optimal value areas for $V = f(n)$ functions plotted by state-oriented indicators $V_{so} = f(n)$ and by business-oriented indicators $V_{bo} = f(n)$ (Figure 4.3) or when the graph of the function $V_{bo} = f(n)$ is inside the graph of the function $V_{so} = f(n)$ (Figure 4.5). In Figure 4.4, the area of the most acceptable options is highlighted in green. The compromise tax area of the diagram is located in the range n_{so1} and n_{bo2} . In this section n_{so} and n_{bo} corresponds to the value $n/2$ defined in the Section 3.3.

In the situation shown in Figure 4.5, the state imposes excessive tax requirements, but since the values of n_{bo1} and n_{so1} and n_{bo2} and n_{so2} , respectively, are close to each other, some slight adjustment to the requirements is necessary in order for the function graphs to match or overlap in the area highlighted in green.

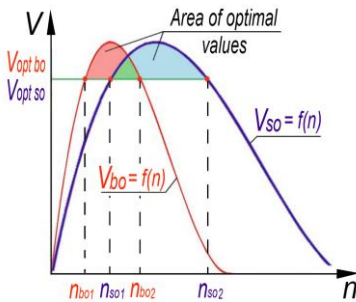


Figure 4.4 Combined diagram
with $V_{bo} = V_{so}$ and $n_{bo} < n_{so}$

Source: created by the author.

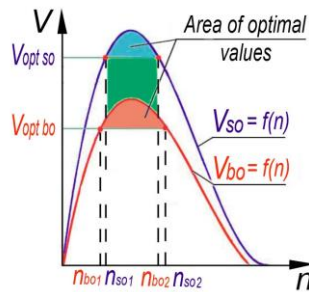


Figure 4.5 Combined diagram
with $V_{bo} < V_{so}$ and $n_{bo} \approx n_{so}$

Source: created by the author.

The most difficult situation will arise in cases where the graphs of these functions will have no intersection (unification) at all in the zones optimal for both subjects of the study (Figure 4.6).

In this case, a serious adjustment of requirements is necessary.

If the adjustment does not lead to the goal, then there is a case of the incompatibility of the requirements of the task. To solve the problem by variant optimisation method it is reasonable to use the optimisation method of successive concessions.⁸²

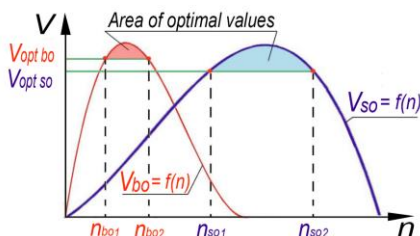


Figure 4.6 Combined diagram with $V_{bo} > V_{so}$ and $n_{bo} < n_{so}$

Source: created by the author.

This will also require forming a hollow prism, the volume of which is equal to V (where V is the amount of taxes paid by the enterprise to the state budget), by cutting off a square characterising a tax burden of the enterprise, from each of the four corners. Such a tax prism will be called business-oriented.

Construction of the tax prism and options for its interpretation

The approach was illustrated on examples on the economic activity of the enterprise, and eight ways of financial optimisation were proposed and considered.

The height of an edge of such a prism is a graphical interpretation of the specified tax.

⁸² Brodeckij, G., Gusev, D., Mazunina, O. and Fel, A. 2017. Possibilities of the Method of Successive Concessions When Selecting for Many Criteria. *Logistics and supply chain management*. 80(3), 91–105.

In this case, the base area of the prism allows to give a qualitative assessment of the profit of the enterprise, remaining after the payment of the required taxes.

Automating the use of the tax prism method

For visual interpretation and simplification of calculations, the author proposed and developed applied software using the Python programming language. This program calculates the visualisation of the tax prism for the given parameters of the tax base and tax, as well as calculates the optimal tax prism for the given size of the tax base. In addition, a graphical interpretation of the ratios of the prism volume when the tax changes (while keeping the tax base unchanged) is available. For this type of visualisation, a comparison of the real and optimal tax size is available.

The author recommends using the tax prism method to study the relationship “tax base – tax volume – tax amount” in the development of tax reforms and other adjustments to the tax system. This approach allows to study not only the tax system as a whole, but also to conduct a discrete analysis of individual taxes.

4.4 Application of the relative single indexes and the successive concessions method in the analysis of the Vehicle Operation Tax and tax costs related to the vehicle operation

Vehicle Operation Tax has been selected in combination with the tax costs related to the vehicle operation, as such combination is the most representative way (both direct and indirect) affects a number of other major taxes such as Value Added Tax, Company Car Tax, Excise Duties, and, in specific cases – others.

The relation between an increase in transport fuel prices and the increase in food and manufactured goods prices has been repeatedly substantiated both in scientific research and in discussions with the media.^{83, 84, 85, 86}

Road transport is a strategic sector of the economy of both Latvia and the entire EU. It has a direct impact on the daily lives of all EU citizens and ensures the flow of goods from more than 11 million producers to consumers, supporting the proper functioning of the European Common Market.⁸⁷

Road transport infrastructure, as well as related logistics services, have a direct impact on competitiveness and economic growth, creating prerequisites for the development of other industries and attracting investment, providing significant revenues from export services, and having a positive impact on the development of the state.

Since 2016, there has been a steady increase in the number of vehicles registered in Latvia. From the end of 2016 to the beginning of 2022, the number of registered vehicles in the country increased by almost 150 000 vehicles and amounted to 1 018 175 units.⁸⁸ At the same time, the results of the Latvian

⁸³ Taghizadeh-Hesary, F., Rasoulinezhad, E. and Yoshino, N. 2019. Energy and Food Security: Linkages through Price Volatility. *Energy Policy*. (128), 796–806.

⁸⁴ Stevens, P. 2022. Rising fuel costs are a massive problem for business and consumers – Here's why they're so high. <https://www.cnn.com/2022/05/19/fuel-is-a-problem-for-business-and-consumers-why-prices-are-so-high.html>.

⁸⁵ J.P. Morgan. 2022. Why Are Gasoline And Food Prices Rising? <https://www.jpmorgan.com/insights/research/gasoline-food-prices-rising>.

⁸⁶ TVNET/LETA. 2022. Energoresursu un pārtikas cenu pieaugums var paaugstināt gada inflāciju līdz 10%, prognozē FM. <https://www.tvnet.lv/7472748/energoresursu-un-partikas-cenu-pieaugums-var-paaugstinat-gada-inflaciju-lidz-10-prognoze-fm>.

⁸⁷ Eiropas Revīzijas palāta. 2018. Ceļā uz veiksmīgu transporta nozari Eiropas Savienībā: risināmās problēmas. https://www.eca.europa.eu/Lists/ECADocuments/INLR_TRANSPORT/INLR_TRANSPORT_LV.pdf.

⁸⁸ CSDD. 2022. Transportlīdzekļu sadalījums pa pilsētām un novadiem. *Transportlīdzekļi. Statistika*. <https://www.csdd.lv/transportlidzekli/transportlidzeklu-sadalijums-pa-pilsetam-un-novadiem>.

population census of 2021 recorded the presence of 1 893 223 citizens.⁸⁹ The well-being of every inhabitant of Latvia is connected with the availability of road transport. In this case, it is mostly related to the vehicle operation tax, which has increased significantly in recent years, and the cost of fuels and lubricants, and primarily fuel. Therefore, in this section, a study is conducted in the aggregate of the Vehicle Operation Tax and the conditional generalised fuel indicator.

As already shown, the EC has repeatedly drawn attention to the fact that one of the goals of tax reform in Latvia was to reduce inequality between the richest and poorest, which was not achieved.

The study of the Vehicle Operation Tax in conjunction with the costs of their operation will also make it possible, if necessary, to provide a qualitative and quantitative forecast for the implementation by Latvia of the tasks set in accordance with the objectives of the EU climate agenda.⁹⁰ This is especially true, because Latvia has a significant share of used cars.

Study of the Vehicle Operation Tax in Latvia and tax costs related to the vehicle operation

As part of the study, the sources of normative, reference and scientific literature on the organisation of vehicle taxation in Latvia and other countries of the European Union were analysed. Based on the analysis of regulatory documentation the current method of calculating the Vehicle Operation Tax in the Republic of Latvia was analysed, identified shortcomings and areas for improving it.

Vehicles in most countries of the world are subject to taxation, bringing a certain share of money to the state budget. The main source of revenue generation in the budget system of the Republic of Latvia is taxes and receipts, in particular,

⁸⁹ Centrālā statistikas pārvalde. 2021. Demogrāfija. *Tautas skaitīšana 2021, Rādītāji*. <https://www.csp.gov.lv/lv/demografija>.

⁹⁰ Latvijas Republikas likums. Par Latvijas Nacionālo enerģētikas un klimata plānu 2021.–2030. gadam. *Latvijas Vēstnesis*, 29, 11.02.2020. Pieņemts: 04.02.2020.

the Vehicle Operation Tax.⁹¹ This tax, like every other, is individual, since it assumes its own legal structure.

Identification of the requirements of incompatibility zone

Before carrying out variant optimisation, it is necessary to determine the numerical values of relative single indexes that characterise the “equity” and “efficiency” of the tax policy for each specific case and time period.

The terms equity and efficiency are used within the framework of the state-oriented and business-oriented aspects of tax optimisation defined in Section 3.1, which correspond to the criteria of efficiency and equity. In the framework of the study of Vehicle Operation Tax and related costs, efficiency means maximising budget fees from the corresponding types of taxes and fees related to transport, while equity means the permissible level of tax burden on the taxpayer. Later in this Section, the fuel equivalent, which is a measure of equity for the taxpayer, is determined.

It is advisable to determine the numerical values of relative single indexes using this scheme for Vehicle Operation Tax:

$$K_{ij}^{vt} = \frac{P_{ij}^{vt}}{P_{i,bl}^{vt}} \text{ or } K_{ij}^{vt} = \frac{P_{i,bl}^{vt}}{P_{ij}^{vt}} \quad (4.1)$$

$$i = \overline{1, N}; j = \overline{1, M},$$

where:

K_{ij}^{vt} – relative designation of relative single index of Vehicle Operation Tax;

⁹¹ Latvijas Republikas likums. Likums Transportlīdzekļa ekspluatācijas nodokļa un uzņēmumu vieglo transportlīdzekļu nodokļa likums. *Latvijas Vēstnesis*, 206, 30.12.2010. Pieņemts: 20.12.2010.

P_{ij}^{vt} – value of single index of researched characteristic (equity or efficiency) of Vehicle Operation Tax;

$P_{i, bl}^{vt}$ – value of single index taken as basic (possible) level of Vehicle Operation Tax;

i – name of the estimated characteristic;

j – the number of variant;

N – the number of relative single indexes;

M – the number of researched variants.

In all cases, when determining the values of relative single indexes from the formulae (4.1), the one that corresponds to the improvement of the quality of the index system with an increase in the single index is selected.

Relative single indexes of “equity” K_{eqj}^{vt} and “efficiency” K_{effj}^{vt} are formed in such a way that their values, which lie in the range of values less than one, reflect an unacceptable value of quality (their characteristics), and acceptable values of indexes K_{ij}^{vt} are equal to or exceed one.

The average annual cost of maintaining a used car in Latvia is between 500 and 600 euros.⁹² According to official data from the Latvian Central statistical bureau, the average salary in Latvia in 2018 after taxes was 737 euros, in 2019 it increased slightly, and as a result, the employee received about 800 euros.⁹³

In this study, the calculations were based on the conditional fuel equivalent, i.e. the maximum amount of fuel that can be purchased for an average salary in Latvia.

⁹² Berzins, A. 2017. How Much Does the Maintenance of the Used Car Cost in Latvia? *BigBank Research*. <http://ru.focus.lv/news/issledovanie-bigbank-skoljko-stoit-soderzhanie-poderzhanogo-avto-v-latvii?14999>.

⁹³ Latvijas statistikas gadagrāmata 2019, Statistical Yearbook of Latvia. 2020. *Centrālā statistikas pārvalde*. www.csb.gov.lv, 228.

One of the options for a possible approach to the formation of a relative unit tax when assessing and assigning a Vehicle Operation Tax was considered. After processing data on the most popular brands of passenger cars registered in Latvia,⁹⁴ it was found that in fuel equivalent, the owner of a passenger vehicle spends an average of 5 to 8 litres of petrol per month on the Vehicle Operation Tax. At the same time, it would not be burdensome to spend no more than 7 litres of fuel per month on the tax under study.

In this situation, it is assumed that in order to replenish the budget, the state needs each owner to contribute at least 9 units of fuel equivalent to the budget on average.

When analysing this optimisation model, it turned out that the relative single indexes of equity $K_{eq}^{vt} j$ and efficiency $K_{eff}^{vt} j$ that characterise the Vehicle Operation Tax were incompatible (Figure 4.7).

In such a situation, if it is impossible to change the calculation conditions, it is necessary to determine the importance of each criterion. If the relative single index of effectiveness $K_{eff}^{vt} j$ is given priority in the ranking, then option 8 or subsequent options located to the right of this option on the abscissa axis (to the right of point *B*) should be selected as acceptable.

⁹⁴ CSDD. 2020. Visi transportlīdzekļi, 1900–2020, pēc ražotāja. *Uzskaitē esošie transportlīdzekļi, Statistika*. <https://www.csdd.lv/transportlidzekli/transportlidzekli-vizualizacija>.

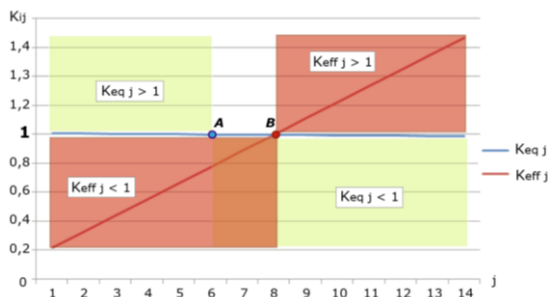


Figure 4.7 **Combined diagram of relative single indexes of equity and efficiency (the first controlling case is incompatibility of requirements)**

Source: created based on the author’s calculations.

The analysis of the results is carried out and on its basis recommendations are formulated in the Thesis.

Identification of the requirements of compatibility zone

Several more possible situations were covered. If the Vehicle Operation Tax calculated in fuel equivalent is sufficient for the budget in the amount of 8 units, and this amount will not be burdensome for vehicle owners, then the combined diagram shown in Figure 4.8, is converted to the diagram shown in Figure 4.9.

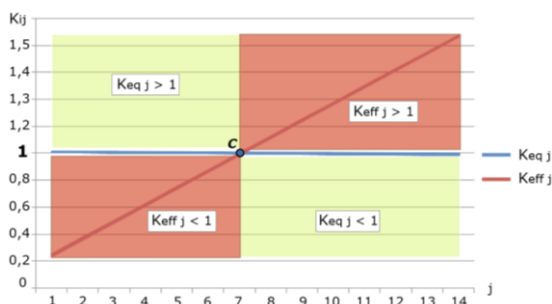


Figure 4.8 **Combined diagram of relative single indexes of equity and efficiency (the second controlling case is the only solution)**

Source: created based on the author's calculations.

In this case, the analysis of the obtained results was also carried out and recommendations were formulated on its basis.

After adjusting the values taken as basic (reference) values, the combined diagram was built again (Figure 4.9). The resulting combination of relative single indexes is the most preferable, since it is not the only possible option, but the area of acceptable values located between the points *D* and *E* in the range of values K_{eqj}^{vt} and K_{effj}^{vt} from one and higher.

To achieve optimum zone, which lies between points *D* and *E*, it is recommended to establish a tax on the use of Latvian roads for owners of passenger cars that are not declared in Latvia. This applies to owners of passenger vehicles who come to the Republic of Latvia from countries that are part of the European Union or outside its borders. At the moment, they do not pay tolls for driving on Latvian roads. This tax is easy to implement, because Latvia has experience of collecting a similar tax, for example, from owners of cargo transport with a gross weight of more than 3000 kg, and from vehicles registered outside of Latvia, whose owners have declared their place of residence on its territory. Similar taxes exist in a number of EU countries and are approximately equal to 12.5 euro for 10 days of road use, 18 euros for a month, and 60 euros for

a year. Such actions at the same time will allow slightly to decrease a burden for local taxpayers, making it closer to the desired 7 relative litres of the tax burden, but it is not yet achieved, but tax burden could be redistributed on foreigners.

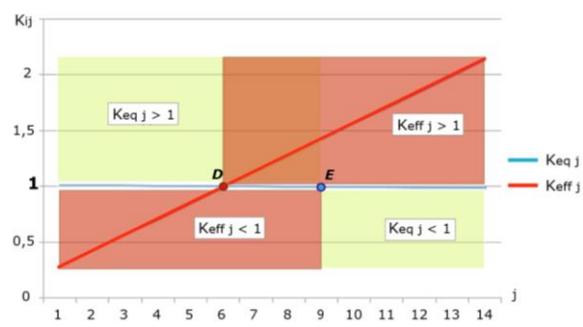


Figure 4.9 **Combined diagram of relative single indexes of equity and efficiency (the second controlling case is a set of possible solutions)**

Source: created based on the author’s calculations.

In situation, where it is necessary to adjust the amount of fuel equivalent when searching for suitable solutions using the proposed combined diagram, various options were considered, and appropriate recommendations were made.

Using the methods of variant optimisation and “tax prism” will allow to visualise the process of modelling various situations when searching for the fairest and most effective model of taxation of vehicle owners.

In Chapter 4, intermediate conclusions were made (results were analysed) regarding the application of the method of relative single indexes for Vehicle Operation Tax and related costs in Latvia.

4.5 Application of expert evaluation for the elimination of requirements incompatibility

The use of the optimisation method of successive concessions in the case of irreducible incompatibility of the requirements of the system “equity – efficiency” is inevitably associated with the ranking of relative single indexes, as well as taxes that are associated with them, in descending order of their importance.

The study using the method of expert evaluations was conducted in three stages.

At the first stage, statistical and expert evaluation methods were used. Only strict ranking was allowed, in which evaluated elements were assigned different ranks.

At this stage, the objectives of this local study were defined and set in the form of prioritising (ranking by importance) the relative single indexes that characterise the criteria of tax policy, namely: equity, certainty and accuracy of taxes, ease of collection of taxes for taxpayers, efficiency and obligation. Besides, the ranking of taxes stipulated by the legislation of the Republic of Latvia was carried out using this approach.

The method of obtaining expert information is a direct interview with a group of experts. Processing method is decision making by vector criteria. In this case different possible solutions are directly ranked by preference (indicators are ranked by importance) for further implementation of the method of successive concessions in cases of incompatibility of requirements.

The expert group was formed from professors, teachers, employees, master’s and PhD students from a number of Latvian universities, as well as from the staff who provide accounting services to firms operating in Latvia. The total number of experts was 26. In order to avoid conformism in the survey, the interaction of experts with each other was excluded.

At the second stage, the quality of the resulting data set was assessed. To concretely determine the necessary combination of equity and efficiency (with irreducible contradictions of these criteria), expert survey data were processed.

As a method for processing the results of the survey was chosen Kendall's Concordance Coefficient W . As a result, at this stage were obtained summary sheets of experts, with the calculated indicators.

At the third stage, the results were evaluated for consistency. The experts' opinion is considered to be consistent if the value of the concordance coefficient is greater than 0.6. In case of revealed inconsistency of expert opinion, measures were taken to eliminate it by dividing the group of experts into subgroups and calculating the indicators for each of the subgroups.

The results of the survey on the priority of taxes of the Republic of Latvia after the expert survey were summarised.

For the data from the survey of tax ranking experts, the coefficient of concordance $W = 0.84$.

The experts' opinion should be considered consistent if the value of the concordance coefficient is greater than 0.6. Consequently, the experts' opinion on this issue should be considered coherent.

A set of the basic taxation principles was also analysed – the concordance coefficient $W = 0.39$. Since in this case the value of $W < 0.6$, the experts are divided according to their opinions (according to the degree of agreement) into two groups (the number of groups may be larger).

The first subgroup included 12 experts and the second subgroup included 14. For the group of 12 experts the concordance coefficient became $W = 0.63$ (i.e. more than 0.6). Consequently, the experts' opinion is agreed upon.

For the group of 14 experts the concordance coefficient became $W = 0.65$ (i.e. more than 0.6).

Consequently, the experts' opinion is agreed upon. Accordingly, the principles of taxation are ranked according to their importance.

It should be noted that, despite the different opinions of the two subgroups of experts into which the overall group of experts had to be divided, both subgroups prioritised the principle of equity in tax collection over the principle of efficiency.

Since the results of the expert survey largely depend on the composition of the expert group, it might be useful to create an automatic expert system for assessing taxes and tax criteria.

Conclusions and recommendations

Based on the results of the research, the following conclusions were made:

1. Methods of tax systems analysis mostly cover particular aspects of taxation, either from the point of view of the state or from the point of view of taxpayers. Furthermore, the criterion of the tax system includes special cases of equity and efficiency. In theoretical and applied studies of the tax, concepts and tax system requirements, a number of researchers stressed the need for an integrated approach to the tax system optimisation. Thus, there is an objective need for the theoretical ground for an integrated approach to tax optimisation. The integrated approach is elaborated in the Thesis from the point of view of both the taxpayer and the state.
2. The Laffer curve is very topical in scientific debates. However, the Laffer curve is not a universal tool, and its application is difficult due to many limitations, practical application difficulties and not always yield reliable results. The studies that attempted to introduce an additional parameter in the form of a tax base, to date, have not led to the creation of a generally recognised universal methodology that gives adequate results.
3. Decisions aimed at the tax system improvement (including by adjusting its fiscal function) based on the analysis and modification of any discrete parameter (or group of the same type of parameters) often do not yield the desired result. Such decisions exert a negative impact on other following choices and can also be a consequence of populist decisions. It is necessary to create a technique that allows analysis and modelling using an integrated approach.
4. For justification of the most appropriate solution for improving the tax system process of optimisation should be used, which is related to the

application of scientific methods, named “operations research”, i.e. application of mathematical, quantitative methods to justify and develop solutions. The reform has to be planned in one or several successive stages with an appropriate breakdown by goals, means and methods.

5. For the creation of a new improved model of tax system optimisation is necessary to consider mutual interactions in the “state – taxpayer” system, which depend on the position of state authorities, and the position of a taxpayer (legal entity or individual), i.e. a state-oriented aspect and a business-oriented aspect.
6. The state-oriented aspect of tax optimisation defined by the author as the actions of the authorities with special powers to fulfil the fiscal function and regulate the taxation process, aimed at improving the state of the business climate in the country and stimulating the establishment and development of the business which allows formalising the trade-off in the “equity – efficiency” system aimed from the position at of the efficiency.
7. The business-oriented aspect of tax optimisation defined by the author as a set of measures used by a taxpayer (an enterprise or an individual) in order to reduce the tax burden in the short or long term and allows to formalise the trade-off in the “equity – efficiency” system from the position of equity.
8. The improvement of the tax system should be carried out not only considering the tasks of the state and local level, but as well as at the international level, because regulations related to the EU competences are obligatory (e.g. related to restrictions on environmentally harmful activities). These tasks require developing timely compensatory measures to keep the budget revenues at the necessary extent.

9. The differences in territorial division in Latvia and economic potential of regions, should be further studied and considered when planning tax reforms. The implementation of the administrative-territorial reform should be based on economic characteristics of the regions, changes in tax flows and evaluation of the impact of tax reform on the efficiency, equity and reliability of the tax system.
10. The reliability as a tool for predicting the life cycle of both the current and the modernised tax system allows to prepare compensatory measures and minimise possible failures in the functioning of the tax system.
11. The tax reforms implementation started in 2018 did not create a stably operating fiscal system that would effectively perform its functions for a sufficiently long time. As a result, the irrational use of public funds spent on further improvement of the reforms did not permit the foreseen objectives which required additional costs for their adjustment. The lack of reliability of the tax reform discredits the fiscal system and significantly increases the probability of failures.
12. The tax prism method is introduced by the author for economic interpretation of the formation of the budget revenues, its assessment and research, which allows to control the dynamics of the volume of taxes received by the state in the studied period, tax rate and their relation to the tax base. The tax prism is also applicable in research conducted from a business-oriented perspective.
13. The tax prism subdivision into static and dynamic versions allows assessing the decrease in the amount of collected taxes, which occurs due to the use of legal tax optimisation schemes by taxpayers. Static and dynamic tax prisms make it possible to visualise the process of tax optimisation carried out by state authorities, when establishing the

types and determining the size of taxes both in the short term and in the long term, making it more accurate. When using static and dynamic tax prisms, it is possible to effectively enhance tax legislation by simulating the qualitative and quantitative consequences of specific changes and innovations.

14. The use of the variant optimisation method in finding compromise solutions in case of contradictions between the main criteria of the tax system, such as equity and efficiency, allows to carry out a qualitative and quantitative analysis. It provides an appropriate assessment of each criterion, and to assign the most rational and reasonable taxation parameters corresponding to a particular situation.
15. The analysis of the case of the Vehicle Operation Tax and tax costs related to the vehicle operation has shown that they are not optimal in Latvia, due to the incompatibility of the requirements between the criteria of equity and efficiency. Eliminating the incomparability of the requirements between these criteria and prioritising the criterion of equity will reduce social inequality.
16. The method of successive concessions with a preliminary ranking of taxes and tax criteria in order to identify criteria by which concessions allows to determine the most rational compromise solution if significant incompatibility of requirements in the “equity – efficiency” system is identified.
17. Implementation of the successive concessions method by ranking based on an expert survey has to be accompanied by a careful selection of a group of experts. A preliminary assessment of experts’ belonging to the appropriate position (business-oriented or state-oriented) and verification of the consistency of opinions within each of the groups is required.

18. The tax system representation as a composite system, where each of the taxes characterises the element of the system allows to assess criteria in the “equity – efficiency” system and the relationship between taxes. The composite system approach makes possible to obtain more accurate results when assessing both one specific tax and the entire tax system as a whole.
19. Time series analysis models (ARIMA and SARIMA) do not always accurately describe all taxes due to the impact of tax reforms and the COVID-19 pandemic. At the same time, most of the taxes can be predicted quite accurately by the developed models (with level of accuracy more than 70–80%). Based on the results of the analysis, it is reasonable to apply an averaging of the obtained models (stacked model). The ability of the model to accurately describe changes in the specific tax income is partially determining the reliability of the concrete tax.
20. An integrated approach to optimising the tax system is successfully implemented, only with the combined use of all the developed and proposed tools, with regards to the most important criteria affecting its quality: efficiency (state-oriented aspect), equity (business-oriented aspect), reliability (as a criterion of the life cycle of the tax system).

The tasks set in the Doctoral Thesis were completed, and the aim has been achieved. The research and analysis carried out in the Thesis confirm the hypothesis that the use of the integrated approach for substantiation of tax policy measures permits rational decision making. A rational combination of the principles of efficiency and equity, as well as compliance with other criteria of taxation, will allow authorities in Latvia to create a tax system that meets the defined interests of both the state and taxpayers.

Based on the conclusions, the author formulated the following **proposals**:

To the Ministry of Finance of the Republic of Latvia:

1. Constant monitoring of the reliability of the tax system is recommended in order to make timely decisions on modernisation and reform of the tax system, avoiding a time lag.
2. Assessment of the reliability of the tax changes is suggested on the preparatory stage, introduced both in the short- and long-term period, before adopting them.
3. Application of the tax prism method is recommended for a comprehensive analysis of the “tax base – tax amount (tax rate) – collected amount of tax” relation when monitoring and making changes to the tax system.
4. Assessment of the impact on the tax system from the point of view of efficiency and equity in the preparatory stage of a tax reform is recommended by applying methods of relative single indexes and successive concessions in cases where there is an incompatibility of studied criteria.
5. The tax on the use of roads in Latvia for owners of vehicles of categories M1 and N1 that are not registered in the country (e.g. in a form of a vignette, with a suggested duration of 10 days, 1 month, 3 months and 1 year) is recommended. Introduction of the tax allows to reduce incomparability between equity and efficiency and to reduce the burden on low-income groups of the population, partially shifting the tax burden from a vulnerable group. The principle “who drives less, pays less tax” for Vehicle Operation Tax is another option to further promote equality between the social groups.

To the Ministry of Environmental Protection and Regional Development of the Republic of Latvia:

6. Regional specificities of taxation and its modelling for assessing changes in reliability and collectability are recommended to consider during the development and implementation phases of future administrative-territorial changes.
7. Cooperation of the Ministry of Environmental Protection and Regional Development with the Ministry of Finance could lead to the effective implementation of tax reforms and would be beneficial on a regional level.

To the State Revenue Service (SRS) of the Republic of Latvia:

8. Two options are suggested: first, the refund period should be established after the last annual filing date of declarations and is not associated with a specific moment of filing the declaration within the specified time period, in order to prevent overloading and failures of the electronic declaration system; second, to divide taxpayers into several groups, according to a certain classification criterion, and for each group to set their own deadlines for filing a declaration. This information should be brought to every taxpayer.

To the Saeima of the Republic of Latvia:

9. The opinion of specialists from the Ministry of Finance and other competent institutions, justifying specific impact on the budget of possible changes is necessary to acquire before considering issues that affect the budget revenues directly or indirectly. This will allow to make more balanced and efficient decisions. In cases where political goals prevail over economic feasibility, to timely develop compensatory measures to keep budget revenues at the required level.

To the Ministry of Education and Science of the Republic of Latvia:

10. In the curricula of educational institutions engaged in advanced training of government officials related to the improvement of the tax system it is advisable to include the conceptual theoretical and practical principles elaborated in the Doctoral Thesis.
11. Advanced educational programs or courses to train specialists, acquiring new knowledge and competences in effective management of the state tax system, is essential. It is necessary to provide funding for implementation of such type of training.
12. The training programs for specialists in tax policy should include special in-depth IT-training, which allows to create and use computer programs in determining the reliability of tax reforms, as well as for assessing previous periods and forecasting future ones.

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