Econometric models of tax reforms

Экономико-математические модели налоговых реформ

Analytic Hierarchy Process in Czech Taxpayers' Decision-Making Regarding their Tax Liability

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ABSTRACT

The article deals with taxation of the earned income of natural persons in the Czech Republic in 1993–2017. The goal is to select the year when the tax burden on the earned income of natural persons was the lowest depending on the taxpayers' preferences, their income level and the number of tax deductions they were entitled to. Based on their income levels, taxpayers analyzed the elements constituting their tax liability and decided whether it became smaller or larger in the given periods. The research methodology includes methods of description, comparison, analysis and synthesis and methods of multi-criteria decision-making. The decision-making analysis focuses on model situations which differ from each other in terms of the amount of gross wage and the number of deductions applied. It is concluded that in most cases, the replacement of the progressive tax rate by the linear rate in 2008 lead to a reduction in the tax burden. The highest decrease of tax liability was observed among taxpayers with below-average incomes. Taxpayers with above-average incomes were subject to a higher tax liability when the nominal tax rate was progressive. Tax credit is yet another factor that influences tax liability; for taxpayers whose income is less than average it takes a form of tax bonus. The most significant change in the legislation regulating income taxation occurred between 2007 and 2008. According to the evaluated criteria weights, the most import criterion for Czech taxpayers is the effective tax rate. The weights of criteria in multi-criteria decision-making analysis were established by using the results of the questionnaire survey conducted by the author among 189 respondents at a manufacturing company in Zlin region.

KEYWORDS

analytic hierarchy process, AHP, consistency, personal income tax, effective tax rate, variant, social security contribution

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Метод анализа иерархий в принятии решений налогоплательщиками Чешской Республики в отношении их личной налоговой нагрузки

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АННОТАЦИЯ

В статье рассматривается налогообложение доходов физических лиц в Чешской Республике в 1993–2017 гг. Цель настоящего исследования – определить год, когда налоговая нагрузка на трудовой доход физических лиц была самой низкой с точки зрения налогоплательщиков, то есть в зависимости от их уровня доходов и количества налоговых вычетов, на которые они имели право. Иными словами, налогоплательщик в зависимости от уровня своего доходов анализи-

ровал компоненты своей налоговой нагрузки и определял, стала ли его или ее личная налоговая нагрузка выше или ниже в указанный период. Методология настоящего исследования включает в себя сравнительный и описательный методы, метод синтеза, а также метод мультикритериального анализа решений. В фокусе анализа иерархий оказываются модели различных ситуаций, которые могут различаться по брутто-заработной плате и количеству налоговых вычетов, применяемых к тому или иному налогоплательщику. В заключение делается вывод о том, что налоговая реформа, в результате которой в Чехии в 2008 г. прогрессивная шкала ставок налогообложения была заменена плоской, привела к снижению налоговой нагрузки. Наибольшее уменьшение налоговых обязательств наблюдалось для налогоплательщиков с доходом ниже среднего. Налоговые обязательства налогоплательщиков с уровнем дохода выше среднего росли, когда применялась прогрессивная номинальная ставка налога. Еще одним фактором, который влияет на налоговые обязательства, является возможность получить налоговый кредит, который для налогоплательщика с доходом ниже среднего является формой налогового бонуса. Наиболее существенное изменение в законодательстве, регулирующем подоходное налогообложение, произошло между 2007 и 2008 гг. Как показала оценка веса критериев, наиболее важным критерием в решениях налогоплательщиков оказалась эффективная ставка налога. В рамках последнего вес критериев устанавливался в соответствии с результатами опроса 189 сотрудников производственной компании, проведенного автором в Злинском крае.

КЛЮЧЕВЫЕ СЛОВА

метод анализа иерархий, налог на доходы физических лиц, эффективная ставка налога, вариант, взнос на обязательное социальное страхование

1. Introduction

Any taxpayer seeks to optimize their tax payments to pay less in taxes and to minimize the difference between their gross and net wage. An employee's net wage depends not only on the income tax, but also on social insurance contributions. As is the case with tax liability, social security contributions are deducted from the gross wage when calculating the net wage. This article analyzes not only the aspects related to personal income but also those linked to social security contributions. In taxation theory, for example, within the framework of the OECD classification of taxes, social insurance payments are considered to be direct tax payments.

The aim of this study is to select the year when the tax burden on natural persons' earned income was the lowest. The results of decision analysis will show when the conditions of personal income taxation were better for taxpayers with an average, above-average or below-average income, entitled or not entitled to child tax benefits. The results of our decision analysis may be used in the future by state authorities to devise new elements of the personal income tax: for example, these results can be compared with the revenue from the personal income tax.

The decision-making situations in the sphere of taxation depend on the amount of income and the number of deductions applied. In this article, we are going to analyse the situation where a Czech taxpayer's income was at the average level, below average or above average between 1993–2017[1]. In some cases, the starting point of decision-making situations was the application of tax deductions for children, in addition to the tax deductions for the taxpayers themselves. Thus, our study focuses primarily on the taxpayer – an employee of a manufacturing company – and on their tax liability.

There are several hypotheses whose validity will be accepted or rejected depending on the results of the study:

– the effective tax rate is the most important criterion for tax liability evaluation;

– a taxpayer with an above-average income had higher tax liability during the period when the nominal tax rate of the progressive type was applied;

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[1] *Average Wage*. Prague: Czech Statistical Office, 2018. Available at: www.czso.cz/csu/czso/prumerne-mzdy

– a taxpayer's tax liability hasn´t changed significantly in the comparison with the first and last analysed year;

– for a taxpayer whose income is above average, it is better when the nominal tax rate is linear and the tax deduction for children takes the form of a tax credit;

– the most significant change in the taxpayer's tax burden was observed after 2007.

The legislation regulating personal income taxation in the Czech Republic – the Income Tax Law – has undergone a number of amendments. In this respect, the question arises as to in which period the parameters of the personal income tax were as favourable as possible for the taxpayer. Similarly, there were changes in the rates of compulsory social security contributions and these changes did not have the same impact on all the taxpayers.

The structure of the paper is as follows: the second part, following the introduction, provides an overview of research literature in this field. The third part contains the formalization of the applied methodology in the application section of the article. The fourth and the most important part describes the application of the AHP method in order to select the year, when, according to taxpayers' preferences, their income and the number of deductions they were entitled to, their tax liability was optimal. In conclusion, the main results of the study are summarized and the limitations and future research possibilities are outlined.

2. Taxation of natural persons' earned income: literature review

Personal income tax is a universal income tax which consists of five particular tax bases in the Czech Republic, the most important of which is the employment income tax base. Taxes have many functions in economy, one of which is the redistributive function. J.R. Aronson et al. [1] found that the redistributive effect depends on four factors: the average tax rate, the progressivity of the tax, the unequal treatment of households with similar incomes and the extent of any re-ranking in the move from the pre-tax income distribution to the post-tax income distribution.

The personal income tax was introduced for the first time in Great Britain in 1799 and it shared many attributes with today's income tax, e.g. citizens had to file a yearly tax return stating their gross income from all sources [2]. Tax allowances that either take the form of the non-taxable part or tax reliefs are applied before the calculation of the tax liability. The non-taxable part reduces the tax base, while tax reliefs reduce the calculated tax.

One of the basic features of the personal income tax in any tax system is progressiveness. As the taxpayer's income increases, the tax burden increases too; unlike the income, however, the tax burden increases more quickly [3]. Progression ensures a better redistribution of taxes [4]. General aspects of tax progressivity measurement are described, for example, by U. Jakobson [5], C. Kakwani [6], B. Suits [7] and W. Kiefer [8].

Legislation regulating personal income taxation tend to change quite frequently for political or economic reasons; the changes may also be linked to preferences of interest groups, but the true driver behind tax reforms is political constraints and incentives [9]. K. Peter et al. [10] analyzed the personal income tax reforms that took place in 1981–2005 in 189 countries and found that the tax rates at higher income levels and structural progressivity declined significantly. Schedules with statutory rates, tax brackets, country-specific tax formulas, basic allowances, standard deductions, tax credits, multiple tax scales were analyzed. All these parameters of the personal income tax system changed almost every year.

One of the major tax reforms was realized in the USA in 1986. M. Feldstein [11] uses a sample of 4,000 taxpayers and demonstrates that the income to high-income workers of lower marginal tax rates after the Tax Reform Act of 1986 were partially offset by the declines in the pre-tax wages of workers in high-income occupations. This research confirms the elasticity of taxable income with respect to the marginal net-of-tax rate. From the state's perspective, it is desirable to set the tax rate in the legislation at the level that would allow

to maximize tax revenue [12]. Similar reforms were conducted in Italy, which also had an impact on tax revenue [13] and changed the nominal tax rate or conditions for applying of tax advantages.

Studies of personal income taxation were also carried out in the Czech Republic. J. Večerník [14] found that personal income tax reforms affect redistribution flows only to a very limited degree. A significant tax reform which replaced the progressive tax rate with the linear tax rate took place in 2008. This reform affected the tax structure and tax progressivity. Tax burden was shifted from labour income to consumption, which is also typical of other countries, for example, Germany [15]. V. Friedrich et al. [16] and M. Gencev et al. [17] demonstrate that the income tax has remained progressive even after 2008. Two years earlier, in 2006, selected tax-free income allowances were replaced by the tax relief. Since in the Czech system deductions were made from the tax base, not from the tax due, tax deductions were less effective in terms of redistribution to poor households [18]. Nowadays there are discussions concerning the type of the tax rate: instead of the linear rate, progressive rates could be applied in the future. L. Lykova, for example, discusses this question in relation to the situation in Russia [19]. H. Yilmazkuday [20] doesn´t recommend to increase the personal income tax burden while J. Vlachý [21] points out that the existing assumptions about the detrimental effect of progressive tax systems should be reconsidered. One of the ways to get more tax revenues may be to increase the rates of other taxes, e.g. environmental taxes [22].

The tax reform which fundamentally changed the taxation of employment income was planned for 1 January 2015 [23]. Using the TAXBEN model, the impact of the tax reform on taxpayers and households was assessed and it was shown that the planned reform would not significantly change labour taxation, but the differences in the tax burden on employees and sole traders would increase more significantly. A more detailed description of tax relations in the Czech Republic can be found in S. Kuznetsova et al. [24]. These authors also emphasize that the effective tax rate is more important than the nominal tax rate.

Compulsory social and health insurance was re-introduced in the Czech Republic in the early 1990s [25]. While the personal income tax rate is progressive, the rate for social security contributions is linear. Social security contributions paid by employees include sickness insurance, pension insurance and a contribution to the state employment policy [26]. The social security contribution is often blamed for having a negative effect on employment [27]. Social security contributions increase the cost of work, which is confirmed by I. Nielsen and R. Smyth [28] or J. Vlachý [29]. These authors examined the extent to which employers shift the burden of compliance with social security obligations back to employees in the form of lower wages. Contributions to these insurances are shared by employers and employees and the proportion of the share is regulated by the government. K. Komamura and A. Yamada [30] found that in Japan, the majority of employers shift health insurance contributions back to employees by reducing their wages.

On the other hand, employers and employees do not shift their contributions in the Netherlands [31]. Similar results were obtained by U. K. Müller and M. Neumann [32], who found out that neither employers nor employees shift a substantial part of their social security contribution burden.

M. Feldstein [33] discusses the changes in taxation and social security contributions in more detail. The existence of compulsory social security contributions and personal income tax creates a situation where the average tax rate on wage income in the Czech Republic is 37.4% [34] in spite of the fact that the nominal tax rate is 15 %. Employees not only need to take into account the effective tax rate but also the rate of social security contributions. Social security contributions influence the cost of labour and employment [35]. Thus, it was found that the nominal tax rate has changed quite often. A similar picture is

characteristic of the social security contribution rate.

Unlike the previous studies described above, in this paper, multiple factors are analysed over a longer period of time (25 years). This type of study hasn´t been done yet. As our literature review has shown, tax reforms often change the non-taxable part or tax reliefs by adding a new type of tax relief or changing the rules regulating tax reliefs. In our study, we relied on the previous findings to formulate the criteria for decision-making process.

3. Methods

We used a standard positivist economic methodology, including such methods as description, deduction, and comparison as well as the study of legal sources and synthesizing methods. To choose the best variant, we applied the method of multi-criteria decision making, i. e. to determine the j-th variant – the year – when the taxation of income was optimal, taking into account the weight of the i-th criteria.

The analytic hierarchy process (AHP) method is widely applied nowadays [36]. The method was proposed by Prof. Saaty [37] and its goal is to find an alternative which will meet all the criteria that were selected and evaluated as the best [38].

Standardized criterion weight υ_i (1) is determined by geometric mean (2) proportion of the i-th criterion and the sum of the geometric mean of all criteria

$$\sum\nolimits_{i=1}^{n} G_i,$$

$$\upsilon_i = \frac{G_i}{\sum\nolimits_{i=1}^{n} G_i},\qquad(1)$$

$$G_i = \sqrt[n]{s_{i1} \cdot s_{i1} \cdot ... \cdot s_{ij}},\qquad(2)$$

where s_{ij} are elements of Saaty´s matrix. The weight reflects the importance of all criteria [39]. For relevant evaluation of the criteria it´s necessary to verify consistency using consistency coefficient CR (3),

$$CR = \frac{CI}{RI},\qquad(3)$$

where RI is the random index. CI is consistency index (for more about consistency, see [40]).

The final weight for the j-th variants is determined by using (4),

$$FW = \sum\nolimits_{j=1}^{n} \upsilon_{gi},\qquad(4)$$

where FW is the final weight and v_{gi} is the general weight of the j-th variant.

The data for the analysis were obtained from a questionnaire survey. It should be noted that for a survey questionnaire it is essential to determine the correct sample size. According to L.W. Neumann [41], it is difficult to obtain data from all the subjects. The sample is determined by (5),

$$n = \frac{z^2.N.r.(1-r)}{\left(d^2.N\right)+\left[z^2.r.(1-rú\right]},\qquad(5)$$

where N is the size of the basic set, z is the reliability coefficient, d is the permitted margin of tolerance and r is the expected margin of tolerance.

The degree of certainty is determined according to P. Newbold et al. [42] at 95%, the coefficient value of reliability for this degree of certainty is 1.96, according to statistical tables. The expected margin of tolerance r is 2%, the permitted margin of tolerance is 5% (d = 0.05), according to the recommendations of the Chamber of Auditors of the Czech Republic[2].

The base set is analyzed for particular subgroups. Statistical credibility is ensured if Moivre-Laplace's theorem conditions (6) are met,

$$n.P(1-P) > 9,\qquad(6)$$

where P is the relative representation of the phenomenon. P. Newbold et al. [42] recommend that 0.5 should be inserted into P value. After being inserted into relation (6), n equals 36. It follows that the data from at least 36 respondents are needed within each analyzed subgroup.

Taxpayers cannot influence the tax rate, social security contribution rate or the number of deductible items. However, they can influence how many deductible items they claim (e.g. whether it is preferable to save money for pension insurance,

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[2] *International Standard on Auditing ISA 530.* Chamber of Auditors of the Czech Republic. 2018. Available at: www.kacr.cz/data/Metodika/ Auditing/Handbook%202010/17_ISA%20530.pdf

for gifts or for public benefit purposes). For this reason, the multi-criteria decision making is applied.

4. Application of the multi-criteria decision-making method

4.1. Characteristics of variants, criteria and decision-making situations

The context of tax and social security contributions payments may change very often. The taxpayer or the subject of decision-making tries to optimize their tax liability by making tax and insurance payments as low as possible. Within the decision-making analysis, the optimal variant will be chosen from a set of 25 variants, i.e. income taxation according to the legislation valid in 1993–2017. 1993 is the year of the Czech Republic's foundation, 2017 is the last analyzed year for which it is possible to quantify the criteria laid down below. For more detailed information on each variant see Table 1 below.

Table 1

Variants

Variant according to the legislation valid in the given year	Description of variants and changes
V_1 – 1993	Progressive tax rate from 15% to 47%; the tax base was the gross wage reduced by social security contributions (SSC) by an employee at 13.5%. Existence of non-taxable parts.
V_2 – 1994	Progressive tax rate from 15% to 44%; the tax base was the gross wage reduced by SSC at 13.25%. New non-taxable part for students.
V_3 – 1995	Progressive tax rate from 15% to 43%; the tax base was the gross wage reduced by SSC at 13.25%.
V_4 – 1996	Progressive tax rate from 15% to 40%; the tax base was the gross wage reduced by SSC at 12.5%.
V_5 – 1997	No significant changes compared with 1998.
V_6 – 1998	New non-taxable part for interests paid on a loan for financing housing needs.
V_7 – 1999	No significant changes compared with 1998.
V_8 – 2000	New non-taxable part for contributions paid by the employer for life insurance.
V_9 – 2001	Progressive tax rate from 15% to 32%. New non-taxable part for contributions paid by the employer for the supplementary pension.
V_{10} – 2002	No significant changes compared with 2001.
V_{11} – 2003	No significant changes compared with 2002.
V_{12} – 2004	No significant changes compared with 2003.
V_{13} – 2005	The non-taxable part for a dependent child was replaced by a tax credit, which can have a character of a tax bonus.
V_{14} – 2006	Progressive tax rate from 15% to 32%. Other non-taxable parts (for taxpayers, students) were replaced by tax reliefs.
V_{15} – 2007	New non-taxable part for results verifying further education.
V_{16} – 2008	The nominal tax rate at 15%; the tax base is the so-called super-gross wage, which is a gross wage increased by SSC paid by the employer.
V_{17} – 2009	No significant changes compared with 2008.
V_{18} – 2010	Tax credit for children was increased.
V_{19} – 2011	No significant changes compared with 2010.
V_{20} – 2012	SSC paid by employees was reduced by 1.5%. Tax credit for children increased.
V_{21} – 2013	The second tax rate – solidarity rate of 7% – was added.
V_{22} – 2014	Tax relief for the taxpayer was temporarily reduced by 1 200 CZK.
V_{23} – 2015	Tax credit which was newly graduated according to the number of children in the household; tax reliefs were at the same level as in 2013.
V_{24} – 2016	Tax credit for children was increased.
V_{25} – 2017	Tax credit for children was increased.

Several criteria with different weights are taken into account to select the optimal variant. The taxpayer wants the effective tax rate (ETR) and the social security contributions rate to be as low as possible and the amount of deductions as high as possible. For criteria K_4 and K_5, it is not possible to clearly determine the type of criterion that derives from the amount of incomes and from the fact of whether or not the taxpayer is entitled to a tax advantage.

The resulting optimal variant is influenced by the following criteria:

K_1 – ETR;

K_2 – social security contribution rate – employee;

K_3 – the number and amount of deductions in the form of the non-taxable part or tax reliefs;

K_4 – the existence of the progressive tax rate;

K_5 – a form of deduction for the taxpayer and children (tax reliefs and credit vs. the non-taxable part).

The AHP method is applied in several decision-making situations that differ in terms of the taxpayer's income and the extent of the deductions applied,

S_1 – a taxpayer with an income equal to the average yearly wage with a deduction for the taxpayer;

S_2 – a taxpayer with an income below the average yearly wage (0.5 times) with a deduction for the taxpayer;

S_3 – a taxpayer with an income above the average yearly wage (2.0 times) with a deduction for the taxpayer;

S_4 – a taxpayer with an income equal to the average yearly wage with a deduction for the taxpayer and 2 children;

S_5 – a taxpayer with an income of 0.5 average yearly wage with a deduction for the taxpayer and 2 children;

S_6 – a taxpayer with an income of 2.0 average yearly wage with a deduction for the taxpayer and 2 children.

Since the number of taxpayers whose income corresponds to the multiple of the average wage would be small and statistically unreliable, we are going to consider taxpayers whose average income is 0.85–1.15 times the average wage as taxpayers with an average income; simi-larly, taxpayers whose income is 0.35–0.65 times the average wage, as taxpayers with below-average income; and those with the income 1.70–2.30 times the average age, as taxpayers with above-average income. Taxpayers with the income that falls between the analyzed intervals are not included in the analysis. The intervals were chosen to cover the most typical wage levels at a given company according to the available internal information about wages.

4.2. Input data for analysis and sample size determination

The input data for quantification of criteria weights were obtained from the questionnaire survey carried out among the employees of a manufacturing company in Zlín Region of the Czech Republic. According to the classification of Czech-Invest agency or Commission Regulation EC 800/2008[3] [44], this company falls within the category of large enterprises. The subject of the decision-making process is the taxpayer, that is, an employee of this company.

The data in Table 2 below indicate the number of payers N meeting the criterion in terms of their gross wage and the number of deductions applied for decision-making situations S_1, S_2, S_3, S_4, S_5 and S_6. Column n shows how many respondents are needed to determine the weighing criteria. The total N set size is 454 respondents. M. Katriak and S. Milly [43] point out that with the base population of up to 1,000 units, the size of the sample should be 40% of the base population, which is, in this case, 182 respondents. In the decision-making analysis, the decision is not made for the whole group of respondents, but for the respondents in selected S_n decision situations. The size of the selective sample is determined by (5); at the same time the relation (6) indicates that the number of respondents in each subgroup should be 36 (excluding decision-making situations

S_3 and S_6, where the size of the base population N does not reach the stated number of 36). Therefore, the total sample should consist of 189 respondents.

Table 2

Sample size

Situation	N	n	n´	Situation	N	n	n´
S_1	52	20	36	S_4	84	23	36
S_2	116	24	36	S_5	157	26	36
S_3	26	14	26	S_6	19	12	19

Source: the author's own calculations

The questionnaire was carried out by the author of this paper in 2018 in the Czech Republic in Zlin region, at an industrial company. This region was chosen because it ranks 8th among the 14 regions of the Czech Republic in terms of its share in gross domestic product. The limitation on the study is that the questionnaire survey was conducted only within one region. However, the region's economic performance corresponds to the average level, which makes it representative of the whole of the Czech Republic[4].

The questionnaire consisted of closed questions, which required the respondents to compare the significance of criteria given in pairs by using a scale from 1 to 9. There were five criteria, which means that the respondents had to make 10 comparisons. The questionnaire survey involved 189 employees of the manufacturing company. The utility (resulting weight) of the selected variant, taking into account the weight of the criterion, was determined with regard to the applicable legislation

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[4] *Description of Zlin Region*. BusinessInfo. 2018. Available at: www.businessinfo.cz/cs/clanky/charakteristika-zlinskeho-kraje-2261.html

governing the tax burden in the relevant year (the input data are given in Table 4).

4.3. Weight of criteria

Criteria weights are determined by applying Saaty's method by using relation (1). In total, 6 decision-making situations are analyzed, and in each case the weight of the i-th criteria is different. As it is apparent from the results shown in Table 3, the most important criterion is K_1 – the ETR. K_2 criterion, which expresses the amount of social security contributions, is the second most significant in most cases (except for situation S_4). The taxpayer does not have to pay any tax, but instead he/she receives the money from the state in the form of a tax credit. On the other hand, K_3 criterion – the number and amount of deductions – is the least significant. In all cases, consistency was verified with the help of *CR* index (3), which takes the value less than 0.1.

4.4. Decision analysis according to the AHP method

For criterion K_2, there is no need to calculate the effective rate as the nominal social security contributions rate corresponds to the actual levy burden. As for criterion K_3, we can observe that the number of deductions (whether tax-free income allowances [in Table 4 identified as *A*] or tax reliefs or tax credit [in Table 4 identified as *C*]) is increasing. Between 1993 and 2006, incomes were taxed by applying the progressive rate (in Table 3 identified as *P*). Since 2008, the nominal tax rate has been linear (in Table 4 identified as *L*), which is expressed by criterion K_4. Criterion K_5 evaluates the type of de-

Table 3

Weight of criteria and consistency test

Situation	v_i					CR				
	K_1	K_2	K_3	K_4	K_5	K_1	K_2	K_3	K_4	K_5
S_1	38.27	34.95	12.11	3.65	11.02	0.069	0.084	0.078	0.057	0.009
S_2	47.09	24.42	8.83	11.00	9.16	0.026	0.003	0.058	0.055	0.076
S_3	42.00	24.12	8.23	13.86	11.78	0.087	0.049	0.054	0.058	0.076
S_4	34.4.	18.66	7.31	11.35	28.28	0.017	0.016	0.020	0.026	0.026
S_5	40.15	23.06	11.53	10.04	15.22	0.012	0.089	0.096	0.053	0.056
S_6	42.57	28.08	10.64	8.07	10.64	0.017	0.081	0.039	0.085	0.039

Source: the author's own calculations

duction available to the taxpayer – either as a non-taxable part or as a tax relief. Criteria K_1 and K_2 are the minimization criteria (it is desirable to have the lowest ETR and the lowest rate of social security contributions), K_3 is the maximization criterion (the taxpayer prefers as many options as possible to optimize tax liability). As for criteria K_4 and K_5, it is irrelevant for a taxpayer with an income corresponding to the average wage level whether they

have a tax relief or a tax-free threshold or whether the tax rate is progressive or linear [16]. For that reason, the same local weight is assigned to these criteria.

The year when the earned income was optimal is determined by the AHP method. In addition to weighting of the i-th criteria, the data in Table 5 are necessary to quantify the general weight. The optimal variant is the one whose final weight (FW) determined by (4) is the highest.

Table 4

Input data for situation S_1-S_6 (taxpayer with an average wage)

Situation	Criterion									
	K_1						K_2	K_3	K_4	K_5
	S_1	S_2	S_3	S_4	S_5	S_6	$S_1, S_2, S_3, S_4, S_5, S_6$			
V_1 (1993)	8.64	4.32	12.29	4.83	0	9.75	13.5	7	*P*	*A*
V_2 (1994)	9.16	5.28	13.12	5.30	0	10.42	13.25	8	*P*	A
V_3 (1995)	9.51	5.78	14.16	5.78	0	11.15	13.25	8	*P*	*A*
V_4 (1996)	9.76	6.39	14.24	6.40	0	11.44	12.5	8	*P*	*A*
V_5 (1997)	9.81	6.46	14.23	6.46	0	11.46	12.5	8	*P*	*A*
V_6 (1998)	9.74	6.33	14.19	5.91	0	11.08	12.5	9	*P*	*A*
V_7 (1999)	9.71	6.29	14.05	5.49	0	10.75	12.5	9	*P*	*A*
V_8 (2000)	9.82	6.51	14.29	5.73	0	10.96	12.5	10	*P*	*A*
V_9 (2001)	9.92	6.5	14.37	5.72	0	10.98	12.5	11	*P*	*A*
V_{10} (2002)	10.48	6.99	14.92	6.27	0	11.77	12.5	11	*P*	*A*
V_{11} (2003)	10.86	7.33	15.30	6.65	0	12.32	12.5	11	*P*	*A*
V_{12} (2004)	11.26	7.67	15.70	6.74	0	12.65	12.5	12	*P*	*A*
V_{13} (2005)	11.56	7.93	16.24	6.11	–2.97	13.52	12.5	12	P	A
V_{14} (2006)	9.94	4.36	16.92	4.82	–5.87	14.36	12.5	12	*P*	*C*
V_{15} (2007)	10.42	4.77	17.66	5.65	–4.77	15.27	12.5	13	*P*	*C*
V_{16} (2008)	11.08	1.91	15.67	3.20	-13.84	11.73	12.5	13	*L*	*C*
V_{17} (2009)	11.23	2.36	15.67	3.60	–12.89	11.85	12.5	13	*L*	*C*
V_{18} (2010)	11.42	2.74	15.76	3.32	–13.46	11.71	12.5	13	*L*	*C*
V_{19} (2011)	12.04	3.99	16.07	4.13	–11.83	12.12	12.5	13	*L*	*C*
V_{20} (2012)	11.84	3.58	15.97	2.93	–14.24	11.51	11.0	13	*L*	*C*
V_{21} (2013)	11.83	3.56	15.97	2.90	–14.29	11.50	11.0	13	*L*	*C*
V_{22} (2014)	12.06	4.03	16.08	3.39	–13.31	11.75	11.0	13	*L*	*C*
V_{23} (2015)	12.42	4.73	16.26	3.38	–13.33	11.74	11.0	13	*L*	*C*
V_{24} (2016)	12.64	5.19	16.37	3.52	–13.07	11.81	11.0	13	*L*	*C*
V_{25} (2017)	13.08	6.06	16.59	3.81	–12.48	11.95	11.0	14	*L*	*S*

Source: the author's own calculations

Table 5

Rank of decision-making situation S_1

V_n	V_1 (1993)	V_{22} (2014)	V_{23} (2015)	V_{25} (2017)	V_{24} (2016)	V_{21} (2013)	V_{20} (2012)	V_2 (1994)	V_7 (1999)
FW	0.0573	0.0570	0.0561	0.0560	0.0557	0.0527	0.0527	0.0465	0.0398
V_n	V_6 (1998)	V_3 (1995)	V_{14} (2006)	V_4 (1996)	V_8 (2000)	V_5 (1997)	V_9 (2001)	V_{15} (2007)	V_{10} (2002)
FW	0.0393	0.0390	0.0388	0.0387	0.0383	0.0375	0.0375	0.0356	0.0301
V_n	V_{16} (2008)	V_{17} (2009)	V_{18} (2010)	V_{19} (2011)	V_{11} (2003)	V_{12} (2004)	V_{13} (2005)		
FW	0.0300	0.0291	0.0280	0.0279	0.0268	0.0257	0.0241		

Source: the author's own calculations

These results show that the largest weight results from *decision-making situation* S_1 for variant V_1, i.e. 1993 (Table 5). In this year, although a taxpayer with an average wage could apply for a smaller number of deductions, the ETR reached 8.5%. This variant appears to be the best despite the highest rate of social security contributions. 2014 is the second best year. Similarly, the years when the rate of social security contributions were the lowest (2012–2017) are at the forefront. What further increases the general weights of these variants is the high number of deductions which the taxpayer can use to optimize their tax liability when the conditions are met.

The variants with the lowest weights correspond to the period of 2003–2005. The reason is the relatively high ETR as well as the high rate of social security contributions. Thus, a taxpayer with an average-level income who applied for the basic deduction had the most optimal situation in 1993 while the worst conditions were observed in 2005.

Decision-making situation S_2 means that the taxpayer's income is 0.5 times the average wage. The taxpayer prefers the progressive tax rate, because to have a tax relief is more advantageous than the non-taxable part (criterion K_5), which is also shown by the ETR since 2006, when, compared to previous years, it reduced significantly.

Table 6 illustrates that the taxpayer had their tax burden set in legislation in the most advantageous way in 2008. We can also observe that in the first half there are the years when the taxpayer's deduction took the form of a tax relief. At the opposite end of the sequence, similar to decision-making situation S_1, there is a variant based on the conditions of 2005. For a low-income taxpayer, the progressive tax rate is advantageous. On the other hand, the deduction takes the form of the non-taxable part, which reduces the ETR less than when the deduction is in the form of a tax relief. In addition, in 2005 the ETR is the highest for the entire time series.

If a taxpayer's income is 2.0 times the average wage (**decision-making situation S_3**), the linear tax rate is more preferable, as they enter the higher tax rate bracket due to the level of their income. Therefore, the taxpayer saves more in tax if the deduction is in the form of the non-taxable part. The lowest ETR is in 1993, which ranks this variant as the first due to the highest weight of this criterion, as shown in Table 7. 2006 corresponds to the variant with the lowest weight.

The remaining decision-making situations assume that, in addition to the basic deduction for the taxpayer, the taxpayer applies a deduction for two dependent children, which results in a lower ETR compared to situations S_1, S_2 and S_3. Tax

Table 6
Rank of decision-making situation S_2

V_n	V_{16} (2008)	V_{17} (2009)	V_{21} (2013)	V_{20} (2012)	V_{22} (2014)	V_{18} (2010)	V_{23} (2015)	V_{24} (2016)	V_{25} (2017)
FW	0.0818	0.0726	0.0699	0.0695	0.0663	0.0653	0.0579	0.0539	0.0492
V_n	V_{19} (2011)	V_{14} (2006)	V_{15} (2007)	V_1 (1993)	V_2 (1994)	V_9 (2001)	V_7 (1999)	V_6 (1998)	V_8 (2000)
FW	0.0465	0.0377	0.0355	0.0335	0.0248	0.0227	0.0225	0.0223	0.0220
V_n	V_4 (1996)	V_3 (1995)	V_5 (1997)	V_{10} (2002)	V_{12} (2004)	V_{11} (2003)	V_{13} (2005)		
FW	0.0218	0.0216	0.0215	0.0211	0.0209	0.0203	0.0189		

Source: the author's own calculations

Table 7
Rank of decision-making situation S_3

V_n	V_1 (1993)	V_2 (1994)	V_{22} (2014)	V_{23} (2015)	V_{24} (2016)	V_{25} (2017)	V_{20} (2012)	V_{21} (2013)	V_7 (1999)
FW	0.0743	0.0583	0.0501	0.0492	0.0487	0.0486	0.0473	0.0473	0.0439
V_n	V_6 (1998)	V_4 (1996)	V_5 (1997)	V_8 (2000)	V_9 (2001)	V_3 (1995)	V_{10} (2002)	V_{16} (2008)	V_{17} (2009)
FW	0.0422	0.0418	0.0413	0.0410	0.0403	0.0397	0.0334	0.0310	0.0310
V_n	V_{18} (2010)	V_{19} (2011)	V_{11} (2003)	V_{12} (2004)	V_{13} (2005)	V_{15} (2007)	V_{14} (2006)		
FW	0.0303	0.0300	0.0299	0.0279	0.0253	0.0240	0.0231		

Source: the author's own calculations

reliefs are more preferable in comparison with the non-taxable part.

A taxpayer with an average income (**decision-making situation S_4**) had the most favourable situation in 2013. In the first half of the sequence there are the years following the significant public finance reform in 2008, which significantly reduced the tax burden for a number of population groups. The period up to 2008, on the contrary, shows lower weights (see Table 8).

A similar order as in **situation S_4** is characteristic of situation S_5 (see Table 9): a more preferable situation for a taxpayer with an income below average would be to have a tax credit and tax reliefs together with the progressive tax rate. For the analyzed period, a taxpayer with a deduction for 2 children has a zero-tax liability and the introduction of the tax credit makes him or her also entitled to a tax bonus.

While for a taxpayer with above-average income, 2013 was the best from the perspective of preferences, for a low-income taxpayer with 2 children, 1993 had the lowest resulting effect. The low effect is shown by the variants until the introduction of the child tax credit, i.e. up to 2005. The reason is that the number of deductions that could optimize tax liability throughout the analyzed period of 1993–2017 increased, no deductions were cancelled and a few new ones were added, which resulted in a situation that was favourable for taxpayers.

In **decision-making situation S_6**, a taxpayer with an income of 2.0 times the average wage is entitled to a deduction for 2 children. As Table 10 shows, in the years when the deduction for children took the form of a tax credit, this effect was stronger. At the same time, the rate of social security contributions was lower in these years.

On the other hand, the smallest resulting weights are in 2002, 2003 and 2004. This is partly due to the fact that in these years there were fewer deductions and there was no tax credit or progressive tax rate, which was against the interests of taxpayers with an above-average income.

Table 8

Rank of decision-making situation S_4

V_n	V_{21} (2013)	V_{20} (2012)	V_{23} (2015)	V_{22} (2014)	V_{24} (2016)	V_{25} (2017)	V_{16} (2008)	V_{18} (2010)	V_{17} (2009)
FW	0.0854	0.0847	0.0771	0.0770	0.0743	0.0708	0.0642	0.0615	0.0553
V_n	V_{19} (2011)	V_{14} (2006)	V_{15} (2007)	V_{13} (2005)	V_1 (1993)	V_7 (1999)	V_9 (2001)	V_8 (2000)	V_6 (1998)
FW	0.0502	0.0412	0.0385	0.0299	0.0183	0.0173	0.0170	0.0164	0.0161
V_n	V_2 (1994)	V_{12} (2004)	V_{10} (2002)	V_{11} (2003)	V_5 (1997)	V_4 (1996)	V_3 (1995)		
FW	0.0159	0.0158	0.0156	0.0149	0.0146	0.0142	0.0139		

Source: the author's own calculations

Table 9

Rank of decision-making situation S_5

V_n	V_{21} (2013)	V_{20} (2012)	V_{23} (2015)	V_{22} (2014)	V_{24} (2016)	V_{25} (2017)	V_{16} (2008)	V_{18} (2010)	V_{17} (2009)
FW	0.0822	0.0818	0.0782	0.0767	0.0767	0.0745	0.0611	0.0582	0.0542
V_n	V_{19} (2011)	V_{15} (2007)	V_{14} (2006)	V_{13} (2005)	V_{12} (2004)	V_9 (2001)	V_{10} (2002)	V_{11} (2003)	V_8 (2000)
FW	0.0501	0.0329	0.0315	0.0249	0.0215	0.0199	0.0199	0.0199	0.0190
V_n	V_6 (1998)	V_7 (1999)	V_4 (1996)	V_5 (1997)	V_2 (1994)	V_3 (1995)	V_1 (1993)		
FW	0.0184	0.0184	0.0180	0.0180	0.0149	0.0149	0.0143		

Source: the author's own calculations

Table 10

Rank of decision-making situation S_6

V_n	V_{23} (2015)	V_{22} (2014)	V_{21} (2013)	V_{24} (2016)	V_{20} (2012)	V_{25} (2017)	V_1 (1993)	V_2 (1994)	V_{18} (2010)
FW	0.0650	0.0649	0.0642	0.0642	0.0641	0.0636	0.0549	0.0414	0.0400
V_n	V_{16} (2008)	V_7 (1999)	V_{17} (2009)	V_{19} (2011)	V_9 (2001)	V_8 (2000)	V_6 (1998)	V_{15} (2007)	V_5 (1997)
FW	0.0398	0.0388	0.0384	0.0379	0.0343	0.0338	0.0328	0.0284	0.0274
V_n	V_3 (1995)	V_{14} (2006)	V_4 (1996)	V_{13} (2005)	V_{10} (2002)	V_{11} (2003)	V_{12} (2004)		
FW	0.0272	0.0264	0.0261	0.0259	0.0233	0.0186	0.0185		

Source: the author's own calculations

5. Conclusion

The selection of the year when the tax burden was optimal from the taxpayer's point of view was influenced by a number of criteria. The weights of the criteria were determined on the basis of the results of the questionnaire survey carried out in a large manufacturing enterprise among 189 respondents. The sample size was chosen in such a way as to make it statistically credible. Regardless of further specification of the decision-making situation, the ETR indicator is the most important for all groups of taxpayers. The hypothesis that the most important criterion is the tax rate, which shows the real tax burden for the taxpayer, was confirmed.

Out of 25 possible variants, i.e. out of 25 possible years, 1993 is considered to be the most advantageous for a taxpayer with an average earned income. A similar effect is also characteristic of the period of 2012–2017. On the other hand, the least favourable situation was in 2005. The same conclusion of the worst-case scenario is for the taxpayer with an income below average. On the other hand, the year which was the most favourable for the taxpayer with such income in terms of tax and social contributions was 2008, when one of the most significant reforms of public finance took place in the Czech Republic. For a taxpayer with an above-average income, the optimal variant was in 1993, which may seem paradoxical since in this year social security contributions were at the highest level. Moreover, taxpayers with an above-average income had the lowest resulting effect in 2005. The initial hypothesis was based on the assumption that the taxpayer with an above-average income had a higher tax liability during the period when the nominal tax was progressive, but it was not confirmed under the condition that the taxpayer would apply only the tax deduction for themselves.

As for those decision-making situations where the taxpayer was entitled to deductions for 2 children, the best years were 2013 and 2012, regardless of the level of income. The reason is the lowest insurance rate and the existence of the tax credit that reduces the ETR. A taxpayer with an average income has the lowest effect after considering the weights of all the criteria and utility resulting from the implementation of the *j*-th variants in 1995. A taxpayer with an income below average, this is the second worst variant. 1993 has the lowest effect for a taxpayer with a below-average income. On the contrary, for a taxpayer with an average income without deductions for children, this year was optimal. These findings confirm the hypothesis that during the period when the nominal tax was linear and the taxpayer applied tax relief for children, the situation had more utility than during the period when the nominal tax was progressive.

The situation in the sphere of personal income taxation is subject to yearly changes. For the taxpayer, the amount of gross wage is not a decisive factor, but the tax burden on their earned income is. Changes in legislation do not always have a uniform impact on all the taxpayers. It all depends on the amount of the taxpayer's income and the number of deductions the taxpayer can use to optimize their tax liability. The input data for our analysis of the ETR confirm the hypothesis that the most significant change occurred between 2007 and 2008. Therefore, when assessing the impact of the tax reforms, this impact can´t be expressed generally, but it is necessary to assess the specific income ratios of this or that taxpayer or household. Changes, for example, changing tax rates or deductions can be beneficial for some taxpayers and lead to a decrease in their tax burden. On the other hand, the same kind of changes may cause an increase in the tax burden on other taxpayers, who are different in terms of their income ratio. Thus, the question of whether the situation in the first or in the last analyzed year is more advantageous for the taxpayer cannot be answered unequivocally and the answer depends on the amount of income and deductions applied by the taxpayer. In the case of situation S_3, where the taxpayer has an average income and applies only the deduction for the taxpayer, 1993 shows the highest weight. On the other hand, in the case of situation S_5, where the taxpayer's income is below average

and the taxpayer applies a deduction for 2 children, this year has the lowest weight.

The decision analysis has led us to the conclusion that not only the nominal or effective tax rate is decisive in the choice of the optimal method of income taxation. It is also important to assess the significance of other criteria and comprehensively evaluate the legislation, the amount of income or social factors that may significantly affect one's tax liability.

There are, however, several limitations of this research and findings. The data used in this study were obtained with the help of a questionnaire survey conducted in the region of the Czech Republic that is average in terms of the wage level in comparison with other regions [43]. Making similar research in a region

with above-average or below-average wages may lead to other results, that is, other criteria can be considered more significant.

Personal income tax is constantly changing, which makes it an interesting subject for further research. If the supergross wage and the change in the tax rate were abolished from 2021 onwards, this change will affect the weight of the criteria as well as the value of the indicators of specific options, taking into account the weight of the i-th criterion. Another avenue for future research may be to carry out a similar study in another country – in a country where the rate is linear as in the Czech Republic or progressive as in many European countries. These results could be used for comparative analysis.

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