

### The Impact of Tax Reforms on the Behaviour of Economic Agents (Indirect Taxation in Russia and the USA)

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#### ABSTRACT

The “turnpike hypothesis” proposed in this article suggests that the trajectory of GDP growth rates is a “turnpike”, which attracts tax revenues of any type. A significant deviation of the rates of tax revenue growth from the turnpike means that this tax has grown unresponsive to the dynamics of the global tax base – GDP. To test this hypothesis, the authors introduce the indicators of surplus return and volatility of tax revenues, which leads them to narrowing the definitions of such terms as budget orientation and efficiency of taxes. To analyze the behaviour of economic agents, the authors construct econometric dependencies of three indirect taxes (VAT, customs duties and excise taxes) on the tax rate (tax burden), GDP and the population income. For the VAT, the tax burden was its nominal rate; for excise taxes, the share of excise taxes in the retail turnover; for customs duties, the share of customs duties in the foreign trade turnover. The resulting models were used to calculate the elasticity of tax revenues, GDP and population incomes with respect to the tax burden, which is equivalent to the analytical expression of the way the three participants of the economic system – state (public budget), producers (business) and consumers (population) – react to the tax burden. To analyze the analytical coefficients and econometric models, the authors used the statistical data of Rosstat for Russia and of the OECD for the USA for the period between 1995 and 2017. The calculations show that the Russian and American tax systems contain taxes that are “insensitive” to economic growth. In Russia, these include the natural resource extraction tax, customs duties and contributions to extra-budgetary funds, and in the USA, excise taxes, property tax and customs duties. The study shows that the Russian economic crises in 2008 and 2014 had a remedial effect on the country’s tax system and helped it get closer to the turnpike of economic growth. The model calculations of the three kinds of elasticity showed that an increase in the VAT tax rate reduced the activity of the three participants of the economic system while an increase in the excise or customs duty burden, on the contrary, enhanced their activity. The conclusion is made that the turnpike hypothesis is confirmed for the majority of taxes both in Russia and the USA. It is also shown that those taxes for which the hypothesis is confirmed only partially are in urgent need of reformation.

#### KEYWORDS

tax reform, state budget revenues, economic growth, turnpike principle, economic behaviour

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## Влияние налоговых реформ на поведение экономических субъектов (на примере косвенных налогов России и США)

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### АННОТАЦИЯ

В статье проверяется гипотеза названная авторами «магистральной». Согласно данной «магистральной гипотезе» траектория темпов роста ВВП является своеобразной «магистралью» и обладает притягивающим свойством для любых видов налоговых доходов. Существенное отклонение темпов роста налоговых доходов от магистралей свидетельствует об отрыве налога от глобальной налоговой базы – ВВП. Для проверки гипотезы введены показатели избыточного дохода и волатильности налоговых доходов. Опираясь на введенные показатели и магистральную гипотезу, авторы дают строгое определение бюджет-ориентированности и эффективности налогов. Для исследования поведения экономических субъектов построены эконометрические зависимости трех косвенных налогов (налог на добавленную стоимость, таможенные сборы и акцизы) от налоговой ставки (налогового бремени), ВВП и доходов населения. Для налога на добавленную стоимость в качестве налогового бремени использовалась его номинальная ставка, для акцизов – доля акцизных сборов в объеме розничной торговли, для таможенных платежей – доля таможенных сборов во внешнеторговом обороте. Построенные модели позволили рассчитать эластичности налоговых доходов, ВВП и доходов населения по налоговому бремени, что эквивалентно аналитическому выражению реакции на налоговое бремя трех участников экономической системы: государства (бюджета), производителя (бизнеса) и потребителя (населения). Для оценки аналитических коэффициентов и эконометрических моделей использовались статистические данные Росстата для России и ОЭСР для США за период 1995–2017 гг. Расчеты показали, что и в России, и в США имеются налоги, крайне слабо реагирующие на экономический рост. Для России это налог на природные ресурсы, таможенные сборы и отчисления во внебюджетные фонды, а для США – акцизы, налог на собственность и таможенные сборы. Показано, что кризисные явления в российской экономике 2008 и 2014 гг. способствовали оздоровлению налоговой системы страны и ее приближению к магистральной экономической траектории. Модельные расчеты трех видов эластичности показали, что рост ставки налога на добавленную стоимость снижал активность всех трех участников экономической системы, тогда как рост акцизного и таможенного бремени оказывал на них, наоборот, стимулирующее действие. Сделан вывод, что магистральная гипотеза выполняется для большинства налогов, как в России, так и в США. Обоснован тезис, согласно которому налоги, для которых магистральная гипотеза выполняется в крайне слабой форме, нуждаются в первоочередном реформировании.

### КЛЮЧЕВЫЕ СЛОВА

налоговая реформа, государственные доходы, экономический рост, магистральный принцип, экономическое поведение

## 1. Introduction

Although fiscal systems in almost all countries of the world are relatively stable institutions, at times the need arises to re-think and reform these systems. Such reforms can be more or less large scale but they always have a visible impact on all the participants of the economic system. Therefore, it is necessary to know the focus and intensity of their impact, which makes it crucial to be able to evaluate how the tax burden (tax rates) weighs on the tax base. In many cases this impact is hard to predict even on the qualitative level. For example, depending on the specific situation, an increase in a certain tax rate can be detrimental to economic activity or, on the contrary, enhance it.

In this article we are going to consider an alternative way of evaluating the impact of tax reforms on the economic activity of agents. In doing so, we are trying to address two interconnected tasks – to evaluate the correlation between the national tax system and GDP dynamics and to evaluate the impact of changing indirect tax rates on the behaviour of various economic agents – the state, business and population. Indirect taxes were chosen as the most representative ones due to their close connection with the subject of taxation. The methodology proposed in this article, however, can be applied to direct taxation without any extra adjustments. The proposed approach relies on the idea that an efficient fiscal system should be characterized by more or less synchronous changes in the rate of growth of fiscal revenues and economic growth. The temporal trajectories of the two types of indicators diverge considerably, which reveals the disparity of interests of the state, business and population and, therefore, the inefficiency of the current fiscal policy. Moreover, the divergence of trajectories can be considered as an important element of macro-economic diagnostics.

## 2. Taxes and economic activity: review of research methods

Changes in budget revenues on different levels are shaped by the fiscal. For example, G. Miles points out that the po-

tential economic growth of any country is determined by the financial resources of the government (budget revenues) and the ways of obtaining and using these resources [1]. An increase in budget revenues can affect the allocation of new state funds, enhance the growth in public spending, contribute to stabilization and intensification of economic activity and the country's economic growth in general.

There is a vast body of research literature analyzing the correlation between taxation and economic growth. Studies of the earlier period used regression models to analyze the impact that the changing tax revenues had on economic growth through public spending in different countries and periods. However, no firm conclusions were drawn about the nature and significance of this correlation. Some studies found no significant correlation between the changes in these indicators [2]; others found a negative correlation between the real GDP growth and public spending [3–5]. E. Engen and J. Skinner analyzed the panel data on 107 developing countries in 1970–1985 and found a negative correlation between the increasing tax revenues and economic growth [6]. There is also evidence showing a negative correlation between the indicators due to an increase in the share of non-production expenses and a positive correlation due to an increase in state investment in the manufacturing sector [7].

Later research, however, has demonstrated the opposite tendencies: for example, J. Andrasic et al. built statistically significant dependencies, which showed that a 1% increase in tax revenues leads to a 0.29% increase in GDP [8]. The study of the relationship between a rise in tax revenues and GDP in Nigeria in 1986–2012 demonstrated a stable positive correlation between these indicators [9]. These findings can hardly be called surprising since the size of the public sector has two opposite effects: on the one hand, higher tax rates can be detrimental to economic activity (Laffer curves), on the other hand, they can also stimulate economic activity by increasing public spending and investment.

Yet another group of studies discussed the impact of taxes on economic growth by focusing on their level or structure (direct vs. indirect). Although the majority of researchers are inclined to agree that the shift from direct taxation (income taxes) to indirect taxation (consumption taxes) enhances economic growth [10], the results acquired so far seem to be quite contradictory: for instance, there is evidence showing that an increase in direct income taxes (personal income tax, property tax, profit tax and so on) has a negative impact on economic growth [11; 12]. Y. Lee and R. Gordon analyzed 70 countries in the period of 1980–1997 and showed that a 10% reduction in the corporate tax rate leads to an increase in the per capita GDP by 0.7–1.1% [13]. Yet another study [14] demonstrated that a reduction in the personal income tax rate results in an increase in the per capita GDP by 1.4–1.8%. There is also evidence of the positive impact of indirect taxes on GDP growth [15; 16].

In [17], however, it is shown that a switch from direct to indirect taxation may have a negative influence on economic growth and exacerbate the economic downturn in EU countries. These findings are based on the results of the aggregative analysis of the EU states for the period of 2000–2014. D.Stoilova and N.Patonov also point out the *greater* economic efficiency of direct taxation for EU countries [18]. J. F. Li and Z. X. Lin analyze the impact of the indirect sales tax on the economic growth in the USA in 1960–2013 and show that, despite certain short-term benefits, in the long run this tax has a negative correlation with economic growth [19]. The negative impact of indirect taxes is also described in [8], showing that a 1% increase in the goods and services tax rate leads to a 0.6% decrease in GDP.

There is also evidence [8; 20] that the application of the direct property tax is conducive to economic growth, although other studies [21] show that this tax has a neutral effect on economic growth.

The analysis of the correlation between taxation and economic growth in Nigeria in 1986–2000 [22] and 1993–2012 [23] demonstrates that the oil tax revenues

play a dominant role in the country's economic growth. In Malaysia, the tax structure is prevailed by direct taxes, in particular income taxes, while indirect taxation is less developed [24].

Russian researchers pay much attention to the correlation between taxation and economic growth. For example, it was found that the economic growth in Russia is mostly influenced by the oil prices dynamics (the correlation coefficient is 0.7985) while the correlation between the real GDP and indirect taxes is 0.7937 [25]. The question about the positive or negative impact of indirect taxes (mostly VAT and excises) is directly connected to the problem of social justice and the social effects of taxation. While direct taxes actually reflect the paying capacity of taxpayers and perform a distribution function in society, indirect taxes are regressive in nature and, as a rule, they impose a harsher burden on poorer social groups [26]. It should be noted that this effect is to a greater extent characteristic of flat taxation while progressive taxation has a positive impact on economic growth [27]. On the other hand, an increase in specific indirect taxes, for example, excise duties on tobacco, can contribute to the improvement of public health and enhance state revenues. For instance, an increase in excise taxes in Indonesia by 57% led to a rise in state revenues by 58% and to a reduction in tobacco use by 18% [28]. In Grenada, as a result of a 17% increase in tobacco excise rates, state revenues rose by 8.7% while tobacco consumption fell by 5% [29]. In general, simulation models show that in low- and medium-income countries, a 20% increase in excise taxes on average leads to a 14% rise in state revenues and a 5% drop in tobacco use [30].

Some researchers try to evaluate the outcomes of those tax reform projects that involve substantial adjustments of tax rates. For example, a three-factor model was applied for evaluating the scenarios of the personal income tax reform in Russia, including calculations of the expected impact on budget revenues and social inequality as well as the feasibility of each scenario [31]. The analytical scheme of

this type takes into account the reactions of different economic agents (state and population) to tax stimuli.

Summarizing our literature review, we can make the following conclusions.

First, at the moment there is no agreement about the relationship between taxation and economic growth as it varies depending on the time interval and country.

Second, although researchers tend to consider the impact of tax revenues on economic growth, a considerable body of research focuses on the inverse relationship [32; 33], treating economic growth as the main factor that determines the tax revenue [34].

Third, the analysis of the tax structure shows that indirect taxation is to a greater extent characteristic of developing countries and countries in transition [35] while in EU countries the share of indirect taxes dropped from two thirds to one third in the last hundred years [36]. There is evidence that there is a close connection between the level of a country's development and its tax structure [37], which means that less developed countries are more dependent on foreign trade taxes while developed countries, on income taxes. Russia has also been experiencing the trend of the decreasing importance of indirect taxation: according to Rosstat, the share of indirect taxation was 30.1% in 2017 compared with 38.7% in 2010. This trend is mostly caused by the falling revenues from foreign trade taxes, such as customs duties, due to the sanctions and increased tensions in international relations. Contrary to popular belief in the "stability" of indirect taxes, this situation shows that indirect taxes are subject to external factors.

In view of the above, our further analysis will go in two directions: first, we are going to evaluate the stability and reliability of fiscal instruments by looking at their turnpike properties; second, we are going to analyze their impact on the Russian national economy.

### **3. Analytical toolkit for the analysis of the turnpike properties of taxes**

To study such properties of fiscal instruments as stability, reliability and ad-

equacy we can use a comparatively new concept of efficient fiscal policy described in [38–40]. This concept is underpinned by the idea that a tax system can function efficiently when reactions of taxpayers (production enterprises, businesses) and the state budget all but coincide. The difference in the reactions of the two above-mentioned economic agents is estimated by looking at the difference in the values of the Laffer points of the first and second kind. The bigger is the distance between these points, the bigger is the clash of interests of the state and business and the less efficient the fiscal system is.

This principle is applicable to the problem of stability of tax revenues. In this case, we are going to specify our methodological assumptions the following way: *the dynamics of tax revenues should correspond to the dynamics of the tax base*. Therefore, it seems reasonable that the dynamics of the tax base for the whole national economy can be approximated by the dynamics of GDP, which leads us to the following methodological assumption: *the rates of tax revenue growth should correspond to the rates of GDP growth*. In this case, fiscal indicators and GDP will be expressed in current prices, which means that the inflation effect is present in both indicators and can be ignored when comparing them.

Hereinafter we are going to refer to this methodological principle as *the turnpike principle* or the turnpike hypothesis. Such terminology is also related to the fact that the GDP trajectory serves as the turnpike of economic development *while the trajectories of all tax revenues should run parallel to this turnpike*. The deviation degree of the trajectory of tax revenues from the turnpike indirectly reflects how efficient or inefficient the tax is and how sensitive or insensitive is the fiscal system to the activity of economic entities. Although terminology used in this study is not directly connected to the turnpike theory of optimal paths in the models of John von Neumann, some analogy can still be drawn: for example, while Neumann's models consider the optimal paths that parallel the turnpike or the von Neumann

ray, in our case we consider the fiscal trajectories that run near the trajectory of economic growth.

Thus, according to the turnpike principle, all taxes should to a certain extent be connected to the economic activity of the system. The GDP growth rate is the most accurate measurement of economic activity. Even though the tax base is not directly related to GDP, the turnpike principle is still at work here. The only question in this respect is how significant the deviation from this principle should be to remain acceptable. This assumption correlates with the findings of M. Mishustin, who analyzed the factors of tax revenue growth and showed that regardless of the specific factors that affected tax revenues, the latter were still determined by the general geo-economic situation in the country [41].

Thus, the turnpike principle enables us to build a simple analytical scheme to analyze the turnpike properties of tax revenues. To this end, let us introduce four simple indicators:

$$I = \frac{1}{T} \sum_{t=1}^T (\mu_{it} - \lambda_t), \quad (1)$$

$$V = \frac{1}{T} \sum_{t=1}^T |\mu_{it} - \lambda_t|, \quad (2)$$

$$\lambda = \frac{1}{T} \sum_{t=1}^T \lambda_t, \quad (3)$$

$$RI = I / \lambda, \quad (4)$$

where  $\lambda_t$  and  $\mu_t$  are the rate of GDP growth and the  $i$ -th tax revenue in the  $t$ -th year respectively;  $T$  is the length of the retrospective dataset;  $I$  is the mean value of the absolute surplus revenue from the  $i$ -th fiscal instrument;  $RI$  is the mean value of the relative surplus revenue from the  $i$ -th fiscal instrument; and  $V$  is the volatility of the  $i$ -th tax revenue.

If  $RI > 0$ , then the trajectory of tax revenues lies above the trajectory of economic growth and there is a surplus tax revenue; if  $RI < 0$ , then the fiscal trajectory lies below the trajectory of economic growth and in this case we are dealing with the loss of revenue.

The indicator we introduced (4) allows us to classify fiscal instruments ac-

ording to two turnpike qualities – budget orientation and efficiency. A fiscal instrument is considered *budget-oriented* if it provides positive values of surplus revenue, that is,  $RI > 0$ ; otherwise, a fiscal instrument is called *liberal*. In other words, the rates of growth of a budget-oriented tax exceed those of economic growth. *Efficient fiscal instruments* are characterized by insignificant values of the surplus revenue; otherwise, we shall deem them *inefficient*. To specify this criterion, we shall assume that the value is insignificant if  $|RI| = 5\%$ . Thus, a tax is considered efficient if it is closely associated with the dynamics of economic growth.

In addition to the classification described above, we can also formulate two criteria of severe inefficiency. The first criterion is that a tax is considered *extremely inefficient* if the following condition is fulfilled:  $|RI| > 20\%$ . The second criterion is that a tax is considered extremely inefficient if the following strong or weak condition is fulfilled:  $|RI| > V$  or  $|RI| \approx V$ ; this criterion is auxiliary. These criteria are purely empirical but they can still be useful for conclusive diagnostics of the fiscal instruments and their efficiency.

It should be noted that efficiency of a fiscal instrument can be also understood as a manifestation of social justice. For example, if an increase in the tax rate significantly exceeds the growth of the tax base, it is a sign of some ill-considered governmental decision-making in the fiscal sphere, for example, when the government increases the tax burden on economic agents without taking into account the actual situation. Otherwise we are dealing with another kind of injustice, when economic agents are underpaying taxes and the state budget receives less than due.

These concepts are sufficient for our research of the turnpike properties of the current taxes. They also enable us to identify the significant setbacks of the Russian national tax system. Hereinafter we are going to refer to these analytical indicators as turnpike parameters. The properties of the tax system to be studied by applying these parameters will be referred to as turnpike properties.

#### 4. Turnpike properties of fiscal instruments: the case of Russia

To test the methodology described above, we used the annual data provided by the Rosstat for 1995–2018. To calculate the aggregate data on tax revenues and GDP, we used the current prices. The fiscal instruments we are going to consider include ten types of fiscal revenues. Direct taxes include the income tax (*IT*); personal income tax (*PIT*); property tax (*PT*); and natural resource extraction tax (*NRT*). Indirect taxes include the value-added tax or VAT; excise taxes (*ET*); customs duties<sup>1</sup> (*CD*); extrabudgetary payments or contributions to the pension fund (*PC*); health insurance fund (*HIC*); and the social security fund (*SSC*). In our calculations we took into account the functional characteristics of the fiscal instruments. The results are shown in the table below.

Table 1

##### Turnpike parameters of the Russian tax system

Fiscal instrument	Turnpike parameters	
	RI, %	V, %
<i>Direct taxes</i>		
Income tax	-0.7	17.8
Personal income tax, PIT	7.7	8.6
Property Tax, PT	6.4	17.5
Natural Resource Tax, NRT	42.4	26.4
<i>Indirect taxes</i>		
Value-added tax, VAT	-1.3	9.5
Excise taxes, ET	5.3	18.0
Customs duties, CD	33.7	35.4
<i>Extra-budgetary contributions</i>		
Pension Contribution, PC	-24.8	14.8
Health Insurance Contributions, HIC	58.6	45.2
Social Security Contributions, SSC	-56.5	12.6

Source: Calculated by the authors according to formulae (1)-(4) by using the Rosstat data.

This quantitative evaluation allows us to draw the following matrix to classify the fiscal instruments (see Table 2, the extremely inefficient fiscal instruments are shown in italics).

<sup>1</sup> In Russian statistics, customs duties and levies as well as other revenues from foreign trade constitute one group of revenues – these data are then used for further calculations.

Table 2

##### Classification of fiscal instruments in Russia

Liberality criterion	Efficiency criterion	
	Efficient	Inefficient
Budget-oriented	-	ET, PT, PIT, CD, NRT, HIC
Liberal	IT, VAT	PC, SSC

Let us now consider these results in more detail.

First, there are no fundamental functional differences between direct and indirect taxes if we apply this approach. For both types of taxes we can distinguish between “efficient/liberal” and “inefficient/budget-oriented”. Therefore, from the point of view of their turnpike properties, direct and indirect taxes are virtually equal and neither of the two types is more preferable than the other.

Second, one of the four groups of taxes shown in Table 2 and containing the most productive instruments is empty, which means that at the moment the Russian Ministry of Finance does not have truly efficient instruments for replenishing the state budget. In fact, Russian regulators constantly have to choose between the liberality and efficiency of a fiscal instrument.

Third, Russian tax regulators usually give preference to the budget orientation of taxes rather than their efficiency, which means that they use 20% of the available efficient instruments, and 60%, of the budget-oriented instruments.

Fourth, the Russian taxation system is characterized by an obvious anomaly consisting in two inefficient and liberal payments to extra-budgetary funds. The fact that this structural element accounts for 20% of the given fiscal instruments is alarming.

Fifth, the Russian tax system has already accumulated an extremely large number of inefficient instruments. For example, the share of inefficient instruments in the set we analyzed is 50%, which is a significant figure. All five instruments of this group – the CD, NRT, HIC, PC and the SSC – prove to be extremely unproductive according to both criteria. Furthermore, they are characterized by extremely high

values of the indicator  $|RI|$ , which means that there is a high level of distortions in the adjustment of the fiscal system to meet the country's actual economic needs. In fact, Russia has several fiscal instruments that are unrelated to the economic activity of the system: CD, NRT and extra-budgetary funds.

Extra-budgetary funds are particularly important in this respect since they reveal the specific characteristics of the Russian tax regulation system oriented towards the "non-economic" ways of replenishing the state budget – through and customs duties. In other words, extra-budgetary funds are no longer connected to the dynamics of economic growth.

In order to understand the drawbacks of the Russian tax system, we need to look at the trajectories of the three groups of fiscal instruments and put them in the context of the country's economic growth (in current prices). Let us look at the following figures.

These diagrams point to the fact that, despite significant deviations of the Russian tax system from the turnpike – GDP – there tend to be less deviations from the turnpike properties. For example, there were two distinct stages in the development of the tax system – before and after the 2008 crisis, both for direct (Figure 1) and indirect (Figure 2) taxes. Before 2008 there were considerable discrepancies between

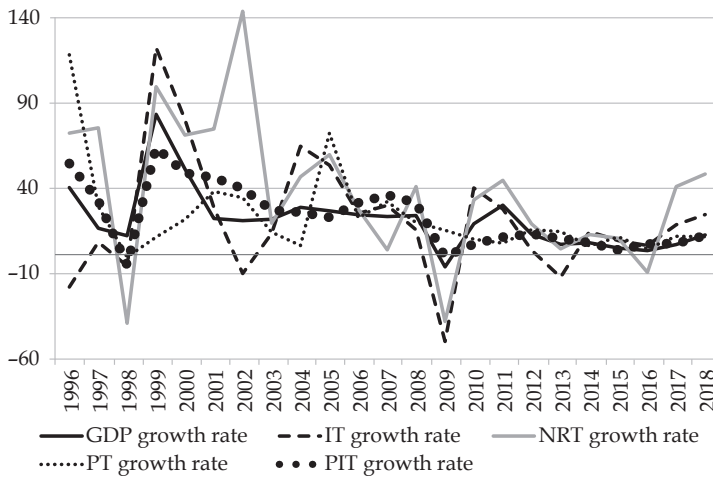


Figure 1. Trajectories of the rates of growth of direct tax revenues in Russia

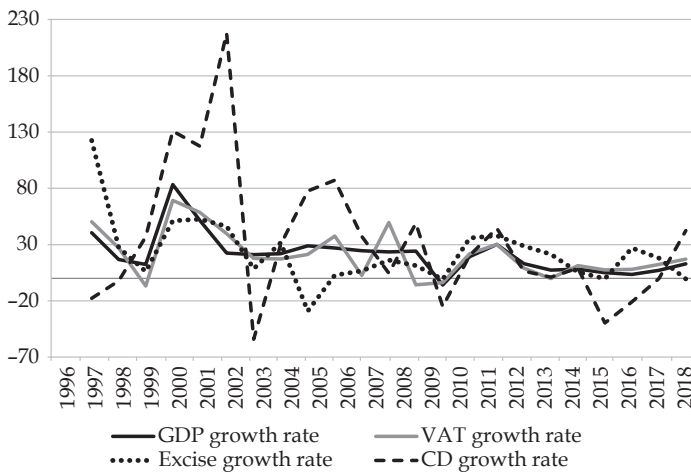


Figure 2. Trajectories of the rates of growth of indirect tax revenues in Russia



GDP growth and tax revenues, while after 2008 they tended to synchronize. A similar trend was observed in relation to extra-budgetary funds, although after 2008 the health insurance funds continued to undergo some serious transformations (Figure 3). The tax reforms of 2005–2006 and 2011–2012 disrupted the process of stabilization of extra-budgetary revenues. In general, crises in Russian economy seem to have invigorated the country’s fiscal system by improving its turnpike properties.

**5. Turnpike properties of fiscal instruments: the case of the USA**

In order to gain a better understanding of the turnpike properties of tax systems, let us compare the tax systems of Russia and the USA. First, we are going to calculate the turnpike parameters of the seven taxes applied in the USA for the period from 1995 to 2017. The set of fiscal instruments applied in the USA does not fully coincide with its Russian counterpart but some analogies can still be drawn. We are going to consider the following instruments: the individual income tax (IIT); property tax (PT); corporate profits tax (TPC); sales tax (ST); excise taxes (ET); customs import duties (CID); and social security contributions (SSC).

In our calculations we used the statistical data provided by the OECD (see Table 3).

Table 3

**Turnpike parameters of the US tax system**

Fiscal instrument	Turnpike parameters	
	RI, %	V, %
<i>Direct taxes</i>		
Corporate profits tax, TPC	4.8	14.0
Individual income tax, IIT	11.6	6.0
Property tax, PT	31.2	3.7
<i>Indirect taxes</i>		
Sales tax, ST	-9.3	1.2
Excise taxes, ET	-74,5	2.7
Customs import duties, CID	-28,6	5.1
<i>Extra-budgetary contributions</i>		
Social security contributions, SSC	-6.5	1.8

Source: Calculated by the authors according to formulae (1)–(4) by using the OECD data.

The results of our calculations lead us to the following conclusions.

First, the turnpike properties of the Russian tax system are generally weaker than those of the USA. For example, the absolute mean value of indicator RI of the tax portfolio in Table 1 is 23.7% while in the USA the similar indicator for the tax portfolio in Table 2 is 25.2%, that is, there is a certain parity in the ways both tax systems are adjusted to react to the dynamics of economic growth. The average volatility (V), however, is 20.6% for Russia and 4.9% for the USA, which means that the fluctuations of tax revenues about the

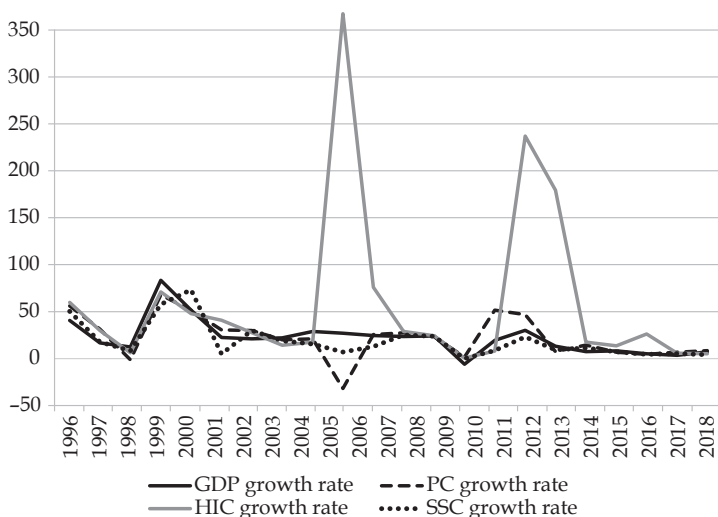


Figure 3. Trajectories of the rates of growth of extra-budgetary expenses in Russia

turnpike in Russia is more than five times higher than in the USA.

Second, there is a consistent pattern in the way the turnpike parameters are formed in the USA, while in Russia there is no such pattern. For example, indicator RI in the USA takes positive values for direct taxes and negative for indirect taxes on a regular basis, which confirms the above-mentioned idea that in developed countries direct taxation is preferred to indirect taxation [34]. It should be noted that the USA have broken a local record for indicator RI for excise taxes. This fact means that in the recent decades the US state policy has been aimed towards reducing the burden of indirect taxation and prioritizing direct taxation.

Third, the tax systems of both countries have taxes which are “insensitive” to the economic growth: in Russia, it is the natural resource extraction tax and customs duties while in the USA these are the excise taxes and customs duties. This situation is hardly surprising since these taxes directly depend not only on economic growth but on other kinds of state policy as well. For example, payments for using natural resources are determined primarily by the current economic and environmental situation, excise tax payments – by social imperatives such as the public health imperative and the customs revenues, by global trends in the sphere of foreign trade liberalization and trade wars.

This leads us to an important conclusion that the initial priorities in different kinds of state policy can significantly mitigate the turnpike property of the tax system, which can be considered as natural. In fact, any serious reforms distort the turnpike effects of national taxes.

Table 4

#### Classification of fiscal instruments in the USA

Liberality criterion	Efficiency criterion	
	Efficient	Inefficient
Budget-oriented	TPC	IIT; PT
Liberal	-	ST; SSC; ET; CID

Our classification of the taxes in the USA (see Table 4) shows that few fiscal instruments can be considered efficient,

which is true not only for the Russian but also American economy. According to the available data, the only tax that qualifies as efficient/budget-oriented is the corporate profit tax. This conclusion correlates with the results of B.Kalas et al., who showed that in the USA, the TPC is one of the key taxes affecting economic growth [42]. This study also provided evidence that taxes like the IIT do not influence significantly the country’s economic growth. In this respect, the IIT is even less important than the SSC, whose share in the US tax structure is considerably smaller.

Similarly, American taxes can be budget-oriented, but this quality is not universal. Thus, tax systems of any countries face a number of problems while trying to maintain a close relationship with economic growth.

## 6. The VAT reform and its impact on the national economy

The main focus of tax reforms tends to be the changes in the tax burden, in particular, various tax rates. In practice, however, what matters is how the tax reform affects the behaviour of the economic system and its three core components – the budget (state), producers (business) and consumers (population). As it will be discussed below, in certain cases this task has an analytical and numerical solution.

The general approach to this task is to assume that the budget system has a turnpike property, which can manifest itself to a greater or lesser degree. This assumption can be further specified by constructing econometric dependencies of tax revenues on tax rates and tax base. For the latter, we use different statistical aggregates. If the turnpike property of budget and extra-budgetary revenues manifests itself clearly enough, the above-mentioned econometric dependencies can be constructed, which allows us to measure the impact of tax reforms on the national economy. Otherwise, such dependencies cannot be constructed, which, in turn, will make it difficult to evaluate the effect of these reforms. We are going to consider three types of elasticity at a given tax rate – the tax revenues and tax base of physical and

legal entities – as a set of tools used by a tax reform to affect the economy.

For a more accurate picture let us consider the current indirect taxes in Russia, starting with the value-added tax (VAT).

To reveal the connection between the budget revenues from the VAT and the VAT rate we are going to build an econometric model for the interval between 1995 and 2018 based on the Rosstat data (Table 5) in the multiplicative form:

$$T_{VAT} = \beta + \alpha \cdot GDP, \quad (5)$$

where  $\alpha$  and  $\beta$  are the parameters of the model.

In its final form, this econometric model looks the following way:

$$T_{VAT} = 35.092 + 0.231(q \cdot GDP), \quad (6)$$

(2.393)      (6.846)

$N = 22$ ;  $R^2 = 0.70$ ;  $DW = 2.00$ ;  $A = 8,76\%$ , where  $T_{VAT}$  is the annual VAT revenue deflated by the deflator;  $q$  is the nominal VAT rate, which, until the end of 2003, was 20% and in 2004 was reduced to 18%; GDP

is the annual GDP deflated by the deflator. The  $t$ -statistics are given in parentheses below the regression coefficients;  $A$  is an approximation error (in percentage); the rest of the nomenclature is standard.

All the statistical characteristics of model (6) are satisfactory, which means that it can be used for further calculations. We decided to use aggregates expressed in comparable prices because the current prices contain an inflation component, which, when we are dealing with large values, creates unnecessary information noise and makes it difficult to establish the statistical relations between the variables. In Russia, the inflation noise in the given interval was so significant that it prevented us from building an econometric dependency, which is why we used the deflation procedure. As for the multiplicative form of model (6), it should be said that it is quite natural, especially if we take into consideration that fiscal revenues are formed through

Table 5

Initial data for building models (6) and (8)

Years	GDP, bln rbs (current prices)	$T_{VAT}$ , bln rbs (current prices)	INC, bln rbs (current prices)	Deflator (against the previous year), %	VAT rate ( $q$ )
1996	2007.8	143.9	1357.1	145.8	0.20
1997	2342.5	182.8	1656.4	115.1	0.20
1998	2629.6	170.3	1776.0	118.6	0.20
1999	4823.2	288.2	2908.1	172.5	0.20
2000	7305.6	457.3	3983.9	137.6	0.20
2001	8943.6	639.0	5325.8	116.5	0.20
2002	10830.5	752.7	6831.0	115.6	0.20
2003	13208.2	882.1	8900.5	113.8	0.20
2004	17027.2	1069.7	10930.0	120.3	0.18
2005	21609.8	1472.3	13819.0	119.3	0.18
2006	26917.2	1511.1	17290.1	115.2	0.18
2007	33247.5	2261.7	21311.5	113.8	0.18
2008	41276.8	2132.5	25244.0	118.0	0.18
2009	38807.2	2050.3	28708.4	102.0	0.18
2010	46308.5	2498.6	32498.0	114.2	0.18
2011	60282.5	3250.8	35649.0	115.9	0.18
2012	68163.9	3546.1	39904.0	109.1	0.18
2013	73133.9	3539.4	44650.0	105.4	0.18
2014	79058.5	3940.2	47919.0	107.5	0.18
2015	83094.3	4233.9	53526.0	107.6	0.18
2016	86014.2	4571.4	54117.0	103.2	0.18
2017	92101.3	5137.6	55368.0	105.4	0.18
2018	103875.8	6017.0	n/a	110.3	0.18

Source: Rosstat.

multiplication of the tax rate and the tax base. In this case, we use GDP as the general aggregate, which serves as a proxy variable for the tax base of the national producer. It should be noted that our attempts to build a model in the additive form with a linear division of the effects of the tax rate and the tax base failed to yield any positive results.

Our goal is to identify the impact of VAT liberalization (a one-time reduction in the tax rate by 2 percentage points) on the budget and producers, that is, on state and business revenues. This impact can be measured with the help of standard elasticity indicators such as the elasticity of the VAT revenue at the rate of VAT ( $E_{VAT}$ ) and the GDP elasticity at the rate of VAT ( $E_{GDP}$ ). It is not hard to find the elasticity of the tax revenue, which can be calculated in the discrete form as a mean value for the whole period of research  $E_{VAT} \approx (\Delta T/T)/\Delta q/q$ . Taking into account the form of this relationship (5) and the fact that a change in the tax rate influences not only the state revenue ( $T_{VAT}(q)$ ) but also GDP ( $GDP(q)$ ), we can write the following expansion for the elasticity of tax revenues:

$$E_{VAT} = (1 - \beta / T_{VAT})(1 + E_{GDP}). \quad (7)$$

If we know the value of elasticity  $E_{VAT}$ , we can use equation (7) to get the value of elasticity  $E_{GDP}$ .

The results of our calculations of the effect the VAT has on the state and business are shown in Table 6. In our calculations, we used the mean value of  $T_{VAT}$  for the given period.

Table 6  
Reaction of Russian economic agents to the VAT reform

Economic agent	Activity index	Elasticity parameter	Elasticity value
State	Tax revenue	$E_{VAT}$	-0.33
Business	Production output	$E_{GDP}$	-1.45
Population	Monetary income	$E_{INC}$	-1.47

To show the correlation between the VAT revenue, tax parameters and consumer behaviour, we shall rely on the initial data shown in Table 1 and build

an econometric model for the interval 1995–2017 by using the Rosstat data in the previously applied multiplicative form:

$$T_{VAT} = 38.931 + 0.346(q \cdot INC), \quad (8)$$

(3.165) (7.478)

$$N = 22; R^2 = 0.73; DW = 1.65; A = 7.24\%$$

where  $INC$  is the annual population income deflated by the deflator while all the other nomenclature remains the same.

Similar to model (6), where GDP is used as a proxy variable for the reaction of producers (business) to the changing tax burden, in model (8) we use the  $INC$  as a proxy variable for the reaction of consumers (population). It is quite obvious that the dependence of the VAT on consumers' income is almost the same as the dependence of the VAT on producers' income. The results of our calculations of the population's income elasticity at the rate of VAT  $E_{INC}$  according to formula (7) are shown in Table 6.

Our results concerning the reactions of the three economic agents are quite predictable. As our calculations show, businesses and consumers reacted to an increase in the VAT rate in virtually the same way – by becoming less active. The reaction of the state also falls within the depressed scenario but to a lesser degree than for business enterprises and the population. This observation can be interpreted the following way: an increase in rate  $q$  leads to a considerable reduction in the tax base, which cannot be compensated by an increase in this rate and results in a fall in state tax revenues.

The values of the elasticities can be used to evaluate the rates of growth of the three aggregates – VAT revenues ( $\mu_{VAT}$ ), GDP volume ( $\lambda_{GDP}$ ) and the population income ( $\lambda_{INC}$ ) – resulting from the changes in tax rate  $q$ . To this end, let us use formula  $\mu_{VAT} = E_{VAT}(\Delta q/q)$  and its equivalents for other characteristics related to rates. We can calculate the effect of the VAT reduction by 2 percentage points in 2004 and the effect of its reverse increase by 2 percentage points in 2019. It is worth pointing out that there is a small asymmetry in the results of calculations due to the changing standard tax rate (Table 7).

Table 7  
Effect of the VAT reform in Russia, %

Economic agent	Activity index	Reform scenario	
		Reduced tax rate (-2 percentage points)	Increased tax rate (+2 percentage points)
State	$\mu_{VAT}$	0.03	-0.04
Business	$\lambda_{GDP}$	0.15	-0.16
Population	$\lambda_{INC}$	0.15	-0.16

These results can be explained by the fact that the growth rates of GDP and population income are more than modest. We should also take into account the fact that a certain instantaneous potential effect is implied when we calculate the corresponding effect. For example, potential GDP growth in 2004, when the VAT rate was reduced, was 0.15%. In all likelihood, however, this effect was not realized within one year but took longer. We suppose that it reached its peak the second or the third year after the tax reform and that afterwards it faded gradually. For example, if we suppose that the impact of the tax reform will be evenly distributed throughout the following fifteen years, it will be vanishingly small – just 0.01% a year. Thus, the stimulus it gives to the Russian economy as a result from the reduced VAT rate would not make a big difference. Similarly, a rise in the VAT rate in 2019 is likely to have only a weak recessive effect which takes time to manifest itself.

It should be noted that in accordance with formula (7), as the tax revenues grow, the elasticity of GDP and population income decrease proportionally. For example, in 2004, when the new VAT rate was introduced, elasticity  $E_{GDP}$  was 1.46 and in 2018, 1.41, which means that the effect of the tax reform tends to decrease in the course of time.

### 7. Customs duty burden and its impact on the national economy

Apart from the VAT reform, there have also been significant changes to the system of customs duties. In order to evaluate the impact of these changes, we can use the same analytical scheme described

in the previous section with some minor adjustments.

The peculiarity of customs duties is that this fiscal instrument does not have a single rate but instead includes a large number of percentage rates applied for various imported and exported goods. Therefore, first we need to obtain some kind of generalized measure of the customs duty burden. Let us assume that the tax base for the  $CD$  is the foreign trade turnover  $TT$  (export and import). Then, if we convert this statistical aggregate into the national currency by using the average annual exchange rate  $k$ , we can calculate the average customs duty burden  $q$  as a ratio of customs duties  $T_{CD}$  (foreign trade revenues) to the trade turnover:  $q = T_{CD}/k \cdot TT$ .

As in the previous section, in this section we are going to assume that the formation of revenues  $T_{CD}$  is determined by the two factors – tax burden  $q$  and economic activity measured through GDP. We shall try to build the desired dependency in an additive form:

$$T_{CD} = \alpha + \beta q + \gamma \cdot GDP, \quad (9)$$

where  $\alpha$ ,  $\beta$  and  $\gamma$  are the parameters of the model.

The peculiar feature of model (9) is that it clearly distinguishes the effects of the tax base and tax burden. It should be noted that since we failed to construct a satisfactory econometric dependence in a multiplicative form, we have decided to use an additive model instead (9).

As a result of our computational experiments based on the data in Table 8, we have obtained the following econometric model for customs duties:

$$T_{CD} = -64.559 + 970.917 \cdot q + 0.031 \cdot GDP, \quad (10)$$

(7.719)      (19.491)      (6.357)

$$N = 23; R^2 = 0.97; DW = 1.93; A = 8,8\%.$$

Characteristics of model (10) are satisfactory, which makes it suitable for use in other analytical calculations. Therefore, as before, we are going to calculate the elasticity of customs duties by using customs duty burden  $E_{CD}$  in the discrete form (Table 9). Taking into account the form of this relationship (9), the expression of elasticity of GDP will be as follows:

Table 8

## Initial data for building models (10) and (12)

Years	$T_{CDr}$ bln rbs	Export, mln dollars	Import, mln dollars	Exchange rate $k$	Customs burden $q$
1995	48.3	78 217	46 709	4.559	0.085
1996	39.7	85 189	46 458	5.218	0.058
1997	38.8	85 096	53 123	5.786	0.049
1998	53.1	71 314	43 579	9.700	0.048
1999	122.6	72 885	30 278	24.620	0.048
2000	266.6	103,093	33 880	28.140	0.069
2001	846.8	99 969	41 883	29.170	0.205
2002	388.8	106,712	46 177	31.350	0.081
2003	505.7	133,656	57 347	30.688	0.086
2004	898.2	181,600	75 569	28.815	0.121
2005	1680.9	241,473	98 708	28.286	0.175
2006	2306.3	301,244	137,807	27.185	0.193
2007	2408.3	351,928	199,753	25.577	0.171
2008	3584.9	467,581	267,101	24.855	0.196
2009	2683.3	301,667	167,348	31.723	0.180
2010	3227.7	397,068	228,912	30.369	0.170
2011	4664.4	516,718	305,760	29.387	0.193
2012	4962.7	524,735	317,263	31.093	0.190
2013	5011.0	525,976	315,298	31.848	0.187
2014	5463.7	497,359	287,063	38.422	0.181
2015	3295.3	343,512	182,902	60.958	0.103
2016	2606.0	285,652	182,448	67.035	0.083
2017	2602.8	357,767	227,464	58.353	0.076

Source: Rosstat.

$$E_{GDP} = \frac{E_{CD} - \beta q / T_{CD}}{\gamma \cdot GDP / T_{CD}}. \quad (11)$$

To estimate the population's reaction, we apply the following econometric model:

$$T_{CD} = -65.879 + 994.543 \cdot q + 0.044 \cdot INC, \quad (12)$$

(6.079)      (16.984)  
(4.791)

$N = 23$ ;  $R^2 = 0.97$ ;  $DW = 2.04$ ;  $A = 11.2\%$ .

The results of our calculations according to formula (11) are shown in Table 9. As this table illustrates, the functional characteristics of the CD and the VAT as fiscal tools are completely opposite. While for the VAT all elasticities in Table 6 are negative, for the CD in Table 9 they are positive. The latter means that an increase in the customs duty burden does not curb economic activity, as we might have expected, but, on the contrary, enhances it for producers and consumers. This anomalous effect raises some questions but it is

congruent with our calculations from the previous sections, which showed that the turnpike property of the CD is extremely weak and that they are to a great extent autonomous from economic growth. Thus, when the customs duty burden increases, producers and consumers try to compensate for their losses by becoming more active.

Table 9

## Reaction of Russian economic agents to changes in the CD

Economic agent	Activity index	Elasticity parameter	Elasticity value
State	Tax revenue	$E_{CD}$	1.53
Business	Production output	$E_{GDP}$	0.93
Population	Monetary income	$E_{INC}$	0.99

In order to measure the customs duty burden, we need to take into account the fact that it changes constantly and unpredictably, that is, annually, unlike the VAT

burden, which changed once in a discrete and unidirectional way. Therefore, our results do not show any comprehensive effect of the customs policy on the Russian economy. In other words, since the customs duty burden constantly fluctuates, its changes fail to have a comprehensive effect. For instance, in the given period the range of its fluctuations was 5.8–20.5%. The customs duty burden tended to increase from 2001 to 2014. In 2015, there was a reversal of this trend probably due to the international sanctions imposed on Russia.

To estimate the effect caused by the shifts in the customs duty burden, let us consider the period from 2015 to 2016, when the burden decreased by 2 percentage points. Our calculations of the macroeconomic indicators characterizing the reactions of the state, business and population are shown in Table 10.

Table 10  
Effect of the CD tax changes  
in 2015–2016, %

Economic agent	Activity index	Reduced rate of $q$ (-2 percentage points)
State	$\mu_{VAT}$	-0.29
Business	$\lambda_{GDP}$	-0.18
Population	$\lambda_{INC}$	-0.19

If we compare the data in Table 7 and 10, we shall see that the impact of the VAT and CD on business and the population expressed in absolute values is comparable while their impact on the state budget differs significantly, which can be explained by the already established fact that the VAT is characterized by a strong turnpike property while for the CD this property is extremely weak.

### 8. Excise burden and its impact on the national economy

Excise taxes (ET) are an important kind of indirect taxes in Russia. The excise burden in the given period changed considerably. Like customs revenues, excise taxes do not have a single rate but instead their rates are expressed as an amount per unit of goods or as an amount per unit of goods and a percentage of the retail price. Therefore, we are going to estimate the excise burden the same way as we did it with the

customs burden: we are going to calculate the mean rate of excise taxes  $q$  as a share of excise revenues  $T_{ET}$  from the volume of the retail turnover  $RET$ , that is,  $q = T_{ET}/RET$ . The rest of the methodology will remain the same as in the case of customs duties.

The initial data for constructing econometric models are provided by Rosstat and are shown in Table 11. It is easy to see that the mean rate of excise taxes varied within the range from 2.5 to 7.8% of the volume of retail trade, which serves as a proxy variable of the excise tax base.

Table 11  
Initial data for building models (13)  
and (14)

Years	Excise duties, bln rbs (current prices)	Retail turnover, bln rbs (current prices)	Rate
1995	24.0	512.0	0.047
1996	53.4	728.9	0.073
1997	68.1	852.9	0.080
1998	72.2	1042.8	0.069
1999	109.1	1797.4	0.061
2000	166.4	2352.3	0.071
2001	243.3	3070.0	0.079
2002	264.1	3765.4	0.070
2003	347.8	4529.6	0.077
2004	246.9	5642.5	0.044
2005	253.7	7041.5	0.036
2006	270.6	8711.9	0.031
2007	314.4	10869.0	0.029
2008	350.0	13944.2	0.025
2009	347.2	14599.2	0.024
2010	471.5	16512.0	0.029
2011	650.5	19104.3	0.034
2012	837.0	21394.5	0.039
2013	1015.9	23685.9	0.043
2014	1072.2	26356.2	0.041
2015	1068.4	27526.8	0.039
2016	1356.0	28240.9	0.048
2017	1599.5	29745.5	0.054
2018	1589.5	31579.4	0.050

Source: Rosstat.

As a result of our computational experiments, we have built the following econometric dependencies:

$$T_{ET} = -29.419 + 649.830 \cdot q + 0.014 \cdot GDP, \quad (13)$$

(10.016)      (23.441)      (17.509)

$N = 24$ ;  $R^2 = 0,96$ ;  $DW = 1,61$ ;  $A = 4,4\%$ .

$$T_{ET} = -\underset{(7.486)}{33.749} + \underset{(16.989)}{687.155} \cdot q + \underset{(12.088)}{0.024} \cdot INC, \tag{14}$$

$N = 23; R^2 = 0,94; DW = 1,35; A = 5,5\%$ .

The models we built have enabled us to identify the parameters of the reaction of the state, business and population to changes in the average excise burden (Table 12) and the correlation between the rates of growth of the corresponding variables and the changes in the average excise rate, for instance, by 2 percentage points (Table 13).

Table 12  
**Reaction of Russian economic agents to ET changes**

Economic agent	Activity index	Elasticity parameter	Elasticity value
State	Tax revenue	$E_{ET}$	2.12
Business	Production output	$E_{GDP}$	1.33
Population	Monetary income	$E_{INC}$	1.18

Table 13  
**Effects of the changes in the ET burden, %**

Economic agent	Activity index	Reduced rate of $q$ (-2 percentage points)
State	$\mu_{ET}$	0.85
Business	$\lambda_{GDP}$	0.53
Population	$\lambda_{INC}$	0.47

We can see that the changes in the excises and customs duties have a stimulating effect on business and the population. Apparently, in both cases the economic agents are trying to compensate for their losses by increasing their activity. What is interesting is that the three groups of economic agents are much more sensitive towards the average excise burden than that of the VAT or CD. For example, for business the GDP growth rate resulting from the 2-percentage points change in excise taxes is three times higher than if we change the VAT or customs duty burden in a similar way. Such effects can be explained by the much bigger “weight” of each percentage point in the rate for the ET in comparison with the VAT and CD.

Interestingly, all the three elasticities are positive for the ET, their sign is the same as the CD but different from the VAT. This corresponds to the previously established turnpike property for the three taxes:  $RI_{VAT} < 0, RI_{ET} > 0, RI_{CD} > 0$  (Table 1). Thus, in our analysis the turnpike effects of taxes are comprehensive in the sense that they manifest themselves in different aspects depending on the given functional property.

### 9. Conclusion

The turnpike hypothesis discussed in this paper has led us to the conclusion that in fiscal systems of different countries there always are certain fiscal instruments that are “insensitive” to economic growth. Such instruments perform a purely fiscal function and depend primarily on political imperatives. Nevertheless, even these “insensitive” fiscal instruments respond to the dynamics of economic growth and the reaction of national producers. Our calculations show that not only are “insensitive” taxes characterized by an extremely weak turnpike property but the population and business also prove to be insensitive to changes in the rates of these taxes.

“Insensitive” taxes are detrimental to the efficiency of the tax system and their share in the tax system should be minimized. Therefore, the detection of such “insensitive” taxes will help us tackle the problem of their restructurization and thus balance the interests of different economic agents.

The quantitative evaluation of the reactions of the state budget, business and population to tax reforms given in this article can be used as a preparatory step in the decision-making process. In order to elaborate a more detailed model of a tax reform we need to improve the accuracy of our macro-economic evaluations by taking into account the effects of compensation and substitution. For example, an increase in excises on expensive goods can reduce their consumption and stimulate the consumption of other groups of goods. In a similar way customs barriers to certain groups of goods may lead to an increase in the turnover of other goods.



However, a detailed analysis of these effects falls outside the scope of this paper.

Another issue to be discussed is related to the universality of the turnpike principle. For example, if we assume that the environmental taxes will be raised proportionally to the decrease in the share of pollution-intensive industries and, vice versa, decrease even when GDP is growing on the condition that outdated technologies are being replaced by new, environmentally safe ones. It is true that such local deviations in the dynamics of

tax revenues and GDP are possible but we can hardly consider it a realistic scenario that such deviations will persist for many years or even decades. Thus, the turnpike principle can be considered universally applicable despite some possible local deviations. This does not contradict the turnpike hypothesis but expands the scope of our analysis as we are now able to identify the periods when the turnpike principle is not fulfilled, which signifies a clash of interests of different economic agents, for example, business and the state.

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