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Economic Growth and Optimal Tax Burden: A Case of Uzbekistan's Economy

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ABSTRACT

Taxes have always been the largest contributor to the government budget revenue, so it is critical to collect maximum amount of tax revenue to meet policy objectives. The revenue performance of the countries, in turn, depends primarily on optimality of tax burden in an economy and capacity of revenue agencies to levy taxes set by the law. These factors have been major issues for all countries around the world, particularly for transition economies which are on the verge of major economic transformation. Uzbekistan as one of such countries, since 2017 has implemented multiple fiscal reforms to improve the fiscal capacity of the tax system, thereby increasing economic growth. To assess to what extent current tax policies are efficient, we put forward aim of the article as to elaborate the efficiency of Uzbekistan's tax system using tax effort index to measure collection capability of potential tax revenue and optimal tax burden to maximize economic growth. In this study, we first using mathematical model identified tax effort index for Uzbekistan, which appeared to be approximately 45%. This implies that revenue agencies of Uzbekistan failed to collect on average half of the potential tax revenue over the period 2010–2020. Furthermore, we attempted to determine the optimal tax burden using the Ordinary Least Squares (OLS) method. According to the results of the econometric analysis, the optimal level of tax burden in Uzbekistan for the years 2000–2019 is estimated to be around 19%. Targeting tax burden to this level could reduce GDP gap by 1%.

KEYWORDS

optimal tax burden, tax effort, economic growth, fiscal policy, taxation, tax system, potential tax revenue

JEL H20, H21, H26, O4

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Экономический рост и оптимальная налоговая нагрузка: пример экономики Узбекистана

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АННОТАЦИЯ

Налоги всегда были основным источником доходов государственного бюджета, поэтому крайне важно собрать максимальную сумму налоговых поступлений для достижения целей экономического роста. Динамика доходов стран зависит, прежде всего, от оптимальности налоговой нагрузки в экономике и способности

налоговых органов взимать в полной мере налоги, установленные законом. Эти факторы являются основными проблемами для всех стран мира, особенно для стран с переходной экономикой, которые находятся на грани крупных экономических преобразований. Узбекистан, как одна из таких стран, в 2017 г. осуществил многочисленные фискальные реформы для улучшения фискального потенциала налоговой системы, тем самым увеличив экономический рост. Чтобы оценить, насколько эффективна действующая налоговая политика, мы выдвинули цель статьи по повышению эффективности налоговой системы Узбекистана с использованием индекса налоговых усилий для оценки размера потенциальных налоговых поступлений и величины оптимальной налоговой нагрузки, способствующим максимизации экономического роста. В данном исследовании мы впервые с помощью математической модели определили индекс налоговых усилий для Узбекистана, который оказался примерно 45%. Это означает, что фискальные органы Узбекистана не смогли собрать в среднем половину потенциальных налоговых поступлений за период 2010–2020 гг. Кроме того, мы попытались определить оптимальную налоговую нагрузку с помощью метода обыкновенных наименьших квадратов (OLS). По результатам эконометрического анализа оптимальный уровень налоговой нагрузки в Узбекистане на 2000–2019 гг. оценивается примерно в 19%. Ориентация налоговой нагрузки на этот уровень позволит сократить Правительству Узбекистана разрыв в ВВП на 1%.

КЛЮЧЕВЫЕ СЛОВА

оптимальная налоговая нагрузка, налоговые усилия, экономический рост, фискальная политика, налогообложение, налоговая система, потенциальные налоговые поступления

1. Introduction

Increasing living standards of nations has been major policy objective of the governments around the world over the last several decades. According to welfare economics, well-being of an individual primarily requires high consumption level and availability of preferred goods and services [1], which are in turn depend on economy's gross domestic product (GDP). However, it is not just GDP in a particular period that plays a central role in improving living standards, but the maximum rate of its growth and the duration that matters the most [2].

The degree at which economy expands depends on the rate of total factor productivity, capital accumulation, and labor force [3]. Since, capital and labor have limited contribution to the economic growth due to diminishing marginal productivity, total factor productivity (efficient & effective use of production factors) have been considered a key driver of the long-run sustainable economic growth [2].

According to the endogenous theory [4] the level of productivity is highly correlated with the advancement of hu-

man capital, infrastructure, and technology, whose development require continues investment. It is a national saving rate (e.g., private and public sector saving rates) that ensures an adequate level of investment each year [5], which is heavily influenced by the government's fiscal policy. In this perspective, fiscal policy by arbitrarily allocating gross national income between the government and the private sector using different types of taxes creates fund to investment in different types of public goods which then help to boost the economic growth in the long-run.

The budget revenue from taxes enables the government to direct investment to a specific direction that can be critical to economic growth but would not occur or would be insufficient without government intervention. However, there are two main issues that governments around the world, particularly developing countries are struggling to solve:

– first, whether revenue authorities are enough capable of administering and levying all taxes imposed by the law that otherwise would be in underground economy, thereby, limiting capacity of fiscal policies.

– second, to what extent national income should be taxed that does not jeopardize investment capacity of private sector, thereby, maximizing economic growth.

Uzbekistan as one of the low-middle income developing countries due to low economic growth has recently implemented a number of fiscal reforms in order to optimize collection capacity and the tax burden on both the demand and supply sides of the economy. However, regardless of the reforms, according to the Central Bank of Uzbekistan economic growth has been below its potential level, expanding GDP gap by 1–1.5% during 2021 [6].

This necessitates identifying to what extent tax authority is effective to collect potential tax liability imposed by tax law, and whether current tax burden is optimal to the economy of Uzbekistan, or it deviates from the ideal level.

To assess to what extent current tax policies are efficient, we put forward *aim of the article* as to elaborate the efficiency of Uzbekistan's tax system using tax effort index to measure collection capability of potential tax revenue and optimal tax burden to maximize economic growth.

Based on the above arguments we set following *hypotheses*:

H1. Tax effort in Uzbekistan is well below than its potential level.

H2. Tax burden in Uzbekistan is high than growth maximizing optimal level.

Thus, in this article we first focus on determining how much on average potential tax revenue is being collected using *tax effort index*. Because, actual and potential tax revenues may not be optimal to the economic growth, the second part of the study is devoted to estimating growth maximizing *optimal tax burden* for Uzbekistan.

2. Literature Review

2.1. Literature on tax effort index

The sound fiscal policy has become pivotal instrument to boost economic growth through raising revenue and investing them into education, infrastructure, healthcare and other necessary directions. In this perspective, tax revenue performance depends primarily on the fis-

cal adequacy and administrative feasibility of the tax system. The former concept requires revenues by imposed taxes to be sufficient to cover government expenditures, whereas the latter requires revenue agencies to be capable of efficiently and effectively administering process of taxation in order to encourage compliance.

Thus, to measure to what extent revenue agencies are effective to levy taxes imposed by the law are significant to plan fiscal policy.

There are several approaches that employed by researchers; however, taxable capacity and tax effort index are the most referred indicators that used to calculate taxation performance.

Taxable capacity is a hazy and evasive term that is challenging to explain because views vary greatly at various points in time and in differing situations [7]. Howard [8] defines it as the amount of tax that may be justly or reasonably charged on a nation. According to Fenochietto & Pessino [9], tax capacity refers to the highest amount of tax income that a nation is capable of collecting.

According to Gupta [10], absolute taxable capacity is the excess of output over the lower limit of production per capita that ensures to maintain the basic living standards relatively steady over a period of time. Furthermore, he defined relative taxable capacity as the level of tax burden that should be placed on different individuals in order to fund public goods.

Martin & Lewis [11] established the first statistical method to determine taxable capacity. Using total tax revenue and GDP ratio they analyzed the patterns in taxation of various countries at various phases of economic development. Findings revealed that tax jurisdiction with higher income, openness, industrialization, and urbanization levels tend to have higher overall taxable capacity.

Since taxable capacity is based on ratio of actual tax revenue to the GDP, it fails to concentrate on specification of tax laws and capture specific factors influencing economies tax capacity. Therefore, studies on the topic suggest that the best

way to measure taxable capacity is to determine tax effort. Previous studies have recognized the critical role of tax effort in determining the economy's and individuals' capacity to carry the tax burden at different periods, which help policy-makers to consider introduction of new taxes or changing tax rates [12].

In studies there are various definition of tax effort which gives idea of measurement of methods. In fact, Leuthold [13] defines it as the effort a nation does to levy its tax income taking into account existing tax instruments. Estimating tax effort for 8 African countries by taking the ratio of the actual tax share to the predicted tax share, he found that low tax effort is the result of imbalanced share of direct and indirect taxes in budget revenue.

Similarly, Gillis [14] defines tax effort as governments ability to what degree it can efficiently use of its taxable capacity. Using ratio of actual tax revenues to taxable capacity he found that level, structure, and administration are the three main dimensions determining national tax effort. He further, stated that the structure is the focal point because it determines how easily any given level can be achieved and how efficiently taxes will be administered. It also determines tax policy's allocating, redistributing, and stabilizing functions.

Lee et al. [15] using the tax effort as a ratio of the tax burden to the taxable capacity evaluated 104 countries between 1994 and 2003. According to him, tax effort considers the nation's unique economic, demographic, and institutional characteristics in comparison to its peers and so offers a more complete view of the nation's tax performance. Research suggests that low tax effort associates with structural problems of taxation. Therefore, all nations must choose a long-term strategy for tax reforms by ignoring idea of "one size fits all" approach. Along with structural considerations, the politics of taxation play a crucial role in revenue reforms in all nations with widely varying levels of development.

According to Stotsky & Wolde-Mariam [16], tax effort is calculated as the ratio of the real tax share and the estima-

ted (or potential) tax share. They studied 43 sub-Saharan African nations between 1990 and 1995 and found that the GDP shares of mining and agriculture had a negative and substantial impact on tax collection, whereas the GDP proportions of exports and per capita income had a positive and significant impact.

Mertens [17] researched Central and Eastern European (CEE) countries the years of 1992–2000. The results show that tax effort of these countries effected heavily by the level of economic growth and sectoral shares of GDP.

Dalamagas et al. [18] analyzing 30 European countries found that on average, the actual tax burden was lower than the potential tax burden. In particular, the average tax effort index was 0.83, which means that the actual tax revenue is only 83% of the potential tax revenue. In this study potential tax revenue is defined as the difference between GDP and personal consumption.

These studies are mainly based on two common methodologies to measure tax effort: (1) the potential tax revenue method and (2) the average tax ratio method. In the first method, which uses multiple regression, the tax share is measured as the ratio of actual tax revenue to potential tax revenue and is estimated through GDP. In the second method, tax effort is estimated by the share of tax revenue in GDP. Based on the research by Kim [19], it can be said that both methods define the tax effort as the ratio of the actual value to the potential value.

In all of the discussed studies on tax effort the threshold for identifying how well a country is using its taxable capacity is set as follows:

1) "low tax effort" - when the value is less than one. It indicates a bad use of the tax base in the process of collecting taxes. This implies that the tax burden less than the taxpayer's ability to pay. Therefore, it is necessary for a government to improve so-called tax handles to raise tax revenue [16].

2) "average tax effort" - when the value is equal to one. It indicates that economy effectively utilizing tax handles

to capture all potential tax bases and may indicate the appropriate policy for dealing with a fiscal imbalance [15].

3) "high tax effort" - when the value is higher than one. It indicates the correct use of the tax base. But it is suggested countries with high tax effort index may need to look at reducing expenditures rather than raising taxes [16].

Studies on determinants of low tax effort show socio-economic factors as the major contributors. In fact, according to Bird et al. [20] and Murunga et al. [21] shown that institutional variables including corruption, democracy, and transparency are the primary factors affecting level of tax effort index.

Similarly, study by Fenochietto & Pessino [9] revealed that tax effort of the countries influenced by income per capita, structure of the economy, openness, public debt, literacy, and institutional characteristics such as corruption and governance.

Considering above mentioned factors it is reasonable to expect that Uzbekistan has low tax effort, since the country is struggling to solve institutional deficiency in recent years.

2.2. Literature on optimal tax burden

Impact of taxes burden on economic growth has long been challenged by academics. While authorities vigorously pushed development by employing tax incentives, others have long claimed that taxes had little effect on growth. However, no consensus has been reached on their relationship because different studies have produced contradictory results.

In fact, studies by Romer & Romer [22], have shown that increasing taxes has negative impact on economic growth of South African countries, while researches by Asaolu et. al. [23] and Babatunde et al. [24] revealed positive relationship between taxation and economic growth and concluded that taxation is a powerful tool for economic prosperity.

Supply-side economics, which emerged in the late 1970s [25], and Laffer's [26] work demonstrated that there is an ideal level of taxation for a particular economy that maximizes economic growth. Similar-

ly, Barro [27], and Armeij [28] presented theoretical and empirical existence of an optimal, growth-maximizing tax rate as illustrated by an inverse U curve. Growth rate is increasing at a decreasing rate up until the tax rate becomes equal to t^* (where growth rate is G^*) but decreases thereafter. The general argument is that government public goods and services maximize the productivity of private economic activity when taxes reach t^* and further tax rate hikes are counterproductive (Fig. 1).

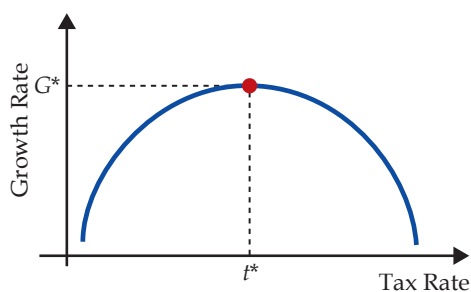


Figure 1. Armeij Curve

Generally, according to the theory of optimal taxation, there are two important factors that determine tax revenues: namely private consumption and the production potential of the country (gross domestic product). Since GDP and consumer spending reflect the impact of almost all factors on tax revenues, the rest of the macroeconomic and microeconomic factors can be ignored.

That is why, to determine optimal level of the tax burden one should bear in mind that tax is an important tool of fiscal policy to finance public goods and at the same time financial charges levied on taxpayers who drives economic growth by producing and consuming goods.

In public finance, there are two ways to evaluate the tax burden:

First, as a monetary payment arising from the choice of the tax rate or as a share of collected tax revenue in GDP.

Second, by identifying the losses of taxpayers in connection with the payment of taxes.

Keynes [29] emphasized how fiscal policy interventions by the government can have an impact on economic activity. According to the Keynesian hypothesis, taxes

have an impact on the level of income, overall demand, and consequently, the amount of output. Taxation and economic growth have a positive and negative relationship, according to the theoretical underpinnings of the two concepts. Over-taxation is the cause of a negative relationship, whereas the success of tax-financed spending is the cause of a positive relationship [30].

Thus, a tax increase more than optimum level is commonly viewed as an inducement to a loss of economic efficiency, also known as a deadweight loss or excess tax burden, because it reduces consumer and producer surplus, which does not fully reach the government. The amount of unrecoverable loss grows as the tax rate rises. As a result, higher tax rates result in greater economic inefficiency, which leads to lower economic growth [31].

In fact, Amgain [32] employing the Scully baseline model and the quadratic model calculated the optimal tax rate for 32 Asian countries from 1991 to 2012. According to the findings of the research, optimal share of tax revenues in the gross domestic product appeared to be 18%. The findings support the theoretical assumption that there is a tax rate that maximizes economic growth.

Similarly, to examine the nature of the relationship between tax burden and growth in Vietnam and China over a ten-year period, Liu et al. [33] used qualitative and quantitative analyses over 2002–2011. The study demonstrated effect of the tax burden on Vietnam's pace of economic growth. According to China's experience, it is also believed that the country's economic growth is currently 6.55 percent, and that if taxes are decreased to 18.17 percent from their present level of 22.8%, economic growth may rise to 10.16 percent.

In the same vein, using quarterly data for the years 1994 to 2016, Saibu [34] and assessed South Africa's optimal tax rates using an ARDL bound-testing methodology. The findings indicate that there was no discernible link between taxation and economic development over the research period. Keho [35] calculated the ideal tax burden for the Côte d'Ivoire economy using data from 1960–2006 with Scully and

quadratic regression models. The outcomes support the hypothesis that high tax rates are harmful to economic growth. Chokri et al. [36] calculated the ideal tax burden for Tunisia using data from 1966 to 2015 and a quadratic model and a basic Scully model. According to the results of the analysis the ideal tax burden should fall between 12.8% and 19.6%.

In the following sections to estimate optimal tax burden and tax effort for Uzbekistan we employ the Ordinary Least Squares (OLS) method based on the quadratic function.

3. Methodology

3.1. Data

The research used annual data from the Statistics Committee of the Republic of Uzbekistan, the Tax Committee of the Republic of Uzbekistan, the World Development Indicators database of the World Bank, and the World Economic Outlook database of the International Monetary Fund. The analysis spans the years 2000 to 2019. Due to a lack of data for other years, the study was limited to a relatively short time period.

We, first, built model to estimate potential tax revenue and tax effort index employing the classical profit maximization method for Uzbekistan over a covered period of time. Then, the optimal tax burden is calculated based on the OLS model with a quadratic functional form and Scully's tax burden optimization model.

3.2. Potential tax revenue and tax effort index (OLS regression model)

The first approach is a standard regression approach in terms of estimating the potential level of tax revenue and compliance with that tax burden. Within a standard regression approach, regression can be performed as described in the literature using tax burden as the dependent variable and all other economic and non-economic factors as independent variables as follows:

$$T_{it} = \alpha + \beta X_{it} + u, \quad (1)$$

where T - tax burden (the share of tax revenue in GDP); X - is a vector of inde-

pendent variables (includes economic and non-economic factors); α – intercept; β – slope of relevant variables (coefficient); u – is the error term; $i = 1, \dots, N$ (country indicator); and $t = 1, \dots, K$ (time indicator).

The subsequent studies have mainly attempted to determine the potential level of tax revenue using modeling. Fundamental research is based on Arrow-Debreu economics [37]. In particular, the potentialization of tax revenues and tax burden is carried out taking into account the assumptions of the Arrow-Debreu economy. According to the basic assumptions, it can be noted that there is no savings in the Arrow-Debreu economy and that the labor supply is fixed. Moreover, the economy consists of N number of households, whose preferences are identical and based on two components: private consumption and public services. Thus, the utility functions of households are:

$$U(Y, G) = \ln(Y) + \ln(G), \quad (2)$$

where U – stands for the utility of households; Y – is GDP; G – goods and services provided by the state.

The rationale of the utility function is that production resources in the economy are divided into two parts: the private sector (production of goods and services in the private sector) and the public sector (goods and services provided by the state). Since, capital is transferred from the private to the public sectors through taxation, fiscal decision is crucial in this process. It should also be underlined that resources should be allocated by politicians to the potential level between the private and public sectors for a given degree of production capacity. Due to the high likelihood of private sector insolvency, low-profit sectors are typically funded by the government. Additionally, the government has responsibilities to its citizens and must offer them crucial social, legal, and infrastructure services.

Thus, to achieve Pareto efficiency (the first most efficient distribution of resources), the government must select income vectors (private consumption) and goods and services delivered by the government to maximize social welfare (the

gross utility function of households). In this situation, it is important to consider the requirement of collecting sufficient tax money to guarantee the required level of goods and services provided by the state. On the other hand, the state budget is predicated on the assumption that the government revenue solely based on the personal income tax (a direct tax) and tax on the consumption of goods and services (an indirect tax) as follows:

$$G = T = T_y + T_p, \quad (3)$$

where G – state budget income; T – is tax revenue; T_y – personal income tax revenue; T_p – is consumption tax revenue.

It should be noted here that according to the general equilibrium theory of the Arrow-Debreu economy, there will be no private savings and no government borrowing in the economy. The model also makes the assumption that there is no preference for products and services offered by the government. This is because it is presumed that government action in the market does not alter consumer choices for commercial goods and services. Additionally, the government uses equal-valued labor to enter the labor market and serve the populace with non-tradable goods and services (including defense and the justice system).

The government taxes household income on a progressive scale and applies marginal rates as income increases. The sum of these progressive tax scales is assumed to be the tax base for personal income tax:

$$T_y = \sum_{j=1}^M t_{y,j} y_j, \quad (4)$$

where t_y – is the marginal tax rate for the relevant scale of income; y_j – is the income of households in the relevant income scale; $j = 1, \dots, M$ – is the number of income scales.

Now it is possible to work on the average tax rate as shown in equation (5):

$$\bar{t}_y = \frac{\sum_{j=1}^M t_{y,j} y_j}{\sum_{j=1}^M y_j}, \quad (5)$$

where \bar{t}_y – is the average rate of personal income tax.

In general, personal income tax has three main features:

1) average and marginal rates of taxes increase as incomes increase.

2) the average tax rate is lower than the marginal tax rate.

3) income tax elasticity is greater than one.

The above properties can also be proved mathematically. For this, it is necessary to show the progressive functional form of tax revenue in relation to income. A quadratic function is the simplest progressive functional form:

$$T_y = \beta Y^2, \quad (6)$$

where $0 < \beta < 1$ - tax rate.

Now we can determine the marginal and average tax rates. The marginal tax rate is the first derivative of the function and is equal to:

$$t_{y,j} = \frac{dT_y}{dY} = 2\beta Y, \quad (7)$$

average tax rate is:

$$\bar{t}_y = \frac{T_y}{Y} = \beta Y, \quad (8)$$

income tax elasticity is:

$$e = \frac{dT_y}{dY} \frac{Y}{T_y} = \frac{t_{y,j}}{t_y} = 2. \quad (9)$$

Thus, in this article we will use the above (simplest) progressive (6) functional form of personal income tax.

Another tax in the economy is the taxation of raw materials, in which a proportional (*flat*) tax rate is applied to its tax base (*consumption*).

$$T_p = t_p C, \quad (10)$$

where T_p - consumption tax revenue; t_p - proportional (flat) consumption tax rate; C - consumer spending.

However, there is also a regressive tax rate of consumption tax on household income.

$$T_r = t_r Y, \quad (11)$$

where t_r - is the regressive consumption tax rate.

Because a consumption tax is regressive on income because as income increases, the limited (or average) propen-

sity to consume (the ratio of consumption expenditure to income) decreases.

$$c = \frac{C}{Y} = \frac{\lambda}{Y^2}, \text{ or } t_p c = \frac{t_p C}{Y} = \frac{t_p \lambda}{Y^2}, \quad (12)$$

where $\lambda > 1$ is a fixed number.

This implies that, as income increases, consumption also increases, but the rate of consumption growth is not as high as the rate of income growth (12). Alternatively, the acceleration of the growth trend of consumption will be slower than that of income. Also, with an increase in income, the share of consumption decreases.

By equating formulas (10) and (11) and combining with formula (12), tax rates can be related to income and consumption as follows:

$$T_p = t_p C = t_r Y, \text{ or } \frac{t_r}{t_p} = \frac{C}{Y} = \frac{\lambda}{Y^2}, \quad (13)$$

and

$$t_r = t_p \frac{\gamma}{Y^2}, \text{ or } t_p = t_r \frac{Y^2}{\gamma}, \quad (14)$$

$$\text{or } \gamma = \frac{t_r}{t_p} Y^2 = \frac{C}{Y} Y^2 = CY.$$

From the equation (14) it can be seen that the regressive consumption tax is inversely proportional to income, that is, as income decreases, the tax rate increases.

Now we can estimate the potential tax revenue and, hence, the potential tax burden. To do so, we take disposable (after-tax) income as follows:

$$Y^d = \frac{(1 - t_y)Y}{(1 + t_p)P}, \quad (15)$$

where Y_d is disposable (after-tax) income; Y represent income (gross domestic product); P is the standard price level per unit; t_y stands for income tax rate; t_p denotes consumption tax rate.

We can assume from equation (15) that disposable (after-tax) income has a positive effect on total income, whereas the price level, after accounting for the indirect tax, has a negative effect on it. Furthermore, the model includes a direct tax on income, which has a negative impact on disposable (after-tax) income. It should be noted that income tax is calculated as

a percentage of total income, whereas commodity tax is calculated as a percentage of total personal consumption.

Furthermore, the budget is filled by direct (income tax) and indirect (commodity tax) taxes, which are used to fund the public goods provided by government. It can be illustrated as follows:

$$G = T = t_y Y + t_p C = T_y + T_p. \quad (16)$$

This is the state budget standard constraint of the potentialization problem. In particular, in the potentialization problem, we try to maximize the utility function, which is the sum of disposable income and tax revenues to the budget, under the conditions of state budget constraints. We define the Lagrange function as follows:

$$L = \ln(1 - t_y)Y - \ln(1 + t_p)P + \ln G + \lambda(G - t_y Y - t_p C). \quad (17)$$

Now we can potentiate direct and indirect tax rates, which are the only source of state budget revenues:

$$\begin{aligned} \frac{dL}{dt_y} &= -\frac{Y}{(1 - t_y)Y} - \lambda Y = 0 \Rightarrow \\ &\Rightarrow -\frac{1}{1 - t_y} = \lambda Y, \end{aligned} \quad (18)$$

$$\begin{aligned} \frac{dL}{dt_p} &= -\frac{P}{(1 + t_p)P} - \lambda C = 0 \Rightarrow \\ &\Rightarrow -\frac{1}{1 + t_p} = \lambda C. \end{aligned} \quad (19)$$

In addition, from equation above by taking the first-order condition, the potential level of state budget revenues (G) can be obtained:

$$\frac{dL}{dG} = \frac{1}{G} + \lambda = 0 \Rightarrow \lambda = -\frac{1}{G}. \quad (20)$$

Calculating problems (18), (19) and (20) simultaneously, we can get the following result:

$$G = (1 - t_y)Y = Y - T_y, \quad (21)$$

$$G = (1 + t_p)C = C + T_p. \quad (22)$$

Now by equating equation (21) to (22) we can estimate potential tax revenue as follows:

$$Y - T_y = C + T_p, \quad (23)$$

$$Y - C = T_y + T_p, \quad (24)$$

$$Y - C = T. \quad (25)$$

As can be seen from (25), the potential tax revenue should be equal to the difference between income (GDP) and private consumption.

We attempt to utilize a slightly different utility function using private consumption instead of disposable income to make the model more realistic. Thus, the utility function now consists of two parts: personal consumption and goods and services provided by the government.

$$U = U(C, G) = \ln C + \ln G. \quad (26)$$

As a result, personal consumption will also have a slightly different form according to formulas (6), (10), (11), (12), (13) and (14) above:

$$C = \frac{c(1 - t_y)Y}{1 + t_p} = \frac{c(1 - \beta Y)Y}{1 + t_r \frac{Y^2}{\gamma}}. \quad (27)$$

On the other hand, the state budget constraint remains the same as before, that is:

$$T = T_y + T_p = t_y Y + t_p C = \beta Y^2 + \frac{t_r Y^2}{\gamma} C. \quad (28)$$

It should be noted that personal income tax is a progressive type of tax that takes into account household income. Moreover, taxation of commodities is regressive in terms of consumption and proportional in terms of income. However, gross tax revenues from commodity taxation remain unchanged, despite having proportional and regressive characteristics.

$$T_p = t_p C = t_r Y. \quad (29)$$

We can adjust the Lagrange function to maximize the utility, subject to budget constraints, as follows:

$$\begin{aligned} L &= \ln[c(1 - \beta Y)Y] - \ln\left(1 + \frac{t_r Y^2}{\gamma}\right) + \\ &+ \ln G + \lambda\left(G - \beta Y^2 - \frac{t_r Y^2 C}{\gamma}\right). \end{aligned} \quad (30)$$

Now, we can determine the efficiency condition by taking the first-order of β and γ :

$$\frac{dL}{d\beta} = -\frac{cY^2}{c(1-\beta Y)Y} - \lambda Y^2 = 0, \quad (31)$$

$$\frac{dL}{d\gamma} = -\frac{\frac{t_r Y^2}{\gamma^2}}{1 + \frac{t_r Y^2}{\gamma}} + \lambda \frac{t_r Y^2 C}{\gamma^2} = 0 \quad (32)$$

(6), (10), (11), (12), (13) and (14) can now be linked to the two efficiency conditions:

$$G = (1 - t_y)Y, \quad (33)$$

$$G = \left(1 + \frac{t_r}{\gamma} Y^2\right) C = (1 + t_p). \quad (34)$$

By equating (33) and (34), we can determine the potential tax burden along with the potential level of tax revenues:

$$(1 - t_y)Y = (1 + t_p)C, \quad (35)$$

$$Y - t_y Y = C + t_p C, \quad (36)$$

$$Y - C = t_y Y + t_p C \quad (37)$$

$$\text{or } Y - C = T. \quad (38)$$

In models with progressive and regressive tax rates, it is clearly evident that the potential level of tax revenue must be equal to the difference between income (GDP) and private consumption. The out-

comes were in line with those from the above-mentioned simple model.

There are still a few issues with the model, though. For instance, the objective function of the empowerment model might not meet efficiency and/or fairness requirements. It just considers the potentiality condition. This is mostly caused by the model's singular focus on gross tax revenue estimation. We must consider the structure of several types of taxes, such as the personal income tax and commodities taxation, in order to give society an effective and equitable tax system.

4. Results

4.1. Tax burden analysis

According to the reviewed literature above, there are several methods of determining the optimal tax revenue, all of which identify the optimal tax revenue as the difference between GDP and private consumption. Based on the methodology discussed, first we determine the potential tax revenue, then the tax effort index, that is, the ratio of real tax revenue to potential tax revenue. Estimations show that average the tax effort in Uzbekistan for the years 2010 to 2020 is equal to 45%. Which means that in Uzbekistan on average only 0.45 fraction of tax revenue was collected over the period in the study (Fig. 2).

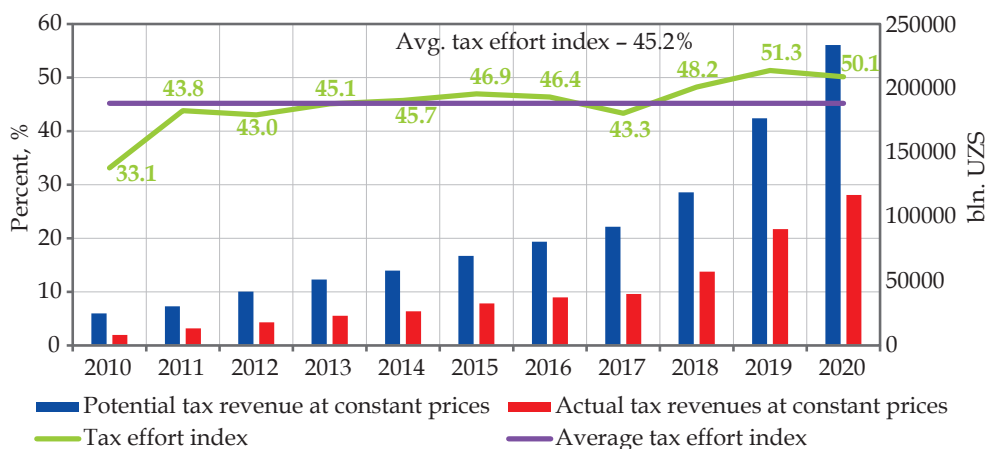


Figure 2. Potential and actual tax revenue, and tax effort index

Source: Authors estimations based on data from State Tax committee of Uzbekistan (<https://soliq.uz>)

Since the index is less than one, it can be concluded that the economy has “low tax effort” which evidence confirmation of research hypothesis. Such a low tax effort implies that Uzbekistan’s tax system is ineffective to capture all potential tax base, reflecting there is room for enhancing taxation instrument increase tax revenue.

This large difference can be explained by several intrinsic problems. First possible explanation could be high level of shadow economy in the economy. The studies on this issue revealed that in Uzbekistan share of shadow economy amounted to on average 50 percent of GDP [38].

Regarding structural problems of the tax system, it is important to analyze major taxes that contribute large portion of the budget revenue. Value added tax (VAT) is the largest contributor of tax revenue and income tax comes next [39]. This implies that Uzbekistan’s tax policy focused more on indirect taxation of consumption rather than taxing directly incomes. In turn, in the economy with high tax burden, profit-seeking tax agents (companies) try to conceal potential tax base, thereby reducing tax effort.

In fact, research by Rakhmonov & Safarov [40], the average amount of VAT revenue that is actually being collected is just 51% of potential VAT revenue in 2020. In other words, tax system in Uzbekistan is failing to collect 49 percent of poten-

tial value-added tax revenue due to huge policy gap (36%) and compliance gap (23%) issues.

Given the importance of personal income tax contributions after value-added tax in terms of the share of overall tax revenue, a large portion of the potential tax revenue is being wasted because of the inadequate labor market regulations and tax administration. In fact, according to the Tax Committee of the Republic of Uzbekistan, due to the presence of huge informal labor market, in 2020, the ratio of personal income tax to the officially employed people was approximately 33 percent. It means that Uzbekistan is losing approximately 67 percent of potential personal income tax revenues from individuals.

It can be concluded that, in Uzbekistan there is the opportunity to increase tax revenues while reducing the tax burden. To accomplish this, the tax system should undergo political, systematic, and structural changes aimed at covering as much tax bases as possible.

4.2. Optimization of the tax burden

Tax burden in Uzbekistan is believed to be considerably high that is preventing economy to grow at its potential level. As for the Fig. 3, it can be seen that the tax burden in Uzbekistan has steadily decreased between 2000 and 2017.

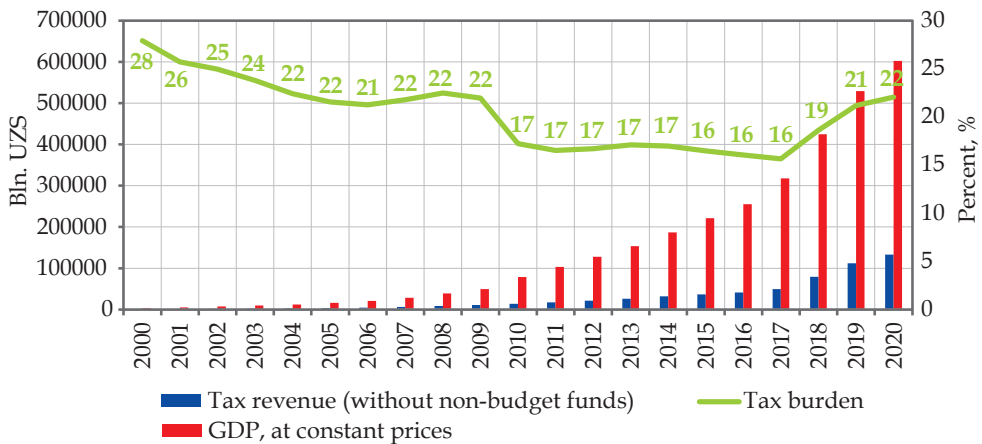


Figure 3. Tax burden and economic growth in Uzbekistan

Source: State Tax committee of Uzbekistan (<https://soliq.uz>) and State statistics committee (<https://stat.uz/uz>)

It is interesting that after the fiscal reforms implemented in the country, the tax burden started to increase from 2017 and has continued to grow until now. In fact, in 2020 the tax burden reached approximately 22%. Although, tax burden has increased in recent years, it does not mean current level of tax burden has negative impact on economic growth. To identify whether existent tax burden is optimal for economic growth or not, in the next section we conduct analysis.

4.3. OLS model based on a quadratic function

We first attempt to estimate the relationship between the level of the tax burden and the rate of economic growth or GDP per capita based on the OLS model. Empirical specifications support a concave parabolic trend consistent with the Laffer curve.

This method employs square shapes to represent an inverted U-curve. As a result, we define a 2nd-order polynomial relationship between the growth rate (G_t) and the tax burden (T_t).

$$G_t = \beta_0 + \beta_1 \cdot T_t + \beta_2 \cdot (T_t)^2 + e_t. \quad (39)$$

Now, by deriving the tax burden from G_t , it is possible to determine the optimal level of the tax burden that maximizes economic growth as follows:

$$T_t^* = -\frac{\beta_1}{2\beta_2}. \quad (40)$$

The coefficients β_1 and β_2 have opposite signs. The first coefficient (β_1), which measures the impact of taxes on growth, should be positive. The second coefficient (β_2) should be negative, which indicates the effects of the tax burden being higher than the optimal rate.

4.4. Regression Results

Based on the above model, we constructed an econometric regression model to estimate the optimal level of the tax burden for Uzbekistan in the period from 2000 to 2019 (Table 1).

Based on the regression results the parameters of equation (39) can be determined. Specifically, in the case of Uzbekistan equation (39) can be formulated as follows:

$$G_t = -25.71 + 3.107 \cdot T_t - 0.0766 \cdot (T_t)^2 + e_t. \quad (41)$$

Now we can determine the optimal tax burden using equation (40) as below:

$$T_t^* = -\frac{3.107}{2 \cdot (-0.0766)} = 20.28. \quad (42)$$

At this point, it is worth noting that with the above optimal tax burden of 20.28%, Uzbekistan could achieve high growth rates of GDP per capita in 2000–2019. In particular, according to the data of the World Bank, between 2000 and 2019, the average annual growth rate of GDP per capita was 4.85 percent. If the tax burden were targeted at around 20.28% per year, the average annual growth rate of GDP per capita could be 5.79%, which is 0.94% higher than actual growth rate.

In addition, we also performed regression with control variables (\check{Z}).

$$G_t = \beta_0 + \beta_1 \cdot T_t + \beta_2 \cdot (T_t)^2 + \beta_3 \cdot \check{Z}_t + e_t. \quad (43)$$

Specifically, the model includes following indicators as controlling variables (\check{Z}) fixed capital investment, age dependency ratio, employment rate, birth rate, gross final consumption expenditure, share of the population using the Internet, labor force participation rate, life expectancy and unemployment rate. We added indicators as control variables. Another difference from the first model is that we took the annual GDP growth rate rather than the annual GDP per capita growth rate as the dependent variable (Table 2).

Table 1

Regression Results	
Variables	(Eq.1)
	GDP per capita
Tax burden	3.107*** (1.037)
Tax burden (square)	-0.0766*** (0.0247)
Constant	-25.71** (10.65)
Observations	20
R ²	0.396

Significance levels: *** $p < 0.01$ (99%), ** $p < 0.05$ (95%), * $p < 0.1$ (90%).

Table 2

Regression Results		
Variables	(Eq. 1)	
	GDP growth	Std. Err.
Tax burden	6.737***	(1.124)
Tax burden (square)	-0.177***	(0.028)
Gross capital formation	-0.354***	(0.084)
Age dependency ratio	5.523***	(0.816)
Total employment	19.84***	(2.454)
Fertility rate	7.118***	(1.088)
Final consumption ratio	-0.314***	(0.058)
Number of internet users	-0.309***	(0.062)
Labor participation	-60.98***	(9.054)
Life expectancy	49.36***	(7.814)
Unemployment	12.03***	(1.634)
Constant	-936.9***	(155.1)
Observations	20	
R-squared	0.991	

4.5. The optimal tax burden

Based on the regression results, the parameters of equation (43) can be determined. Specifically, in the case of Uzbekistan, equation (43) is as follows:

$$G_t = -936.9 + 6.737 \cdot T_t - 0.177 \cdot (T_t)^2 + \dots + e_t \tag{44}$$

Now we can determine the optimal tax burden using equation (40) as below:

$$T_t^* = -\frac{6.737}{2 \cdot (-0.177)} = 19.03. \tag{45}$$

According to the results of this regression, the optimal tax rate is approximately 19%. Graphically it can be illustrated as in Fig. 4.

As we can see in the case of optimal tax burden results are in line with set research hypothesis. In fact, in 2020 observed actual tax burden (excluding other mandatory contribution) was 22 percent, while estimated optimal tax burden recorded 19%.

5. Discussion

According to the “World Economic Outlook” report of the International Monetary Fund, the actual average annual growth of GDP in Uzbekistan in the period from 2000 to 2019 was almost 6.5%. In order to calculate economic growth by targeting tax burden to an optimal level we simulated data based on the regression results. Specifically, we modeled the rate of economic growth by arbitrary setting the tax burden at 19%, and discovered that, if the tax burden had been fixed at 19% per year, the average annual GDP growth rate between 2000 and 2019 would have been approximately 7.5%, which is 1% higher than actual economic growth.

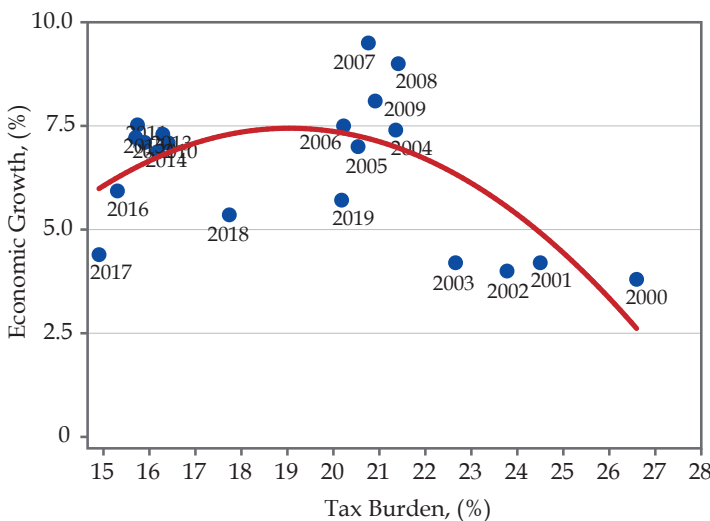


Figure 4. Economic growth and Tax burden

Our findings fairly diverge from previous studies of optimal tax burden for Uzbekistan. Study by Abdullaev & Konya [41], which covered period between 1996–2011, shows that to maximize economic growth it is necessary for Uzbekistan to keep tax burden at 22 percent. However, the main difference of this research from current one is that former one to estimate optimal tax burden include other mandatory payments, while in our research we focused only on taxes. The second difference comes from the tax policy of the two different time periods. Starting 2017 Uzbekistan adopted new concept of tax policy and in 2020 new version of the tax code both of which may affect tax burden that economic entities bear.

As a result, in the process of this study, we confirmed both hypotheses of the study: (1) Tax effort in Uzbekistan is well below than its potential level; (2) Tax burden in Uzbekistan is high than growth maximizing optimal level.

Although the methods and findings are unquestionably original, this study has a number of limitations.

First, empirical analysis is based on the limited number of annual time series data due to unavailability of quarterly statistics data. Thus, it is possible that using quarterly data and increasing number of observations will enable to capture effects of short-term shocks and give more detailed results.

Second, we used total tax burden for our analysis, ignoring specific effects of the direct and indirect taxes on tax burden. Analyzing weight of each tax category will reveal issues of the tax policy in detail. We leave all these shortcomings to future studies, which might produce more comprehensive conclusions.

6. Conclusion

According to the literatures, we found that the optimal tax burden and tax effort index are the theoretically most reasonable methods to determine an economy's optimal tax revenue. These methods, in particular, are based on the utility maximization model and aimed to

optimize the general welfare function under the conditions of a balanced budget. It should be noted that general welfare equals the sum of personal disposable income plus government goods and services.

Based on the various literature suggestions, we build up model in order to identify to what extent tax policy and tax administration in Uzbekistan are capable of collecting taxes using mathematical model and data for the years 2010–2020. The results revealed that average tax effort index for Uzbekistan was approximately 45%, implying that fiscal capacity of revenue agencies in Uzbekistan were twice in-effective.

This, first, can be explained by high level of shadow which causing collection of less than half of the potential tax liability imposed by tax law that was in force at these periods. Further investigation revealed that such a large disparity was caused by losses from two major revenue contributors, namely VAT and income tax, as a result of compliance and policy deficiencies.

In order to identify optimal tax burden that maximizes economic growth of Uzbekistan, we utilized two model, specifically, OLS regression model. The estimations confirmed that from 2000 to 2019, optimal tax burden for Uzbekistan's economy was around 19–20%. If the government of Uzbekistan targeted its tax burden to that optimal level, it could have been achieved up to about 7.5% economic growth over the period covered in the study. This means that there is still room for increasing tax revenue by taxing shadow economy to improve tax effort and reducing tax burden to boost the economic growth in Uzbekistan.

The main policy outcome of this study is that it is likely to be ineffective to implement any additional tax policy in Uzbekistan. Therefore, along with the raising direct taxes and lowering indirect taxes, tax policy reform should focus on addressing the fundamental problems with the tax system.

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