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THE EFFECT OF TAX-TARIFF REFORM: EVIDENCE FROM UKRAINE

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Summary

The paper examines the tax-tariff reform, recommended for Ukraine by donor organization (IMF and the World Bank), which consists in trade liberalization by way of trade tax cuts with simultaneous compensation of state tax revenue losses by VAT base broadening. We developed the mathematical model of evaluation of cross-border taxation influence on commodity flows, on economic agents' profits and on state tax revenues, which can be considered as extension of "Devarajan" and "Emran–Stiglitz" models, with regard to possibility of tax evasion and receiving the illegally compensated VAT.

The evaluation of model using data bases, prepared by Ukrainian State Statistic Committee and Customs administration of Ukraine, revealed that the expediency to reform a tax-tariff system, according to the IMF recommendations, is not clearly obvious and it depends on tax rates elasticity of size of informal sector.

We find that providing the trade liberalization by way of substitution of trade tax revenues by enlarged VAT is expedient in those branches of economy, which are characterized by monopoly and oligopoly situation.

JEL Codes: C30, F13, H26

Key words: trade tax, tax-tariff reform, VAT, informal sector

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I Introduction

One of the main functions of donor organizations (IMF and the World Bank) is the work with developing counties[3] to help them achieve macroeconomic stability and reduce poverty. They require the fulfillment of definite conditions in exchange for financial resources.

According to the IMF requirements, the main directions of structural reforms in Ukraine are tax reform, infrastructure reform, public service and social sector reform. Tax reform includes the VAT reform, excises and trade tax reform. Trade tax reform supposes reducing of their rates.

Thereat the experts of donor organizations suggest that to minimize the negative impact of tax reform on state tax revenues, the trade tax rates cuts should be accompanied by VAT base broadening with significant reducing of tax preferences. The impact of trade liberalization on tariff revenue is also determined by the extent of exemptions and preferences, and tariff revenue would increase to the extent that exemptions are reduced or abolished. Incentives to smuggle or misrecord would be reduced if tariffs were lowered or consolidated in the interest of greater transparency, thereby improving compliance and broadening the tax base (Elborgh–Woytek et al., 2006).

According to the experts, such a policy leads to rising of national welfare and state tax revenue. Experience suggests that VAT systems complying with standard

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[3]According with the IMF Classification (2012), for instance Ukraine is the developing economy.

best practice of a single base, a reasonable threshold, and few exceptions, were best geared toward offsetting lost trade tax revenue (Lorie, 2003).

The World Bank experts recommend similar measures are recommended also by World Bank experts, noting that trade taxes are not optimal instruments to achieve a revenue objective because they significantly distort production and consumption choices. Preferred instruments to raise revenue are taxes such as income taxes or commodity taxes (excise, VAT, etc.). These are preferred taxes because, since they are applied neutrally to domestically produced and imported goods, they impose less distortion or inefficiency costs (Tarr, 2000).

The IMF recommendation for Ukraine are in that stream. In 1998, Ukraine signed with IMF the Memorandum of economic policies, which stated the main directions of reform in Ukraine for the long-term. In particular, this memorandum determined the significant import tariff cuts.

Hereafter, in Ukraine-IMF Memorandum, signed in 2004, the tax reform was determined as a centerpiece of Ukrainian structural reform. The main goals of the former were to lower the tax burden, to reduce a number of interventions in the tax system, to assure the equal rights to the taxpayers, to reduce the size of informal economy. Also some VAT preferences (particularly, in home construction and pharmacy) were to be eliminated.

Likewise, the government engaged does not introduce the new tax preferences and to set a moratorium, related to creation of new free economic zones and to enlargement of the existing ones. In 2010 IMF approved the loan for Ukraine to provide the needed reforms, in particular, reforms designed to achieving the fiscal sustainability. These reforms will support efforts to broaden the tax base.

But the new Ukrainian Tax Code introduces new tax holidays for small enterprises and specific industries (hotels, shipbuilding and aerospace industry), and a 3-year VAT exemption for several sectors that are subject to significant VAT refund fraud. The IMF experts note that while the overall revenue impact of these measures is likely to be small, they bring unwelcome distortions, add to existing exemptions, and break the VAT chain (IMF report, 2011).

It should be noted that IMF recommendations for Ukraine look as requirement to adopt the pattern of foreign trade policy, the centerpiece of which is the quick trade liberalization by way of cutting of maximum possible number of tariff barriers.

But in case of quick trade liberalization, the domestic economic agents can hope only to opposite concessions from the part of foreign partners, which will permit to Ukrainian enterprises (which will be met the heightened competition), to operate freely in the world markets. Trade liberalization may create competition, but it does not do so automatically. If trade liberalization occurs in an economy with a monopoly importer then rents may just be transferred from the government to the monopolist, with little decrease in price. Trade liberalization is neither necessary nor sufficient for creating a competitive and innovative economy (Stiglitz, 1998).

Therefore, in this case the key factor, defining the gains and losses after trade liberalization, mainly due to import tariff cuts, is the capability of government to favor for domestic competition.

The basic argument to use such policy is to substantial distortional effect of trade tax as tool of rising the state tax revenues (it distorts both producer and consumer prices). While the consumption tax, similar to VAT, has a number of positive characteristics, for example the alleviation of excessive protection of domestic producer from imported substitutes.

Simultaneously, for instance Ukraine faces with the problem of informal economy. Despite a number of actions, taking for the purpose of unshadowing the national economy, a large part of it belongs to the informal sector. Such conditions show that the increase of VAT or production taxes, necessary to neutralize the changes in consumer/producer prices, can be performed only in the case if the good is produced or/and processed and sold in formal sector of economy. Those constraints determine the situation where such neutral (in respect to consumer/producer prices) can reduce both the state tax revenues and national welfare. In those circumstances the number of goods, destined to increase of VAT, is limited because of large informal sector; and the trade tariff cuts can lead to mentioned consequences.

In this case the levying of import tariff permits the indirect taxation of imported resources, which are used in production in informal sector; in such a way the distortions, appeared as a result of limited VAT incidence, reduce.

Besides, the imperfection of tax administration system itself in Ukraine can lead to no gains after trade-tax reform, because the administrative costs can exceed the possible gains from moving to broaden VAT base (with simultaneous trade taxes cuts).

Therefore, on one side, the maximum possible trade tax cuts in Ukraine will lead to maximum openness of country's home market. How far those consequences are gainful for Ukraine at actual level of economic development and for Ukrainian economy's competitiveness is the debating point, but the fact that the openness of Ukrainian market is gainful for developed countries, which established the IMF strategy, is undoubtful. This refers to possibility of market development for products, which are more competitive than the products of Ukrainian home market, and also to possibility of buying the raw materials at law prices.

At the same time, the some constraints, reflecting the real situation in Ukrainian economy, notably, the large informal sector, existence of non-traded and intermediate goods; different administrative costs of levying of different taxes; existence of smuggling and cross-border shopping, can complicate the problem of partial shifting from taxes, levied at the border, to taxes, levied domestically. Therefore, the question concerning expediency of providing such policy in Ukraine remains undetermined.

The paper is organized as follows.

Section II includes the literature review concerning the theoretical and empirical investigations, related to providing tax-tariff reform. Section III contains the model specification. Quantitative evaluation of the model is given in Section IV.

II Literature review

An analysis of trade taxes and VAT in developing countries, which takes into account the considerable informal sector in economy, and also consequences of tax-tariff reform in countries with different levels of income, taking into account the costs of tax administration (Munk (2008)), was done by modern economists.

A trade tax cuts with a compensating or revenue-enhancing increase in value-added tax (henceforth VAT) has been the center-piece of such a reform, and it has been implemented in a large number of developing countries under the structural adjustment and stabilization policy conditionalities of the IMF and the World Bank.

The VAT and withholding taxes and their role in informal sector in the frame of small open economy were studied by Keen (2007). He finds the conditions under which a VAT alone is fully optimal, precisely because it is in part a tax on informal sector production. But they are restrictive: in particular, the author concludes that efficient tax structure requires deploying both a VAT and withholding taxes.

Boadway and Sato (2007) examined the similar problem. Using an optimal commodity tax approach they compared trade taxes and VATs when some goods are produced informally. The authors find that VAT can achieve production efficiency within the formal sector, but unlike the trade tax regime, it cannot indirectly tax pure profits. Changing of informal sector size (due to government's enforcement) may also tilt the balance in favor of the VAT.

Theoretical researches, made by Stiglitz and Shahe Emran (2004, 2005, 2007), showed when there is no informal sector, such a reform can yield double dividend in the sense that it increase both revenue and welfare and such a reform is as likely to reduce both welfare and revenue when the existence of a large informal and shadow economy in developing countries is taken into account. They have focused on a revenue-neutral reform of VAT and trade tax in the presence of a large informal economy, particularly in the context of developing countries. They have analyzed both a revenue-neutral selective reform of VAT and trade tax on the existing bases and a VAT base broadening with a revenue-neutral reduction in trade taxes. They have shown that then the choice of the commodity for VAT increase is restricted by the existence of a large informal sector, the standard policy reform can reduce welfare. However, the models model used in those papers ignore smuggling, differential administrative costs of different taxes etc.

Ligthart and van der Meijden (2010) continued investigations in this area. They studied the revenue, efficiency, and distributional implications of a simple strategy of offsetting tariff reductions with increases in destination-based consumption taxes in a small open developing economy with informal sector which cannot be taxed. Taking into account the dynamic effects of taxes and tariffs on factor markets, as opposed to Emran and Stiglitz (2005), the authors find that existing generations benefit more than future generations, who – depending on pre-existing tax and tariff rates and the informal sector size – even may become worse off.

Some empirical estimations of fiscal impact of trade reform on public revenue are considered in Devarajan et al. (1999), and Keen and Baunsgaard (2005).

Devarajan et al. (1999) using a tax model of an open economy provided a method for estimating the fiscal impact of trade reform. They used the data on 60 countries all over the world at 1987. Basic parameters of model were size of tariff cuts, the response of imports to the tax change and the relative importance of import tariffs as a source of government revenue. Both values of elasticites have to be greater than 20 before revenue growth becomes really positive.

Keen and Baunsgaard (2005), using an econometrical model, estimated the influence of trade liberalization on government revenue. This paper used panel data for 111 countries over 25 years. High-income countries clearly have recovered from other sources the revenues they have lost from trade liberalization. For middle-income countries, recovery has been in the order of 45–60 cents for each dollar of lost trade tax revenue. However, revenue recovery has been extremely weak in low-income countries: they have recovered, at best, no more than about 30 cents of each lost dollar. Nor is there much evidence that the presence of a value-added tax has in it made it easier to cope with the revenue effects of trade liberalization.

Piggott and Whalley (1999) have constructed simple numerical examples of a general equilibrium economy, where a VAT base broadening reduces welfare because of supply side substitutions toward informal and home production (self supply). Results from calibration of their model to the data from Canada have shown that the base broadening of VAT has, in fact, reduced aggregate efficiency. Their analysis was confined to the implications of an informal sector for a VAT base broadening.

In this context the given paper aims to discover the influence of trade taxes and VAT on commodity flows, profits of economic agents and state tax revenues in developing economy with large informal sector, which size can change.

III Model specification

The model was built up according to the following hypothesis: the expediency of compensation of state revenue losses from trade tax cuts due to rising of VAT real rate depends on trade tax and VAT rates elasticity (further –*tax rates elasticity*) of informal sector sizes. *Tax rates elasticity* here is understood to be a measurement of how changing the tax rates affects the changing of informal sector size.

This refers to the IMF and the World Bank recommendations, concerning the providing of tax-tariff reform, which can assure the "non-reduction" of state revenue only with direct anti-evasion measures (to reduce smuggling, VAT manipulations etc.) as a whole.

It should be noted that the given hypothesis does not consider the different elasticity for each tax in the informal sector; the proposed model is based on the assumption (feasible for Ukrainian economy), that the intention of the taxpayer to evade tax is influenced not by the tax type but by amount of all his tax liabilities.

It is provided the development of a theoretical model, empirical robustness of which will be examined by the example of Ukraine.

Input Data

structure of commodity import and export of Ukraine;

current trade taxes and VAT rates;

current level of smuggling;

production of goods of low and high processing;

average rate of return and added cost.

The main parameters of the model, which has a crucial importance for its empirical calibration, are the figures of real and financial sectors of economy.

Main data sources:

official data prepared by Customs administration of Ukraine concerning the structure of commodity import and export of Ukraine and their volumes and the trade taxes rates;

official data prepared by Ministry of Finance of Ukraine about current VAT rates and appropriate preferences and exemptions;

official data given by Ministry of Economic Development and Trade of Ukraine and National Institute for Strategic Studies concerning tendencies of informal sector in Ukraine, which include the estimations of Ukrainian informal sector by different methods (the physical input (electricity) method, the currency demand approach etc.);

official statements concerning the level of smuggling. The official statistical data for this parameter are absent, but people concerned the subject know very well how many goods are transported across the state border illegally.

official data given by Ukrainian State Statistic Committee about values of added costs by branches.

The input data are presented in appendix A (table A1).

At once it should be noted that the given model is not the instrument of forecasting of changes in external trade of Ukraine, but it is designed for analysis of trade tax and VAT influence on external trade, state tax and economic agents' revenues in presence of the informal sector.

Economy is characterizing by the following.

1. The economy is presented by two managing agents – by government which is authorized to set and levy taxes, and enterprises which produce goods, participate in foreign trade and pay taxes.

2. There is a middle openness of national economy (active participation of producers in international trade, but no influence on prices in world market).

3. There is a different tax rates elasticity of commodity flow (export and import, raw materials and finished products) in foreign trade.

4. A home country market is able to consume all offered goods (i.e. change of volumes of imported goods does not influence essentially on volumes of consumption of the domestic goods).

5. There were two types of levied taxes in economy – VAT, levied on domestic consumption and commodity import, and also trade taxes, levied on commodity export and import. In contrast to "Devarajan model", which used only import tariffs, in calculations in proposed model, we'll use also export taxes. That is the requirement for characterizing the raw-oriented economies, including Ukraine[4].

6. VAT on export is levied according to the destination principle.

7. Proposed model takes into account the possibility of agents' opportunistic behavior, which in the given case consists in tax evasion (smuggling, VAT manipulations). Belonging to formal sector is defined in given model as a zero

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[4] The assumptions 4, 5 (like some other ones) are used for model simplification and they can be excluded in further research.

tax evasion; any evasion, differing from zero is regarded as belonging to informal sector. This implies that there are state tax revenues, collected in informal sector.

Smuggling in the informal sector (k):

$$0 \leq k \leq 1,$$

where $k\ = 1$ denotes the existence of smuggling (the good crosses the border without paying any taxes); $0 \leq k \leq 1$ means the partial tax payment when the good crosses the border. $k = 0$ means that all cross-border taxes are paid. In the formal sector $k = 0$.

Distinction in kind of proposed model from ones developed by Devarajan and also Emran and Stiglitz lies in introduction of possibility of tax evasion (opportunistic behavior) in concerned economy, namely the introduction of parameter “smuggling”, taking into account the possibility of illegal agents’ profit, proceeded from VAT manipulations.

8. The informal sector, in turn, consists of:

a) enterprises, paying domestic VAT and cross-border taxes, besides $0 < k \leq 1$ (i.e., if VAT is fully paid, there should be a trade tax evasion ($k > 0$));

b) enterprises, do not paying the domestic VAT, but paying cross-border taxes, besides $0 \leq k \leq 1$.

9. All profits, received in informal sector, are exported.

The assumption about direct correlation between values of tax evasion and changes of tax rates was suggested based on a number of existing studies, which confirm such type of correlation (see for example N. Loyaza (1996); C. Kuchta-

Helbling et al. (2000); F. Schneider and D. Enste (2000); R. Klinglmair and F. Schneider (2004)).

The model of commodity flows in merchandise trade and domestic economy operates the set of values, which are presented in Table 1.

Thus, in given model the economy is structured on industries working mainly on export and domestic production (the high processing and law processing goods are distinguished). Thus, in comparison with "Devarajan model", which operates with standard 1-2-3 model that separates the economy into three distinct goods: export, imports and non-traded goods, the presented one substantially enlarges the set of branches. This is also a principal improvement (with respect to economies, which export principally raw materials) in comparison with "Emran-Stiglitz model", which considers only abstract sets of exportable and importable commodities.

Also, proposed model looks more attractive in comparison with "Emran-Stiglitz model" and "Ligthart-Meijden model" from the point of the verification of its parameters: data for parameterization are substantially more available that data needed for parameterization of "Emran-Stiglitz model" and "Ligthart- Meijden model".

Table 1.

Values of commodity flows

	Value	Label
1	Finished products value (high processing) made from domestic raw materials and then exported	αX_{FP}
2	Domestic raw materials export value (law processing)	αX_{RM}
3	Value of goods made from the imported raw materials and then exported	βX
4	Value of products made from domestic raw materials and then consumed in country	αCP
5	Value of goods made from the imported raw materials and then consumed in country	βCP
6	Value of goods imported for domestic consumption, not requiring the further processing	αM
7	Value of imported raw materials*	βM

*To simplify the calculation it is assumed that there no re-export of raw materials

For Ukrainian economy αX_{FP}, αX_{RM}, αM and βM values define as the total for all commodity flows (which are and are not subject to trade tax) in formal and informal sectors:

$$\alpha X_{FP} = \sum_{j \in \alpha X_{FP}^{f+}} X_j + \sum_{j \in \alpha X_{FP}^{f-}} X_j + \sum_{j \in \alpha X_{FP}^{i+}} X_j + \sum_{j \in \alpha X_{FP}^{i-}} X_j; \quad (1)$$

$$\alpha X_{RM} = \sum_{j \in \alpha X_{RM}^{f+}} X_j + \sum_{j \in \alpha X_{RM}^{f-}} X_j + \sum_{j \in \alpha X_{RM}^{i+}} X_j + \sum_{j \in \alpha X_{RM}^{i-}} X_j; \quad (2)$$

$$\alpha M = \sum_{j \in \alpha M^{f+}} X_j + \sum_{j \in \alpha M^{f-}} X_j + \sum_{j \in \alpha M^{i+}} X_j + \sum_{j \in \alpha M^{i-}} X_j\,; \quad (3)$$

$$\beta M = \sum_{j \in \beta M^{f+}} X_j + \sum_{j \in \beta M^{f-}} X_j + \sum_{j \in \beta M^{i+}} X_j + \sum_{j \in \beta M^{i-}} X_j, \quad (4)$$

where $\forall j: j \in \alpha X_{FP}^{f+}, j \in \alpha X_{FP}^{i+}, j \in \alpha M^{i-}: X_j = 0$, X_j defines the value of commodity flow;

the *f* and *i* indexes define the belonging to formal and informal sectors agreeably;

$+$ and – indexes define the payment and non-payment of taxes agreeably in the sectors.

Define ū as the weight of domestic raw materials for producing goods which will be consumed in country; u as the weight of domestic raw materials for producing finished products which will be exported; ù as the weight of domestic raw materials (law processing) which are exported. It's obvious that $u + ù + ū = 1$.

Then assume that the final goods are sold at the same prices in the country and outside (export).

Then

$$\alpha CP = \alpha X_{FP} \cdot \frac{ū}{u} = \alpha X_{FP} \cdot \frac{1-u-ù}{u} = \alpha X_{FP} \cdot \left(\frac{1-ù}{u} - 1\right). \quad (5)$$

The total value of imported goods (M):

$$M = \alpha M + \beta M. \quad (6)$$

During the processing of imported raw materials inside the country for βX and βCP sectors the added value p is creating ($p > 1$). Then βX and βCP can be written as

$$\beta X = (\omega \cdot \beta M) \cdot p,$$

$$\beta CP = (\acute{\omega} \cdot \beta M) \cdot p, \quad (7)$$

where ω and $\acute{\omega}$ are the coefficients, determining the amount of imported raw materials for βX and βCP agreeably ($\omega + \acute{\omega} = 1$)[5]; p is the added cost, which appears during the domestic processing of imported raw materials ($p > 1$).

We can formalize the total output (C) as:

$$C = \alpha X_{FP} + \alpha X_{RM} + \alpha CP + \alpha M + p \cdot \beta M, \tag{8}$$

that we can rewrite taking into consideration the correlations (2)-(3) as:

$$C = \alpha X_{FP} + \alpha X_{RM} + \alpha CP + \alpha M + \beta X + \beta CP \tag{9}$$

or

$$C = \alpha X_{FP} \cdot \frac{1-\grave{u}}{u} + \alpha X_{RM} + \alpha M + \beta X + \beta CP. \tag{10}$$

The equations (5)-(10) describe the model of influence of trade tax rates changes on commodity flows in external trade and home economy.

It should be noted that since at the present stage in Ukraine the informal activity touches all branches of economy, the equations, defining the price of production in formal and informal economy, will be absolutely identical with regard to parameters.

IV Quantitative evaluation of the model

There were tariff cuts in trade liberalization. The standard situation is described by the simultaneous cuts in export (t_x) and import duties (t_m), which is considered further.

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[5] The values of total added value by branches of economy are the official data, prepared by Ukrainian State Statistical Committee.

Influence of import tariff cuts on value of commodity flows

The import tariff cuts leads to increase of import of goods – αM and βM. It's assumed, that the increase of αM does not lead to decrease of αCP and αX_{RM} ($\alpha X_{RM} = \alpha X_{FP} + \alpha X_{RM}$), i.e. those parameters do not depend from each other (there are no substitution effect).

The increase of βM leads to the increase βCP and βX. It is also assumed that there no substitution effect between αX_{RM} and βX (domestic raw materials are not imported, consequently αX_{RM} and βX use different production facilities and there is no competition). Similarly, for αCP и βCP.

Influence of export duty cuts on value of commodity flow

Export duties reduction does not affect βX, (in Ukraine there are no export duty on final products). There is no direct influence on αX_{FP}.

Export duty cuts leads to the increase of αX_{RM}.

However in the conditions of limited resources the increase of raw materials export one day can result in reducing of domestic raw material base (needed for production of final goods). This statement is based on the law of diminishing marginal utility; its empirical verification for Ukraine has been made in Vishnevskyy and Luk'yanenko (2006).

So, the export duty cuts can cause reduction of αCP and αX_{FP} (table 2).

Table 2.

Influence of trade tax cuts on values of commodity flows

Δt_m	Δt_x
$\downarrow t_m \rightarrow \uparrow \alpha M$	$\downarrow t_x \rightarrow \uparrow \alpha X_{RM}$
$\downarrow t_m \rightarrow \uparrow \beta X$	$\downarrow t_x \rightarrow \downarrow \alpha X_{FP}$
$\downarrow t_m \rightarrow \uparrow \beta CP$	$\downarrow t_x \rightarrow \downarrow \alpha CP$
$\downarrow t_m \rightarrow \Delta\alpha CP = 0$	$\downarrow t_x \rightarrow \Delta\beta X = 0$
$\downarrow t_m \rightarrow \Delta\alpha X = 0$	$\downarrow t_x \rightarrow \Delta\beta CP = 0$

The change of volume of commodity flow due to change of trade tax (ΔMF) can be defined knowing commodity flow trade tax rate elasticity, namely, since the commodity flow elasticity E with regard to trade tax rate can be defined as

$$E = \frac{\Delta MF}{\Delta t}, \qquad (11)$$

where Δt is the trade tax rate change, unit fraction;

then $\Delta MF = E \cdot \Delta t$.

A new value of commodity flow after the trade tax change (MF) can be calculated according to the formula (12) for each sector; the results are in the table 3.

$$M\acute{F} = MF + (MF \cdot \Delta MF) = MF \cdot (1 + \Delta MF) = MF \cdot (1 + E \cdot \Delta t), \qquad (12)$$

where MF is the value of commodity flow at the initial trade tax rate, unit fraction.

Table 3.

New value of commodity flows after trade tax cuts (by sectors)

New value of commodity flows after trade tax cuts (in formal sector)	New value of commodity flows after trade tax cuts (in the informal sector)
$\alpha M^{\prime f} = \alpha M^{f} \cdot (1 + (E^{\alpha M} \cdot \Delta t_{m}))$	$\alpha M^{\prime i} = \alpha M^{i} \cdot (1 + (E^{\alpha M} \cdot \Delta t_{m}))$
$\beta M^{\prime f} = \beta M^{f} \cdot (1 + (E^{\beta M} \cdot \Delta t_{m}))$	$\beta M^{\prime i} = \beta M^{i} \cdot (1 + (E^{\beta M} \cdot \Delta t_{m}))$
$\beta X^{\prime f} \cdot (1 + (E^{\beta M} \cdot \Delta t_{m} \cdot p \cdot \omega = \left[\left(\omega \cdot \beta M^{f}\right) \cdot p\right] \cdot [1 + E^{\beta M} \cdot \Delta t_{m} \cdot p \cdot \omega)]$	$\beta X^{\prime i} = \beta X^{i} \cdot (1 + (E^{\beta M} \cdot \Delta t_{m} \cdot p \cdot \omega)) = \left[\left(\omega \cdot \beta M^{fi}\right) \cdot p\right] \cdot [1 + E^{\beta M} \cdot \Delta t_{m} \cdot p \cdot \omega)]$
$\beta CP^{\prime f} = \beta CP^{f} \cdot (1 + (E^{\beta M} \cdot \Delta t_{m} \cdot p \cdot \acute{\omega})) = \left[\left(\acute{\omega} \cdot \beta M^{f}\right) \cdot p\right] \cdot [1 + E^{\beta M} \cdot \Delta t_{m} \cdot p \cdot \acute{\omega})]$	$\beta CP^{\prime i} = \beta CP^{i} \cdot (1 + (E^{\beta M} \cdot \Delta t_{m} \cdot p \cdot \acute{\omega})) = \left[\left(\acute{\omega} \cdot \beta M^{i}\right) \cdot p\right] \cdot [1 + E^{\beta M} \cdot \Delta t_{m} \cdot p \cdot \acute{\omega})]$
$\alpha X^{\prime f}_{RM} = \alpha X^{f}_{RM} \cdot (1 + (E^{\alpha X_{RM}} \cdot \Delta t_{x}))$	$\alpha X^{\prime i}_{RM} = \alpha X^{i}_{RM} \cdot (1 + (E^{\alpha X_{RM}} \cdot \Delta t_{x}))$
$\alpha X^{\prime f}_{FP} = \alpha X^{f}_{FP} \cdot (1 + (-E^{\alpha X_{FP}} \cdot \Delta t_{x}))$	$\alpha X^{\prime i}_{FP} = \alpha X^{i}_{FP} \cdot (1 + (-E^{\alpha X_{FP}} \cdot \Delta t_{x}))$
$\alpha CP^{\prime f} = \alpha CP^{f} \cdot (1 + (-E^{\alpha X_{RM}} \cdot \Delta t_{x}))$	$\alpha CP^{i/} = \alpha CP^{i} \cdot (1 + (-E^{\alpha X_{RM}} \cdot \Delta t_{x}))$

The state budget constraint $\widehat{R}$ gives:

$$\widehat{R} = R(t, v), \tag{13}$$

where R denotes the total state tax revenues proceeded from the tax collection in all sectors; t denotes the trade tax rate, unit fraction; v denotes the real VAT rate, unit fraction.

Some further assumptions and also values of parameters are calculated according to formulae, presented in Appendix B.

In order to calculate the elasticities, the commodity flows were analyzed, in particular, the analysis concerned the goods, the export duties on which suffered changes (notably, the ferrous scrap and sunflower seeds). The findings were adjusted taking into account the changes of other factors (changes of sunflowers crop acres, the international prices of sunflower seeds; the ferrous scrap supply to Ukrainian metallurgical plants, export and international prices of ferrous scrap etc.).

Concerning the calculation of price elasticity it should be noted the following. The Ministry of Economic Development and Trade of Ukraine monthly issues an instruction in order to set the export prices for some types of goods. Basing on that data the changes of prices and changes of export volumes were analyzed. For further calculations the weighted average of obtained values were used[6].

The given model does not provide the securely fix values of elasticities; as mentioned above, the data for any good and for any period of time can be used. In this case the values of elasticities reflect only the direction (sign) of commodity flows changing (in consequence of changing of trade taxes and prices).

According to the statement of the Head of Customs administration of Ukraine in 2011, there is no official data on the level of smuggling in Ukraine; only the

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[6] According to the WTO rules, the minimum export prices, which are now set by Ministry of Economic Development and Trade of Ukraine, should be cancelled. The custom valuation of such goods will be provided taking into account the listings of international exchanges.

detected injury can be evaluated. Relevant to such evaluation, in 2010 the level of smuggling attained 45% of volume of foreign trade.

On the ground of data of Customs administration of Ukraine about export duty rates, number of commodity items, for which the same import duty rates are established, and quantity of goods, which is subject to export duty, it was calculated the weight-average import duty rates ($\overline{t_{im}}$) and export duty rates ($\overline{t_{ex}}$). In 2010 in Ukraine the average weighted import tariff was about 7%, and the average weighted export duty – about 29%.

For estimating the trade taxes and VAT influence on agents' activity and state tax revenue, it was realized a number of computational experiments using proposed economic-mathematical model.

1. Scenario, characterizing the initial conditions of Ukrainian economy.
2. Scenario with different easiness level of opportunistic behavior of agents (depending on tax rate).
3. Scenario when the informal sector size is not influenced by tax rates.

1. Scenario characterizing the initial conditions of Ukrainian economy

There were defined the possible variants of cuts of existing import tariff[7] and appropriate increase of effective VAT rate (by eliminating the tax exemptions and preferences) (fig. 1), on which the state tax revenue and agent' profit will exceed the initial values.

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[7] At the moment in Ukraine only the raw material are subject to export duty; according to calculations, this parameters makes only 3,08% of all export of raw materials, so in further calculations the export duty rate is held constant.

When the tariff is reduced to the 5%, the real VAT rate, wherein the state revenue losses will be compensated, should be 22,7% – in that case the rates of additions of economic agents' profit (in formal sector) and state tax revenues will be the same (1,09 times). On fig. 1. that is the common point of intersection of right lines, which reflect the changes of economic agents' profit (in formal sector) and the changes of state tax revenues (at the import tariff rate of 5%).

The direct rising of the nominal VAT rate is not provided; but the rising of real VAT rate, according to the World Bank and IMF recommendations, should be provided by eliminating the VAT exemptions and preferences.

When the tariff is reduced to the 1%, the real VAT rate, wherein the state revenue losses will be compensated, should be 24% – in that case the rates of additions of economic agents' profit (in formal sector) and state tax revenues will be the same (1,17 times). On fig. 1. that is the common point of intersection of right lines, which reflect the changes of economic agents' profit (in formal sector) and the changes of state tax revenues (at the import tariff rate of 1%).

If the goal of tax-tariff reform provides only the maximization of state tax revenue, then on fig. 2 there are represented the all possible variants of compensation of state tax revenue losses, which exceed the initial value.

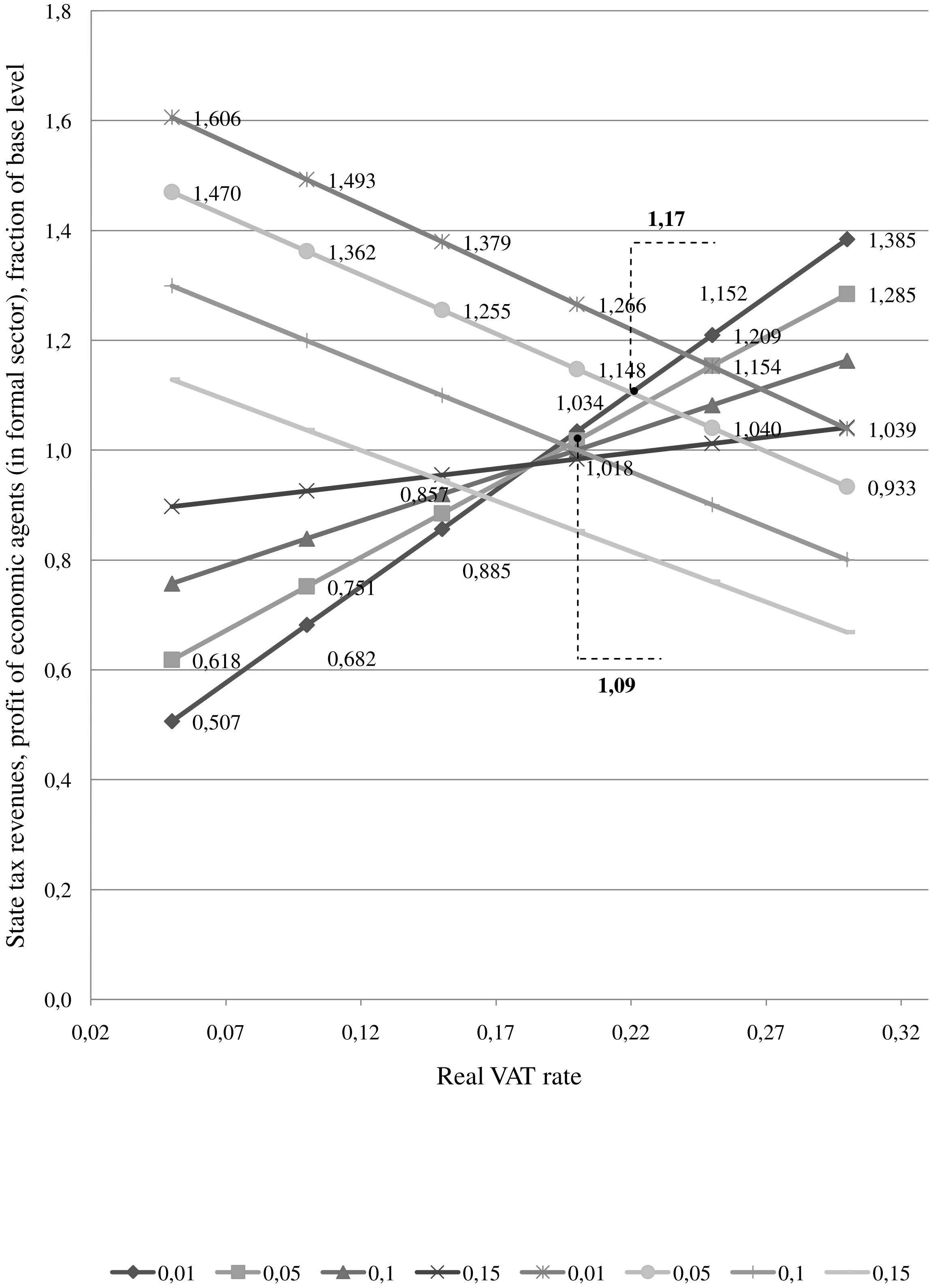


Fig.1. The result of estimation of tax-tariff reform in Ukraine: changes of state tax revenue and profit of economic agents' (in formal sector) at the different rates of import tariff and VAT.

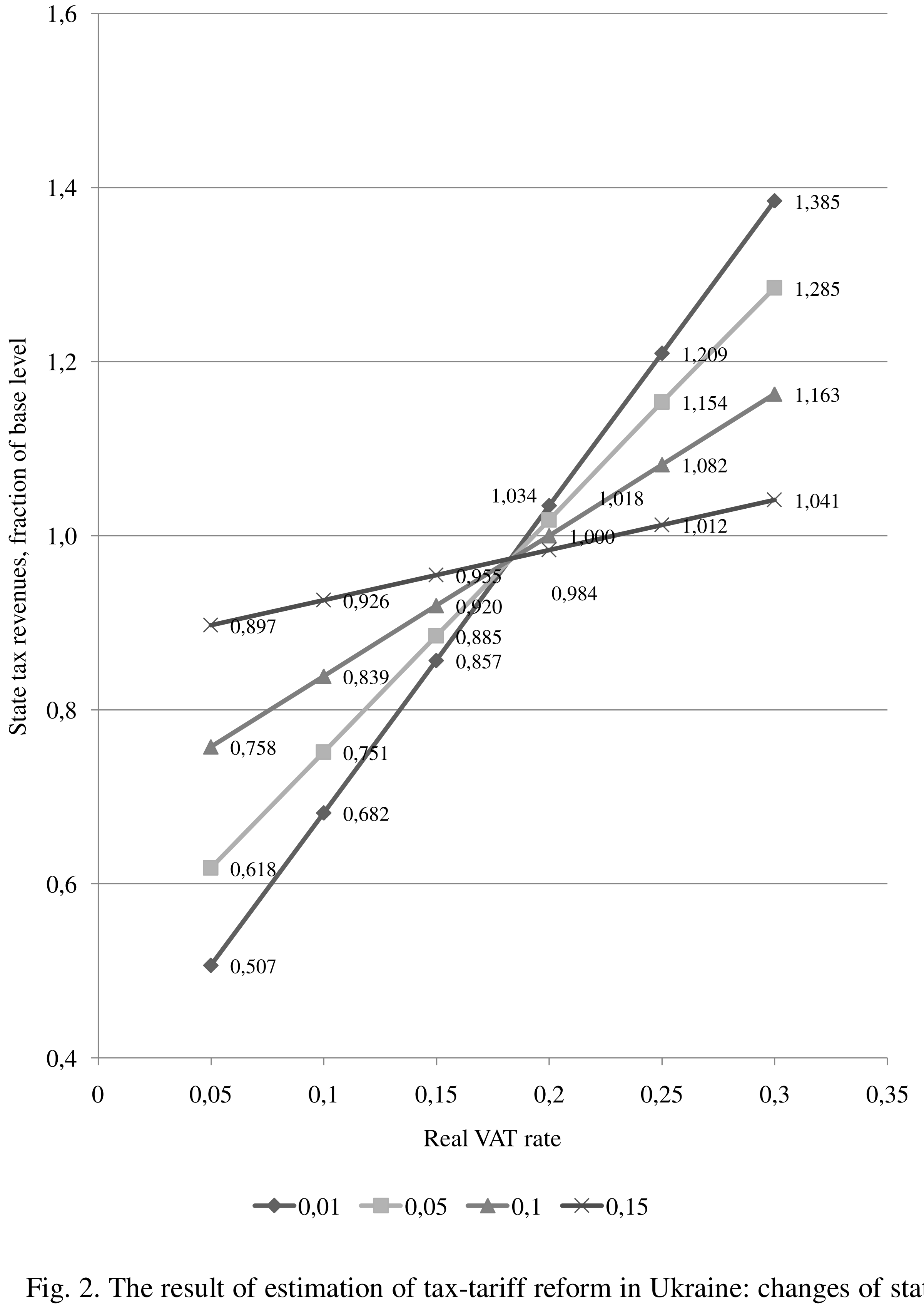


Fig. 2. The result of estimation of tax-tariff reform in Ukraine: changes of state tax revenue at the different rates of import tariff and VAT.

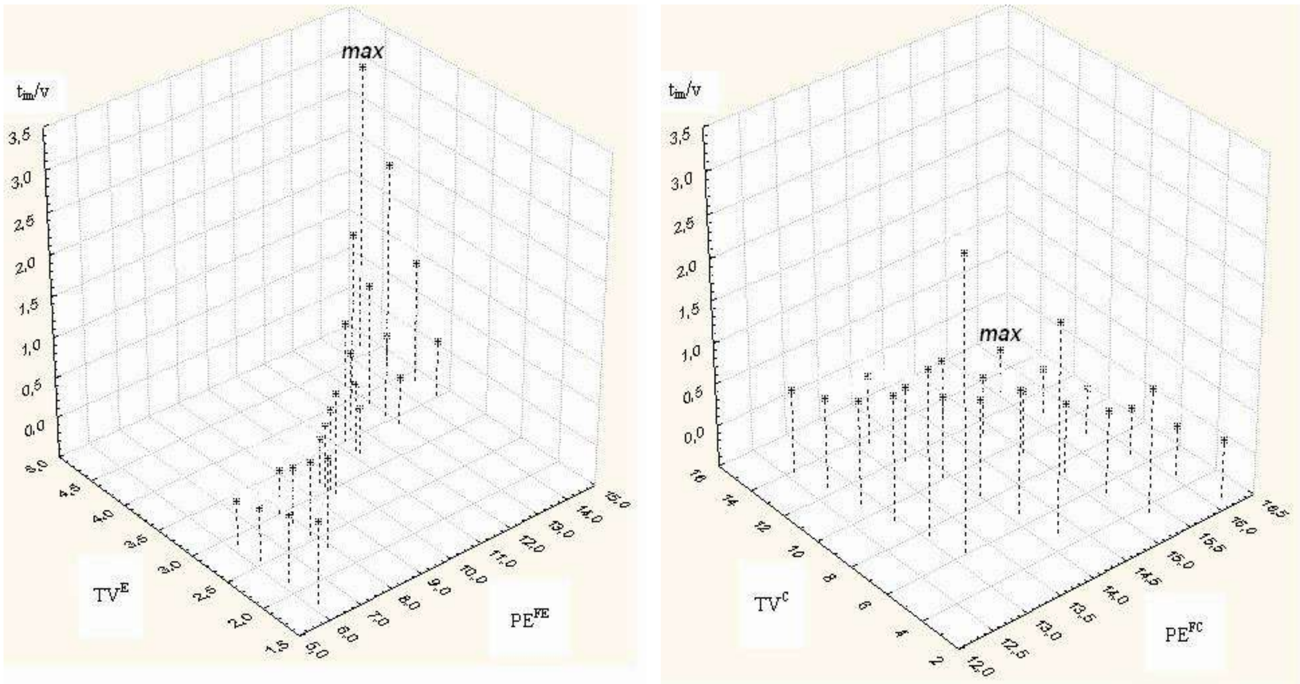
2. Scenario with different easiness level of opportunistic behavior of agents (depending on tax rate)

Here it was defined, specifically, on which trade tax and VAT rates the maximum of state tax revenues and agents' profit would be achieved.

It should be noted that the investigation of scenario is the principal for testing the given hypothesis concerning the compensation of state tax revenue losses from trade tax cuts (those losses are provided to be compensated by rising of real VAT rate) depending on tax rates elasticity of the informal sector size.

In this case tax rates elasticity takes an account the barriers for shifting into the informal sector, which takes place due to rising of tax rate.

Calculations showed that, if the barriers for economic agent' shifting into the informal sector are practically absent, the maximum of state tax revenues and profit of economic agents (in formal sector) can be reached at the minimum VAT rate – 5%, and the maximum import tariff rate – 15%, as can be seen from fig. 3.*a*, i.e., in this case $\frac{t_{im}}{v} = 3$.



a) barriers for shifting into informal sector are minimum

b) barriers for shifting into informal sector are substantial

Fig. 3. State tax revenues and profit of economic agents (in formal sector) for the case with different VAT and trade tax elasticity of informal sector sizes

TV^E– state tax revenues, USD billions;

PE^{fE} – profit of economic agents (in formal sector), USD billions;

TV^C – state tax revenues, USD billions;

PE^{fC} – profit of economic agents (in formal sector), USD billions;

t_{im} – import tariff rate, unit fraction;

v – real VAT rate, unit fraction.

Fig. 3.*b* presents the significant barriers for shifting into the informal sector. In this case, conversely, the maximum of state tax revenues and profit of economic agents (in formal sector) can be reached at the maximum VAT rate – 30%, and the minimum import tariff rate – 1%, i.e., in this case $\frac{t_{im}}{v} = 0{,}03$.

Taking into account all foresaid it can be noted, that the suggested hypothesis is confirmed. It means, that it is reasonable to compensate the state tax revenue losses from trade tax cuts (through rising of VAT rate) in the case, where are the significant barriers for shifting into informal sector.

3. Scenario of calculation when the informal sector size is not influenced by tax rates.

In this case the profit of economic agents (in formal sector) nowise depends on real VAT rate; it depends only on informal sector size. So, only the total state tax revenues, which exceed the initial values at different informal sector sizes, can be defined.

According to the estimations of National Institute for Strategic Studies in 2010 the size of informal sector in Ukraine was about 38%. In this case the maximum state tax revenues and minimum profits of economic agents (in informal sector) can be achieved at real VAT rate of 30% and import tariff rate 1% (Appendix D).

With the purpose of making the concrete guidelines for Ukrainian tax-tariff policy, basing on expected research results, the country's economy is structured by branches according to their tax rates elasticity in different commodity markets (perfect competition, oligopoly and monopoly).

VAT base enlargement in consequence of trade tax cuts is able to entail the price increase in retail trade. On markets, which characterize the situation, similar to perfect competition, this may lead to decrease in demand for goods, supplied by new prices; a part of economic agents will prefer to shift into informal sector (fig. 4), but do not reduce their production output.

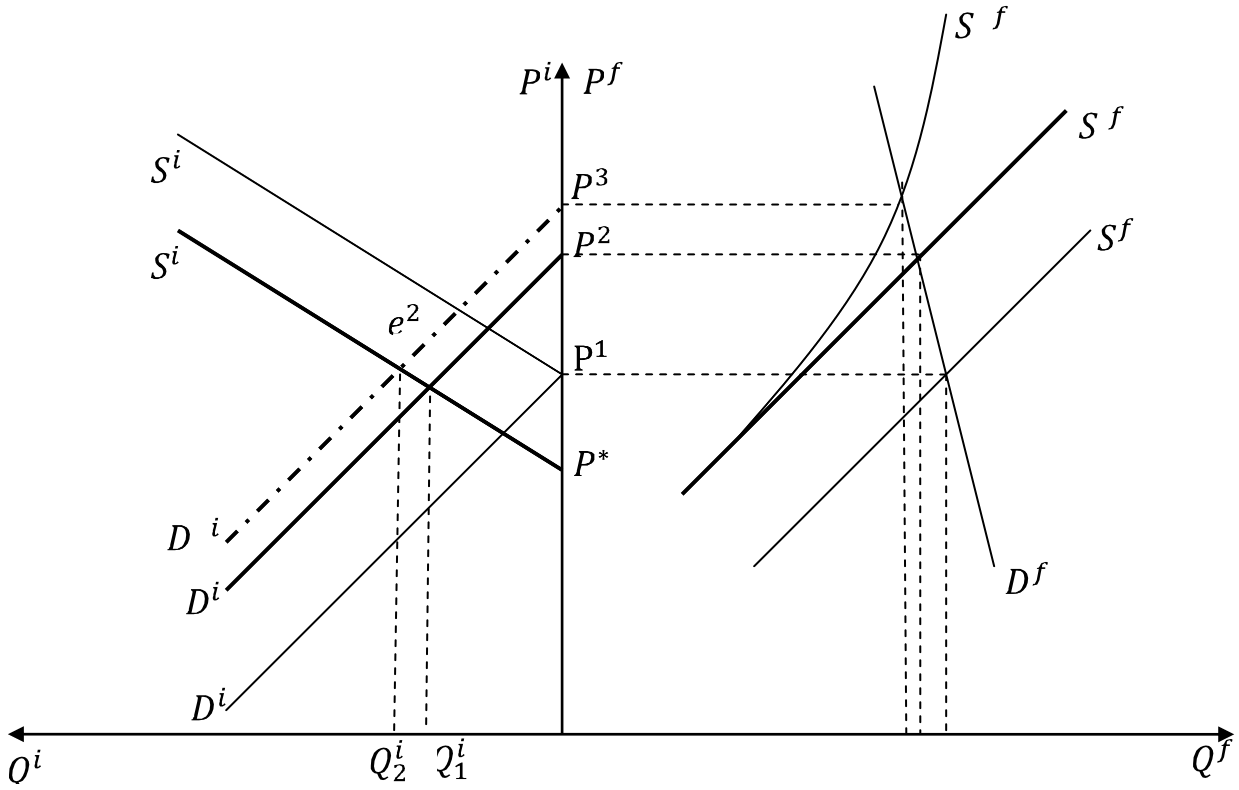


Fig. 4. Impact of tax base enlargement on production output in conditions of perfect competition

Legend:

S^f is supply in formal sector; D^f is demand in formal sector; Q^f is production output in formal sector; P^f is prices in formal sector; S^i is supply in informal sector; D^i is demand in informal sector; Q^i is production output in informal sector; P^i is prices in informal sector.

Before tax base enlargement the equilibrium in formal sector is in e^1. Commodity price in formal sector (P^1) represents the lower bound of commodity supply in informal sector and the upper bound of their demand in informal sector. Production output in formal sector is $Q^f{}_1$. The demand in informal sector depends directly of commodity price in this sector (P^i), which depends on risk premium.

After tax base enlargement the commodity price in formal sector will increase ($P^2 > P^1$). As a result, on the assumption of elastic supply in formal sector (i.e. tax base enlargement is proportionate to decrease in supply), this later will decrease to $S^{/f}$. A new equilibrium in formal sector will be in e^2, where $P^2 > P^1$ and $Q^f{}_1 > Q^f{}_2$.

Economic agents will use the variation in prices ($P^2 > P^*$) in their own interests (P^* is untaxed commodity price in formal sector). They shift a part of their production into informal sector. P^2 is the upper bound of demand ($D^{i/}$) in informal sector. In this situation the equilibrium in informal sector will be in $e^{/1}$; production output in this sector will be $Q^i{}_1$.

In case of inelastic supply in formal sector (i.e. tax base enlargement is disproportionate to decrease in supply), the situation is similar. A new equilibrium will be in e^3, where $P^3 > P^2 > P^1$ and $Q^f{}_3 > Q^f{}_2 > Q^f{}_1$. In informal sector the equilibrium will be in $e^{/2}$, where $Q^i{}_2 > Q^i{}_1$. D^{i++} is the upper bound of demand (D^{i++}) in informal sector.

As for monopoly and oligopoly markets, the tax base enlargement, which will compel the economic agents to reduce their production or to increase prices, most likely will lead to rise in prices, since the consumers will purchase the commodity on new prices.

Conclusion

The given investigation testified the incapability to give a unique estimate of adequacy of tax-tariff reform (recommended by IMF and the World Bank in Ukraine), which provides the compensation of state tax revenue losses from trade tax cuts by broadening the VAT base (eliminating the VAT exemptions and preferences).

It was estimated the influence of foreign trade taxation on commodity flows, on economic agents' profit and on state tax revenues, taking into account the informal sector of economy and the pattern of foreign trade. It is established that it is expedient to cut the trade tax rates with compensation of state tax revenue losses by VAT base enlargement according to the tax rates elasticity of informal sector size. I.e., the easier is the shift into the informal sector, the less degree the trade tax should be cut (and the less should be the enlargement of VAT base).

Therefore, providing the trade liberalization by way of substitution of trade tax revenues by enlarged VAT is expedient in those branches of economy, which are characterized by monopoly and oligopoly situation. For instance in Ukraine among such branches are mining and smelting industries, chemical industry, spirit industry, medical industry etc. On the contrary, in Ukrainian branches of economy, characterizing by the situation, similar to perfect competition (iron and steel scrap market, agriculture, in particular, the oil seeds market, foodstuffs production etc.), the trade taxes cuts with subsequent VAT base enlargement may result to shifting of many economic agents into the informal sector; and realization of this reform will not lead to expected results.

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Appendix A

Table A.1

Input data, USD, millions

Main figures	αM	αXFP	αXRM	βX	αCP	βCP	βM	M
1. Formal sector								
Value of goods, which are subject to “cross-border” taxes (trade taxes and VAT)	15292,6	0,0	322,0	9268,3	–	13902,5	21654,9	36947,5
Value of goods, which are not subject to “cross-border” taxes (trade taxes and VAT)	1329,8	9687,0	17568,0	189,1	–	283,7	441,9	1771,7
Total (in formal sector)	16622,4	9687,0	17890,0	9457,4	16145,0	14186,2	22096,8	38719,3
2. Informal sector								
Value of goods, which are subject to “cross-border” taxes (trade taxes and VAT)	6789,4	0,0	131,5	3785,6	–	5678,5	8845,0	15634,4
Value of goods, which are not subject to “cross-border” taxes (trade taxes and VAT)	0,0	3956,7	7175,7	77,3	–	115,9	180,5	180,5
Total (in informal sector)	6789,4	3956,7	7307,2	3862,9	6594,4	5794,4	9025,5	15814,9
Total (in economy)	23411,9	13643,7	25197,2	13320,4	22739,5	19980,5	31122,3	54534,2
Elasticity of commodity flows (as a result of trade tax changes)	–0,4		–0,4				–0,3	
Price elasticity of commodity flows *	0,7	0,7	0,5				0,6	

*For goods, which are not subject to trade taxes, it is used the price elasticity of commodity flows

Appendix B

Estimation of model parameters for changed tax rates

Notations:

αM is the value of goods imported for domestic consumption, not requiring the further processing;

βM is the value of imported raw materials;

βX is the value of goods made from the imported raw materials and then exported;

αCP is the value of products made from domestic raw materials and then consumed in country;

βCP is the value of goods made from the imported raw materials and then consumed in country;

The f and i indexes define the belonging to formal and informal sectors agreeably;

t_m^+ is the new import tariff rate, unit fraction ($t_m^+ = t_m + \Delta t_m$);

t_x^+ is the export duty rate, unit fraction. ($t_x' = t_x + \Delta t_x$);

v^+ is the new VAT rate, unit fraction. ($v^+ = v + \Delta v$);

Taxation after changing tax rates

TV^+ is the amount of taxes, paid to the state budget by economic agents

$$TV^{f+}(\alpha M^{f+}) = \alpha M^{f+} \cdot t_m^+ + \alpha M^{f+} \cdot t_m^+ \cdot v^+ - \alpha M^{f+} \cdot t_m^+ \cdot v^+ = \alpha M^{f+} \cdot t_m^+,$$

$$TV^{f+}(\alpha X^{f+}) = \alpha X^{f+} \cdot t_x^+ + (\alpha X^{f+} \cdot v^+ - \alpha X^{f+} \cdot v^+) = (\alpha X_{RM}^{f+} + \alpha X_{FP}^{f+}) \cdot t_x^+,$$

де $\alpha X^{f+} = \alpha X^{f+}_{RM} + \alpha X^{f+}_{FP}$.

In Ukrainian economy αX^{f+}_{FP} is not subject to export duty (i.e $\alpha X^{f+}_{FP} \cdot t^{+}_{x} = 0$), hence

$$TV^{f+}(\alpha X^{f+}) = \alpha X^{f+}_{RM} \cdot t^{+}_{x}.$$

$$\begin{aligned} TV^{f+}(\beta X^{f+}) &= \omega\beta M^{f+} \cdot t^{+}_{m} + \omega\beta M^{f+} \cdot t^{+}_{m} \cdot v^{+} - \\ &- (\omega\beta M^{f+} \cdot t^{+}_{m} \cdot v^{+} + \beta X^{f+} \cdot v^{+}_{x}) + (\beta X^{f+} \cdot t^{+}_{m}) = \\ &= (\omega\beta M^{f+} \cdot t^{+}_{m}) + (\beta X^{f+} \cdot t^{+}_{x}). \end{aligned}$$

In Ukrainian economy βX^{f+} is not subject to export duty (i.e. $\beta X^{f+} \cdot t^{+}_{x} = 0$). There are no VAT liabilities, since the according to the generally accepted destination principle $v^{+}_{x} = 0$. Hence

$$TV^{f+}(\alpha CP^{f+}) = \alpha CP^{f+} \cdot v^{+}.$$

$$\begin{aligned} TV^{f+}(\beta CP^{f+}) &= \varpi\beta M^{f+} \cdot t^{+}_{m} + \varpi\beta M^{f+} \cdot t^{+}_{m} \cdot v^{+} - \\ &- (\varpi\beta M^{f+} \cdot t^{+}_{m} \cdot v^{+} + \beta CP^{f+} \cdot v^{+}) = \\ &= (\varpi\beta M^{f+} \cdot t^{+}_{m}) + (\varpi\beta M \cdot p \cdot v^{+}) \end{aligned}$$

$$\begin{aligned} TV^{i+}(\alpha M^{i+}) &= \alpha M^{i+} \cdot (1-k) \cdot t^{+}_{m} + \\ &+ \alpha M^{i+} \cdot (1-k) \cdot t^{+}_{m} \cdot v^{+} - \alpha M^{i+} \cdot (1-k) \cdot t^{+}_{m} \cdot v^{+} = \\ &= \alpha M^{i+} \cdot (1-k) \cdot t^{+}_{m}. \end{aligned}$$

$$TV^{i+}(\alpha X^{i+}) = (\alpha X^{i+}_{RM} + \alpha X^{i+}_{FP}) \cdot (1-k) \cdot t^{+}_{x}.$$

In Ukrainian economy $\alpha X^{i+}_{FP} \; t^{+}_{x} = 0$.

If economic agent do not pay VAT, but requires the compensation from the state, his profit grow to the VAT amount indicated in appropriate documentation:

$$(\alpha X^{i+}_{RM} + \alpha X^{i+}_{FP}) \cdot \frac{v^{+}}{1+v^{+}}.$$

I.e. the sum to be compensated from state budget is calculated according VAT rate, applied for a flow, which contain this tax.

$$TV^{i+}(\beta X^{i+}) = \omega\beta M^{i+}\cdot(1-k)\cdot t_m^+ + \omega\beta M^{i+}\cdot(1-k)\cdot t_m^+\cdot v^+ -$$
$$-\omega\beta M^{i+}\cdot(1-k)\cdot t_m^+\cdot v^+ + \beta X^{i+}\cdot(1-k)\cdot t_x^+ =$$
$$= \omega\beta M^{i+}\cdot(1-k)\cdot t_m^+ + \beta X^{i+}\cdot(1-k)\cdot t_x^+.$$

In Ukrainian economy $\beta X^{i+}\ t_x^+ = 0$. If there is an illegally compensated VAT, the economic agent's profit raises on the following amount:

$$\beta X^{i+}\cdot\frac{p}{1+p}\cdot v^+.$$

$$TV^{i+}(\alpha CP^{i+}) = 0;$$

$$TV^{i+}(\beta CP^{i+}) = \varpi\beta M^{i+}\cdot(1-k)\cdot t_m^+ + \beta CP^{i+}\cdot v^+ = \varpi\beta M^{i+}\cdot(1-k)\cdot t_m^+ + \varpi\beta M^{i+}\cdot p\cdot v^+;$$

– if economic agent pays domestic VAT;

$$TV^{i+}(\beta CP^{i+}) = \varpi\beta M^{i+}\cdot(1-k)\cdot t_m^+ + \varpi\beta M^{i+}\cdot(1-k)\cdot t_m^+\cdot v^+$$

– if economic agent does not pay domestic VAT.

State tax revenues

DS^{f+} are the state tax revenues, collected in formal sector after changing the tax rates;

DS^{i+} are the state tax revenues, collected in informal sector after changing the tax rates;

$$DS^{f+}(\alpha M^{f+}) = \alpha M^{f+}\cdot t_m^+.$$

$$DS^{f+}(\alpha X^{f+}) = (\alpha X_{RM}^{f+} + \alpha X_{FP}^{f+})\cdot t_x^+.$$

In Ukrainian economy $DS^{f+}(\alpha X^{f+}) = \alpha X^{f+}_{RM} \cdot t_x^+$.

$DS^{f+}(\beta X^{f+}) = \omega\beta M^{f+} \cdot t_m^+ + \beta X^{f+} \cdot t_x^+$.

In Ukrainian economy $DS^{f+}(\beta X^{f+}) = \omega\beta M^{f+} \cdot t_m^+$.

$DS^{f+}(\alpha CP^{f+}) = \alpha CP^{f+} \cdot v^+$.

$DS^{f+}(\beta CP^{f+}) = \varpi\beta M^{f+} \cdot t_m^+ + \beta CP^{f+} \cdot v^+ = \varpi\beta M^{f+} \cdot t_m^+ + \varpi\beta M \cdot p \cdot v^+$.

$DS^{i+}(\alpha M^{i+}) = \alpha M^{i+} \cdot (1-k) \cdot t_m^+$.

If economic agent pays domestic VAT:

$DS^{i+}(\alpha X^{i+}) = \alpha X^{i+}_{RM} \cdot (1-k) \cdot t_x^+$;

$DS^{i+}(\beta X^{i+}) = \omega\beta M^{i+} \cdot (1-k) \cdot t_m^+$

$DS^{i+}(\alpha CP^{i+}) = 0$.

$DS^{i+}(\beta CP^{i+}) = \varpi\beta M^{i+} \cdot (1-k) \cdot t_m^+ + \beta CP^{i+} \cdot v^+ = \varpi\beta M^{i+} \cdot (1-k) \cdot t_m^+ + \varpi\beta M^{i+} \cdot p \cdot v^+$;

If economic agent does not pay domestic VAT:

$$DS^{i+}(\alpha X^{i+}) = \alpha X^{i+}_{RM} \cdot (1-k) \cdot t_x^+ - \alpha X^{i+}_{RM} \cdot \frac{v^+}{1+v^+} - \alpha X^{i+}_{FP} \cdot \frac{v^+}{1+v^+} =$$
$$= \alpha X^{i+}_{RM} \cdot (1-k) \cdot t_x^+ - (\alpha X^{i+}_{RM} + \alpha X^{i+}_{FP}) \cdot \frac{v^+}{1+v^+}$$

$$DS^{i+}(\beta X^{i+}) = \omega\beta M^{i+} \cdot (1-k) \cdot t_m^+ - \beta X^{i+} \cdot v^+ \cdot \frac{p}{1+p}$$

$$DS^{i+}(\beta CP^{i+}) = \varpi\beta M^{i+} \cdot (1-k) \cdot t_m^+ + \varpi\beta M^{i+} \cdot (1-k) \cdot t_m^+ \cdot v^+.$$

Profit of economic agent after changing the tax rates

V is the value of goods of sector, in which economic agent operates, USD mln.;

r denotes the profitability of economic agent, unit fraction.

PE^{+} is the profit of economic agent $\left(PE^{+} = \dfrac{V \cdot r}{r+1} \right)$.

$$PE^{f+}(\alpha M^{f+}) = \frac{\alpha M^{f+} \cdot r}{r+1};$$

$$PE^{f+}(\alpha X^{f+}) = \frac{\alpha X_{RM}{}^{f+} \cdot r}{r+1} + \frac{\alpha X_{FP}{}^{f+} \cdot r}{r+1};$$

$$PE^{f+}(\beta X^{f+}) = \frac{\beta X^{f+} \cdot r}{r+1};$$

$$PE^{f+}(\alpha CP^{f+}) = \frac{\alpha CP^{f+} \cdot r}{r+1};$$

$$PE^{f+}(\beta CP^{f+}) = \frac{\beta CP^{f+} \cdot r}{r+1};$$

$$PE^{i+}(\alpha M^{i+}) = \frac{\alpha M^{i+} \cdot r}{r+1} + (\alpha M^{i+} \cdot t_m^{+} - \alpha M^{i+} \cdot (1-k) \cdot t_m^{+}) = \alpha M^{i+}(\frac{r}{r+1} + k \cdot t_m^{+});$$

If economic agent pays domestic VAT:

$$PE^{i+}(\alpha X^{i+}) = \frac{\alpha X_{RM}^{i+} \cdot r}{r+1} + \frac{\alpha X_{FP}^{i+} \cdot r}{r+1} + (\alpha X_{RM}^{i+} \cdot t_x^{+} - \alpha X_{RM}^{i+} \cdot (1-k) \cdot t_x^{+}) =$$
$$= \alpha X_{RM}^{i+}(\frac{r}{r+1} + k \cdot t_x^{+}) + \frac{\alpha X_{FP}^{i+} \cdot r}{r+1}$$

$$PE^{i+}(\beta X^{i+}) = \frac{\beta X^{i+} \cdot r}{r+1} + (\omega \beta M^{i+} \cdot t_m^{+} - \omega \beta M^{i+} \cdot (1-k) \cdot t_m^{+})$$

$$PE^{i+}(\beta CP^{i+}) = \frac{\beta CP^{i+} \cdot r}{r+1} + (\omega \beta M^{i+} \cdot t_m^{+} - \omega \beta M^{i+} \cdot (1-k) \cdot t_m^{+}) =$$
$$= \frac{\beta CP^{i+} \cdot r}{r+1} + \omega \beta M^{i+} \cdot k \cdot t_m^{+}$$

If economic agent does not pay domestic VAT:

$$PE^{i+}(\alpha X^{i+}) = \frac{\alpha X_{RM}^{i+} \cdot r}{r+1} + \frac{\alpha X_{RM}^{i+} \cdot v^{+}}{v^{+}+1} + (\alpha X_{RM}^{i+} \cdot t_x^{+} - \alpha X_{RM}^{i+} \cdot ((1-k) \cdot t_x^{+}) +$$

$$+ \frac{\alpha X_{FP}^{i+} \cdot r}{r+1} + \frac{\alpha X_{FP}^{i+} \cdot v^{+}}{v^{+}+1} =$$

$$= \alpha X_{RM}^{i+} (\frac{r}{r+1} + \frac{v^{+}}{v^{+}+1} + k \cdot t_x^{+}) + \alpha X_{FP}^{i+} (\frac{r}{r+1} + \frac{v^{+}}{v^{+}+1})$$

$$PE^{i+}(\beta X^{i+}) = \frac{\beta X^{i+} \cdot r}{r+1} + (\omega\beta M^{i+} \cdot t_m^{+} - \omega\beta M^{i+} \cdot (1-k) \cdot t_m^{+}) + \beta X^{i+} \cdot v^{+} \cdot \frac{p}{1+p} =$$

$$= \beta X^{i+} (\frac{r}{r+1} + \omega\beta M^{i+} \cdot k \cdot t_m^{+} + v^{+} \cdot \frac{p}{1+p})$$

$$PE^{i+}(\alpha CP^{i+}) = \alpha CP^{i+} \cdot \frac{r}{r+1};$$

$$PE^{i+}(\beta CP^{i+}) = \frac{\beta CP^{i+} \cdot r}{r+1} + \omega\beta M^{i+} \cdot t_m^{+} - \omega\beta M^{i+} \cdot (1-k) \cdot t_m^{+} +$$

$$+ (\varpi\beta M^{i+} \cdot v^{+} \cdot (1-k) \cdot t_m^{+})$$

Total profit for all commodity flows gives

$$P = \frac{V^{\alpha X_{FP}}}{1+{}^{1}/_{r^{\alpha X_{FP}}}} + \frac{V^{\alpha X_{RM}}}{1+{}^{1}/_{r^{\alpha X_{RM}}}} + \frac{V^{\alpha CP}}{1+{}^{1}/_{r^{\alpha CP}}} + \frac{V^{\alpha M}}{1+{}^{1}/_{r^{\alpha M}}} + \frac{V^{\beta X}}{1+{}^{1}/_{r^{\beta X}}} + \frac{V^{\beta CP}}{1+{}^{1}/_{r^{\beta CP}}}.$$

Appendix C

Equation to estimate the profit of economic agents and the state tax revenues for 1 variant

	Effect	Std.Err.	t(1)	p	–95,%	+95,%	Coeff.	Std.Err.	–95,%	+95,%
Mean/Interc.	8611745	1363,9	6314,0	0,000101	8594415	8629075	**8611745**	1363,9	8594415	8629075
(1) IM	3463551	2727,8	1269,7	0,000501	3428891	3498211	**1731775**	1363,9	1714445	1749106
(2) EX	138225	2727,8	50,7	0,012562	103565	172885	**69112**	1363,9	51782	86443
(3) VAT	11338175	2727,8	4156,5	0,000153	11303515	11372835	**5669087**	1363,9	5651757	5686418
1 by 2	18316	2727,8	6,7	0,094122	–16345	52976	9158	1363,9	–8172	26488
1 by 3	453253	2727,8	166,2	0,003831	418593	487913	**226627**	1363,9	209296	243957
2 by 3	–22122	2727,8	–8,1	0,078106	–56782	12538	–11061	1363,9	–28391	6269

profit of economic agent in informal sector PE^{i+}

$$PE^{i+} = 8969062 + 1654736 \cdot t_m^+ + 69160 \cdot t_x^+ + 5904716 \cdot v^+ + 120387 \cdot t_m^+ \cdot v^+$$

	Effect	Std.Err.	t(1)	p	–95,%	+95,%	Coeff.	Std.Err.	–95,%	+95,%
Mean/Interc.	12421265	596,5	20822,4	0,000031	12413685	12428844	**12421265**	596,53	12413685	12428844
(1) IM	–4992428	1193,1	–4184,5	0,000152	–5007587	–4977268	**–2496214**	596,53	–2503793	–2488634
(2) EX	–111096	1193,1	–93,1	0,006836	–126255	–95937	**–55548**	596,53	–63128	–47968
(3) VAT	–5884203	1193,1	–4932,0	0,000129	–5899362	–5869043	**–2942101**	596,53	–2949681	–2934522
1 by 2	–1667	1193,1	–1,4	0,395491	–16826	13493	–833	596,53	–8413	6746
1 by 3	645537	1193,1	541,1	0,001177	630378	660696	**322768**	596,53	315189	330348
2 by 3	35139	1193,1	29,5	0,021607	19979	50298	**17569**	596,53	9990	25149

profit of economic agent in formal sector PE^{f+}

$$PE^{f+} = 14332379 - 2737726 \cdot t_m^+ - 78794 \cdot t_x^+ - 3314053 \cdot v^+ + 345852 \cdot t_m^+ \cdot v^+ + 23674 \cdot t_x^+ \cdot v^+$$

	Effect	Std.Err.	t(1)	p	–95,%	+95,%	Coeff.	Std.Err.	–95,%	+95,%
Mean/Interc.	21033010	767,4	27409,0	0,000023	21023260	21042760	**21033010**	767,38	21023260	21042760
(1) IM	–1528877	1534,8	–996,2	0,000639	–1548378	–1509376	**–764438**	767,38	–774189	–754688
(2) EX	27129	1534,8	17,7	0,035977	7628	46630	**13564**	767,38	3814	23315
(3) VAT	5453972	1534,8	3553,7	0,000179	5434471	5473473	**2726986**	767,38	2717236	2736737
1 by 2	16649	1534,8	10,8	0,058521	–2852	36150	8324	767,38	–1426	18075
1 by 3	1098790	1534,8	715,9	0,000889	1079289	1118291	**549395**	767,38	539645	559145
2 by 3	13017	1534,8	8,5	0,074717	–6484	32518	6508	767,38	–3242	16259

total profit of economic agents PE^{+}

$$PE^{+} = 23301441 - 1082990 \cdot t_m^+ + 2590663 \cdot v^+ + 466238 \cdot t_m^+ \cdot v^+;$$

	Effect	Std.Err.	t(1)	p	–95,%	+95,%	Coeff.	Std.Err.	–95,%	+95,%
Mean/Interc.	–1180357	2411,40	–489,49	0,001301	–1210996	–1149717	**–1180357**	2411,40	–1210996	–1149717
(1) IM	106197	4822,81	22,02	0,028892	44917	167476	**53098**	2411,40	22459	83738
(2) EX	23260	4822,81	4,82	0,130156	–38020	84539	11630	2411,40	–19010	42270
(3) VAT	–2628728	4822,81	–545,06	0,001168	–2690008	–2567449	**–1314364**	2411,40	–1345004	–1283724
1 by 2	11507	4822,81	2,39	0,252653	–49772	72787	5754	2411,40	–24886	36394
1 by 3	–304700	4822,81	–63,18	0,010076	–365980	–243420	**–152350**	2411,40	–182990	–121710
2 by 3	8154	4822,81	1,69	0,340022	–53125	69434	4077	2411,40	–26563	34717

state tax revenues, collected in informal sector TV^{i+}

$$TV^{i+} = -1286630 - 1356466 \cdot v^{+} - 161383 \cdot t_m^{+} \cdot v^{+};$$

	Effect	Std.Err.	t(1)	p	–95,%	+95,%	Coeff.	Std.Err.	–95,%	+95,%
Mean/Interc.	6926012	2569,31	2695,67	0,000236	6893366	6958658	**6926012**	2569,31	6893366	6958658
(1) IM	1340021	5138,62	260,77	0,002441	1274729	1405314	**670011**	2569,31	637364	702657
(2) EX	66782	5138,62	13,00	0,048889	1490	132074	**33391**	2569,31	745	66037
(3) VAT	4200571	5138,62	817,45	0,000779	4135279	4265863	**2100285**	2569,31	2067639	2132932
1 by 2	–30321	5138,62	–5,90	0,106876	–95613	34972	–15160	2569,31	–47806	17486
1 by 3	–2200563	5138,62	–428,24	0,001487	–2265856	–2135271	**–1100282**	2569,31	–1132928	–1067635
2 by 3	–37263	5138,62	–7,25	0,087240	–102556	28029	–18632	2569,31	–51278	14015

state tax revenues, collected in formal sector TV^{f+}

$$TV^{f+} = 8379693 + 92248 \cdot t_m^{+} + 45055 \cdot t_x^{+} + 3245941 \cdot v^{+} - 1194280 \cdot t_m^{+} \cdot v^{+} - 37399 \cdot t_x^{+} \cdot v^{+};$$

	Effect	Std.Err.	t(1)	p	–95,%	+95,%	Coeff.	Std.Err.	–95,%	+95,%
Mean/Interc.	5745655	157,90	36386,90	0,000017	5743649	5747662	**5745655**	157,90	5743649	5747662
(1) IM	1446218	315,81	4579,41	0,000139	1442205	1450231	**723109**	157,90	721103	725115
(2) EX	90042	315,81	285,11	0,002233	86029	94054	**45021**	157,90	43014	47027
(3) VAT	1571843	315,81	4977,19	0,000128	1567830	1575855	**785921**	157,90	783915	787928
1 by 2	–18813	315,81	–59,57	0,010686	–22826	–14800	**–9407**	157,90	–11413	–7400
1 by 3	–2505263	315,81	–7932,84	0,000080	–2509276	–2501251	**–1252632**	157,90	–1254638	–1250625
2 by 3	–29109	315,81	–92,17	0,006907	–33122	–25096	**–14554**	157,90	–16561	–12548

total state tax revenues TV^{+}

$$TV^{+} = 7093062 + 73507 \cdot t_m^{+} + 66188 \cdot t_x^{+} + 1889475 \cdot v^{+} - 1355663 \cdot t_m^{+} \cdot v^{/} - 26544 \cdot t_x^{+} \cdot v^{+}$$

Equation to estimate the profit of economic agents and the state tax revenues for 2 variant

If there are no barriers for shifting into the informal sector:

	Effect	Std.Err.	t(1)	p	–95,%	+95,%	Coeff.	Std.Err.	–95,%	+95,%
Mean/Interc.	14093371	262965,5	53,594	0,011877	10752077	17434664	**14093371**	262965,5	10752077	17434664
(1) IM	5028652	525931,0	9,561	0,066341	–1653934	11711239	2514326	262965,5	–826967	5855619
(2) EX	670110	525931,0	1,274	0,423626	–6012476	7352697	335055	262965,5	–3006238	3676348
(3) VAT	15109437	525931,0	28,729	0,022151	8426850	21792024	**7554719**	262965,5	4213425	10896012
1 by 2	–510471	525931,0	–0,971	0,509496	–7193057	6172116	–255235	262965,5	–3596529	3086058
1 by 3	–2570738	525931,0	–4,888	0,128469	–9253324	4111849	–1285369	262965,5	–4626662	2055924
2 by 3	–579736	525931,0	–1,102	0,469045	–7262322	6102851	–289868	262965,5	–3631161	3051426

profit of economic agent in informal sector PE^{i+}

$$PE^{i+} = 14690897 + 7888896 \cdot v^{+};$$

	Effect	Std.Err.	t(1)	p	–95,%	+95,%	Coeff.	Std.Err.	–95,%	+95,%
Mean/Interc.	8934597	226816,4	39,39	0,016158	6052621	11816573	**8934597**	226816,4	6052621	11816573
(1) IM	–5766595	453632,9	–12,71	0,049977	–11530547	–2643	**–2883297**	226816,4	–5765274	–1321
(2) EX	–556431	453632,9	–1,23	0,435431	–6320383	5207522	**–278215**	226816,4	–3160192	2603761
(3) VAT	–7468141	453632,9	–16,46	0,038622	–13232093	–1704188	**–3734070**	226816,4	–6616046	–852094
1 by 2	450728	453632,9	0,99	0,502045	–5313224	6214680	**225364**	226816,4	–2656612	3107340
1 by 3	3049970	453632,9	6,72	0,093998	–2713982	8813922	**1524985**	226816,4	–1356991	4406961
2 by 3	504996	453632,9	1,11	0,465923	–5258956	6268948	**252498**	226816,4	–2629478	3134474

profit of economic agent in formal sector PE^{f+}

$$PE^{f+} = 10400517 - 4199624 \cdot v^{+};$$

	Effect	Std.Err.	t(1)	p	–95,%	+95,%	Coeff.	Std.Err.	–95,%	+95,%
Mean/Interc.	23027968	36149,04	637,03	0,000999	22568651	23487285	**23027968**	36149,04	22568651	23487285
(1) IM	–737943	72298,09	–10,21	0,062173	–1656577	180692	–368971	36149,04	–828288	90346
(2) EX	113680	72298,09	1,57	0,360618	–804955	1032314	56840	36149,04	–402477	516157
(3) VAT	7641297	72298,09	105,69	0,006023	6722662	8559931	**3820648**	36149,04	3361331	4279965
1 by 2	–59743	72298,09	–0,83	0,560353	–978377	858892	–29871	36149,04	–489189	429446
1 by 3	479232	72298,09	6,63	0,095323	–439402	1397867	239616	36149,04	–219701	698933
2 by 3	–74739	72298,09	–1,03	0,489431	–993374	843895	–37370	36149,04	–496687	421947

total profit of economic agents PE^{+}

$$PE^{+} = 25091414 - 814786 \cdot t_m^{+} + 3689272 \cdot v^{+};$$

	Effect	Std.Err.	t(1)	p	–95,%	+95,%	Coeff.	Std.Err.	–95,%	+95,%
Mean/Interc.	–1742294	19067,70	–91,37	0,006967	–1984572	–1500016	**–1742294**	19067,7	–1984572	–1500016
(1) IM	619067	38135,40	16,23	0,039167	134511	1103624	**309534**	19067,7	67256	551812
(2) EX	19856	38135,40	0,52	0,694387	–464700	504413	9928	19067,7	–232350	252206
(3) VAT	–4139290	38135,40	–108,54	0,005865	–4623846	–3654734	**–2069645**	19067,7	–2311923	–1827367
1 by 2	41938	38135,40	1,10	0,469789	–442618	526494	20969	19067,7	–221309	263247
1 by 3	–303860	38135,40	–7,97	0,079482	–788416	180696	–151930	19067,7	–394208	90348
2 by 3	42741	38135,40	1,12	0,463784	–441815	527297	21371	19067,7	–220907	263649

state tax revenues, collected in informal sector TV^{i+}

$$TV^{i+} = -1925164 - 2104231 \cdot v^{+};$$

	Effect	Std.Err.	t(1)	p	–95,%	+95,%	Coeff.	Std.Err.	–95,%	+95,%
Mean/Interc.	4263084	28895,29	147,54	0,004315	3895934	4630233	**4263084**	28895,3	3895934	4630233
(1) IM	337857	57790,58	5,85	0,107850	–396442	1072155	168928	28895,3	–198221	536078
(2) EX	–37750	57790,58	–0,65	0,631632	–772049	696549	–18875	28895,3	–386024	348275
(3) VAT	1317350	57790,58	22,80	0,027910	583051	2051649	**658675**	28895,3	291526	1025825
1 by 2	37668	57790,58	0,65	0,632265	–696631	771967	18834	28895,3	–348316	385983
1 by 3	–1139842	57790,58	–19,72	0,032249	–1874140	–405543	**–569921**	28895,3	–937070	–202771
2 by 3	43512	57790,58	0,75	0,589146	–690787	777811	21756	28895,3	–345394	388905

state tax revenues, collected in formal sector TV^{f+}

$$TV^{f+} = 5133349 + 1255875 \cdot v^{+} - 562353 \cdot t_m^{+} \cdot v^{+};$$

	Effect	Std.Err.	t(1)	p	–95,%	+95,%	Coeff.	Std.Err.	–95,%	+95,%
Mean/Interc.	2520790	47962,99	52,56	0,012111	1911362	3130218	**2520790**	47962,99	1911362	3130218
(1) IM	956924	95925,98	9,98	0,063605	–261931	2175779	478462	47962,99	–130966	1087890
(2) EX	–17893	95925,98	–0,19	0,882600	–1236748	1200962	–8947	47962,99	–618374	600481
(3) VAT	–2821940	95925,98	–29,42	0,021632	–4040795	–1603085	**–1410970**	47962,99	–2020398	–801542
1 by 2	79606	95925,98	0,83	0,559020	–1139249	1298461	39803	47962,99	–569625	649230
1 by 3	–1443701	95925,98	–15,05	0,042238	–2662557	–224846	**–721851**	47962,99	–1331278	–112423
2 by 3	86253	95925,98	0,90	0,533770	–1132602	1305108	43126	47962,99	–566301	652554

total state tax revenues TV^{+}

$$TV^{+} = 3208185 - 888356 \cdot v^{+}.$$

If there are significant barriers for shifting into the informal sector:

	Effect	Std.Err.	t(1)	p	–95,%	+95,%	Coeff.	Std.Err.	–95,%	+95,%
Mean/Interc.	7775857	47,07	165211,0	0,000004	7775259	7776455	**7775857**	47,06623	7775259	7776455
(1) IM	88166	94,13	936,6	0,000680	86970	89362	**44083**	47,06623	43485	44681
(2) EX	34755	94,13	369,2	0,001724	33559	35951	**17377**	47,06623	16779	17975
(3) VAT	3227773	94,13	34289,7	0,000019	3226577	3228969	**1613886**	47,06623	1613288	1614484
1 by 2	–256	94,13	–2,7	0,224099	–1452	940	–128	47,06623	–726	470
1 by 3	153709	94,13	1632,9	0,000390	152513	154905	**76855**	47,06623	76257	77453
2 by 3	1931	94,13	20,5	0,031009	735	3127	**966**	47,06623	367	1564

profit of economic agent in informal sector PE^{i+}

$$PE^{i+} = 8133458 - 89573 \cdot t_m^{+} + 15625 \cdot t_x^{+} + 1688190 \cdot v^{+} + 38539 \cdot t_m^{+} \cdot v^{+};$$

	Effect	Std.Err.	t(1)	p	–95,%	+95,%	Coeff.	Std.Err.	–95,%	+95,%
Mean/Interc.	12462017	10,78	1155584	0,000001	12461880	12462154	**12462017**	10,78417	12461880	12462154
(1) IM	–2786046	21,57	–129173	0,000005	–2786320	–2785772	**–1393023**	10,78417	–1393160	–1392886
(2) EX	–37945	21,57	–1759	0,000362	–38219	–37671	**–18973**	10,78417	–19110	–18836
(3) VAT	–533834	21,57	–24751	0,000026	–534108	–533560	**–266917**	10,78417	–267054	–266780
1 by 2	1993	21,57	92	0,006891	1719	2267	**996**	10,78417	859	1133
1 by 3	28905	21,57	1340	0,000475	28631	29179	**14453**	10,78417	14316	14590
2 by 3	439	21,57	20	0,031284	165	713	**219**	10,78417	82	356

profit of economic agent in formal sector PE^{f+}

$$PE^{f+} = 14384986 - 1494095 \cdot t_m^+ - 37759 \cdot t_x^+ - 300750 \cdot v^+ + 1214 \cdot t_m^+ \cdot t_x^+ + \\ + 14662 \cdot t_m^+ \cdot v^+ + 600 \cdot t_x^+ \cdot v^+;$$

	Effect	Std.Err.	t(1)	p	–95,%	+95,%	Coeff.	Std.Err.	–95,%	+95,%
Mean/Interc.	20237874	57,85	349831,3	0,000002	20237139	20238609	**20237874**	57,85	20237139	20238609
(1) IM	–2697880	115,70	–23317,7	0,000027	–2699350	–2696410	**–1348940**	57,85	–1349675	–1348205
(2) EX	–3190	115,70	–27,6	0,023077	–4661	–1720	**–1595**	57,85	–2330	–860
(3) VAT	2693938	115,70	23283,7	0,000027	2692468	2695409	**1346969**	57,85	1346234	1347704
1 by 2	1736	115,70	15,0	0,042358	266	3206	**868**	57,85	133	1603
1 by 3	182615	115,70	1578,3	0,000403	181145	184085	**91307**	57,85	90572	92042
2 by 3	2370	115,70	20,5	0,031060	899	3840	**1185**	57,85	450	1920

total profit of economic agents PE^{+}

$$PE^{+} = 22518444 - 1583669 \cdot t_m^+ - 22134 \cdot t_x^+ + 1367439 \cdot v^+ + 795 \cdot t_m^+ \cdot t_x^+ + \\ + 503202 \cdot t_m^+ \cdot v^+ + 615 \cdot t_x^+ \cdot v^+;$$

	Effect	Std.Err.	t(1)	p	–95,%	+95,%	Coeff.	Std.Err.	–95,%	+95,%
Mean/Interc.	–790492	138,09	–5724,28	0,000111	–792247	–788738	**–790492**	138,09	–792247	–788738
(1) IM	529325	276,19	1916,53	0,000332	525815	532834	**264662**	138,09	262908	266417
(2) EX	26157	276,19	94,71	0,006722	22647	29666	**13078**	138,09	11324	14833
(3) VAT	–1740122	276,19	–6300,46	0,000101	–1743631	–1736612	**–870061**	138,09	–871816	–868306
1 by 2	1608	276,19	5,82	0,108319	–1902	5117	804	138,09	–951	2558
1 by 3	–246667	276,19	–893,11	0,000713	–250176	–243158	**–123334**	138,09	–125088	–121579
2 by 3	1311	276,19	4,75	0,132196	–2198	4820	655	138,09	–1099	2410

state tax revenues, collected in informal sector TV^{i+}

$$TV^{i+} = -882111 + 201573 \cdot t_m^+ + 22584 \cdot t_x^+ - 870984 \cdot v^+ + 905 \cdot t_m^+ \cdot t_x^+ + $$
$$+ 101988 \cdot t_m^+ \cdot v^+ + 2056 \cdot t_x^+ \cdot v^+;$$

	Effect	Std.Err.	t(1)	p	–95,%	+95,%	Coeff.	Std.Err.	–95,%	+95,%
Mean/Interc.	8017959	213,58	37541,58	0,000017	8015246	8020673	**8017959**	213,58	8015246	8020673
(1) IM	2644511	427,15	6191,05	0,000103	2639084	2649939	**1322256**	213,58	1319542	1324969
(2) EX	108684	427,15	254,44	0,002502	103257	114111	**54342**	213,58	51628	57056
(3) VAT	7706945	427,15	18042,68	0,000035	7701518	7712373	**3853473**	213,58	3850759	3856186
1 by 2	–3025	427,15	–7,08	0,089315	–8452	2403	–1512	213,58	–4226	1201
1 by 3	–933065	427,15	–2184,39	0,000291	–938492	–927637	**–466532**	213,58	–469246	–463819
2 by 3	–8278	427,15	–19,38	0,032821	–13705	–2850	**–4139**	213,58	–6853	–1425

state tax revenues, collected in formal sector TV^{f+}

$$TV^{f+} = 9798323 + 889594 \cdot t_m^+ + 66587 \cdot t_x^+ + 5405250 \cdot v^+ - 512112 \cdot t_m^+ \cdot v^+ - 17564 \cdot t_x^+ \cdot v^+;$$

	Effect	Std.Err.	t(1)	p	–95,%	+95,%	Coeff.	Std.Err.	–95,%	+95,%
Mean/Interc.	7227467	75,48	95752,46	0,000007	7226508	7228426	**7227467**	75,48	7226508	7228426
(1) IM	3173836	150,96	21024,14	0,000030	3171918	3175754	**1586918**	75,48	1585959	1587877
(2) EX	134841	150,96	893,21	0,000713	132922	136759	**67420**	75,48	66461	68379
(3) VAT	5966824	150,96	39525,47	0,000016	5964905	5968742	**2983412**	75,48	2982453	2984371
1 by 2	–1417	150,96	–9,39	0,067563	–3335	501	–709	75,48	–1668	251
1 by 3	–1179732	150,96	–7814,79	0,000081	–1181650	–1177814	**–589866**	75,48	–590825	–588907

total state tax revenues TV^{+}

$$TV^{+} = 8916212 + 1091166 \cdot t_m^+ + 89441 \cdot t_x^+ + 4534265 \cdot v^+ - 614100 \cdot t_m^+ \cdot v^+ - 15509 \cdot t_x^+ \cdot v^+.$$

Equation to estimate the profit of economic agents and the state tax revenues for 3 variant

	Effect	Std.Err.	t(5)	p	–95,%	+95,%	Coeff.	Std.Err.	–95,%	+95,%
Mean/Interc.	11879793	20222,91	587,44	0,000	11827808	11931778	**11879793**	20222,9	11827808	11931778
(1) IM	–387995	40445,83	–9,59	0,000	–491964	–284026	**–193997**	20222,9	–245982	–142013
(2) EX	13079	40445,83	0,32	0,760	–90891	117048	6539	20222,9	–45445	58524
(3) VAT	3728762	40445,83	92,19	0,000	3624793	3832731	**1864381**	20222,9	1812396	1916366
(4) S_h	18479678	40445,83	456,90	0,000	18375709	18583647	**9239839**	20222,9	9187854	9291824
1 by 2	0	40445,83	0,00	1,000	–103969	103969	0	20222,9	–51985	51985
1 by 3	116208	40445,83	2,87	0,035	12238	220177	**58104**	20222,9	6119	110088
1 by 4	–301774	40445,83	–7,46	0,001	–405743	–197805	**–150887**	20222,9	–202872	–98902
2 by 3	–4088	40445,83	–0,10	0,923	–108058	99881	–2044	20222,9	–54029	49940
2 by 4	10172	40445,83	0,25	0,811	–93797	114142	5086	20222,9	–46899	57071
3 by 4	2900148	40445,83	71,70	0,000	2796179	3004118	**1450074**	20222,9	1398090	1502059

profit of economic agent in informal sector PE^{i+}

$$PE^{i+} = 12432211 - 409127 \cdot t_m^+ + 1920802 \cdot v^+ + 9669497 \cdot S_h +$$
$$+ 7708 \cdot t_m^+ \cdot v^+ - 318210 \cdot t_m^+ \cdot S_h + 1493957 \cdot v^+ \cdot S_h;$$

	Effect	**Std.Err.**	**t(5)**	**p**	**–95,%**	**+95,%**	**Coeff.**	**Std.Err.**	**–95,%**	**+95,%**
Mean/Interc.	21555348	20222,9	1065,89	0,00	21503363	21607332	**21555348**	20222,9	21503363	21607332
(1) IM	–2382175	40445,8	–58,90	0,00	–2486144	–2278205	**–1191087**	20222,9	–1243072	–1139103
(2) EX	–2738	40445,8	–0,07	0,95	–106708	101231	–1369	20222,9	–53354	50616
(3) VAT	3728762	40445,8	92,19	0,00	3624793	3832731	**1864381**	20222,9	1812396	1916366
(4) S_h	6165336	40445,8	152,43	0,00	6061367	6269305	**3082668**	20222,9	3030683	3134653
1 by 2	0	40445,8	0,00	1,00	–103969	103969	0	20222,9	–51985	51985
1 by 3	116208	40445,8	2,87	0,03	12238	220177	**58104**	20222,9	6119	110088
1 by 4	967250	40445,8	23,91	0,00	863280	1071219	**483625**	20222,9	431640	535609
2 by 3	–4088	40445,8	–0,10	0,92	–108058	99881	–2044	20222,9	–54029	49940
2 by 4	20237	40445,8	0,50	0,64	–83732	124207	10119	20222,9	–41866	62103
3 by 4	2900148	40445,8	71,70	0,00	2796179	3004118	**1450074**	20222,9	1398090	1502059

total profit of economic agents PE^{+}

$$PE^{+} = 23679016 - 1473957 \cdot t_m^{+} - 18675 \cdot t_x^{+} + 1920802 \cdot v^{+} + 2733705 \cdot S_h + \\ + 7708 \cdot t_m^{+} \cdot v^{+} + 359409 \cdot t_m^{+} \cdot S_h + 16081 \cdot t_x^{+} \cdot S_h + 1493957 \cdot v^{+} \cdot S_h;$$

	Effect	**Std.Err.**	**t(5)**	**p**	**–95,%**	**+95,%**	**Coeff.**	**Std.Err.**	**–95,%**	**+95,%**
Mean/Interc.	–1159665	63609,0	–18,23	0,00	–1323177	–996153	**–1159665**	63608,98	–1323177	–996153
(1) IM	890278	127218,0	7,00	0,00	563254	1217302	**445139**	63608,98	281627	608651
(2) EX	44030	127218,0	0,35	0,74	–282994	371054	22015	63608,98	–141497	185527
(3) VAT	–2552845	127218,0	–20,07	0,00	–2879869	–2225821	**–1276423**	63608,98	–1439935	–1112910
(4) S_h	–1803924	127218,0	–14,18	0,00	–2130948	–1476899	**–901962**	63608,98	–1065474	–738450
1 by 2	0	127218,0	0,00	1,00	–327024	327024	0	63608,98	–163512	163512
1 by 3	–365722	127218,0	–2,87	0,03	–692746	–38698	**–182861**	63608,98	–346373	–19349
1 by 4	692439	127218,0	5,44	0,00	365414	1019463	**346219**	63608,98	182707	509731
2 by 3	4088	127218,0	0,03	0,98	–322936	331113	2044	63608,98	–161468	165556
2 by 4	34246	127218,0	0,27	0,80	–292779	361270	17123	63608,98	–146389	180635
3 by 4	–1985546	127218,0	–15,61	0,00	–2312570	–1658522	**–992773**	63608,98	–1156285	–829261

state tax revenues, collected in informal sector TV^{i+}

$$TV^{i+} = -1299079 + 348973 \cdot t_m^+ - 1271140 \cdot v^+ - 1010395 \cdot S_h -$$
$$- 144730 \cdot t_m^+ \cdot v^+ + 271424 \cdot t_m^+ \cdot S_h - 988665 \cdot v^+ \cdot S_h ;$$

	Effect	**Std.Err.**	**t(5)**	**p**	**–95,%**	**+95,%**	**Coeff.**	**Std.Err.**	**–95,%**	**+95,%**
Mean/Interc.	6307507	86789,2	72,68	0,000	6084409	6530606	**6307507**	86789,18	6084409	6530606
(1) IM	2159968	173578,4	12,44	0,000	1713770	2606165	**1079984**	86789,18	856885	1303082
(2) EX	93372	173578,4	0,54	0,614	–352826	539569	46686	86789,18	–176413	269784
(3) VAT	6257869	173578,4	36,05	0,000	5811672	6704067	**3128935**	86789,18	2905836	3352033
(4) S_h	–8027737	173578,4	–46,25	0,000	–8473934	–7581539	**–4013868**	86789,18	–4236967	–3790770
1 by 2	0	173578,4	0,00	1,000	–446197	446197	0	86789,18	–223099	223099
1 by 3	–609923	173578,4	–3,51	0,017	–1056121	–163726	**–304962**	86789,18	–528060	–81863
1 by 4	–1374525	173578,4	–7,92	0,001	–1820722	–928327	**–687262**	86789,18	–910361	–464164
2 by 3	0	173578,4	0,00	1,000	–446197	446197	0	86789,18	–223099	223099
2 by 4	–59418	173578,4	–0,34	0,746	–505616	386779	–29709	86789,18	–252808	193390
3 by 4	–3982280	173578,4	–22,94	0,000	–4428478	–3536083	**–1991140**	86789,18	–2214239	–1768041

state tax revenues, collected in formal sector TV^{f+}

$$TV^{f+} = 7714793 + 756849 \cdot t_m^+ + 4364546 \cdot v^+ - 4909413 \cdot S_h -$$
$$- 334942 \cdot t_m^+ \cdot v^+ - 481631 \cdot t_m^+ \cdot S_h - 2777438 \cdot v^+ \cdot S_h;$$

	Effect	Std.Err.	t(5)	p	-95,%	+95,%	Coeff.	Std.Err.	-95,%	+95,%
Mean/Interc.	5147842	23195,09	221,94	0,000	5088217	5207467	**5147842**	23195,09	5088217	5207467
(1) IM	3050246	46390,17	65,75	0,000	2930996	3169495	**1525123**	23195,09	1465498	1584748
(2) EX	137402	46390,17	2,96	0,031	18152	256651	**68701**	23195,09	9076	128326
(3) VAT	3705024	46390,17	79,87	0,000	3585774	3824274	**1852512**	23195,09	1792887	1912137
(4) S_h	-9831660	46390,17	-211,93	0,000	-9950910	-9712411	**-4915830**	23195,09	-4975455	-4856205
1 by 2	0	46390,17	0,00	1,000	-119250	119250	0	23195,09	-59625	59625
1 by 3	-975645	46390,17	-21,03	0,000	-1094895	-856395	**-487823**	23195,09	-547447	-428198
1 by 4	-682086	46390,17	-14,70	0,000	-801336	-562837	**-341043**	23195,09	-400668	-281418
2 by 3	4088	46390,17	0,09	0,933	-115161	123338	2044	23195,09	-57581	61669
2 by 4	-25173	46390,17	-0,54	0,611	-144422	94077	-12586	23195,09	-72211	47039
3 by 4	-5967827	46390,17	-128,64	0,000	-6087076	-5848577	**-2983913**	23195,09	-3043538	-2924288

total state tax revenues TV^+

$$TV^+ = 6415713 + 1105822 \cdot t_m^+ + 3093406 \cdot v^+ - 5919808 \cdot S_h -$$
$$- 479672 \cdot t_m^+ \cdot v^+ - 210207 \cdot t_m^+ \cdot S_h - 3766103 \cdot v^+ \cdot S_h.$$

Note: S_h is the variable, denoting the size of normal sector