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Statistical approach to calculation of VAT and problems related to tax credit and export tax refund

Abstract. The Theory of National Accounts opens up new possibilities for improving VAT taxation. New terms have been introduced: statistical tax rates are equal to the current VAT rate multiplied by the share of value added for VAT or by the share of input for the export tax refund (ETR) in products output, which are calculated for selected sectors of the economy on the basis of National Accounts. Statistical tax rates allow for determining VAT or ETR from sales turnover, which reduces the probability of tax fraud. Time limitations associated with a three-year delay in the calculation of National Accounts are treated as insignificant in many cases. The authors of the article have suggested an algorithm of taking into account VAT exemptions and made calculations using statistical data for the United Kingdom of Great Britain. Information about VAT exempted turnover should be obtained from the State Fiscal Service of Ukraine and compiled into the National Accounts Database. The Input-output approach to the calculation of VAT can be applied both for the analysis of tax legislation and for direct VAT assessment.

Keywords: National Accounts Database; Input-output Tables; Value Added Tax; Tax Rate; Export Tax Refund

JEL Classification: E62; O17; E01; C10

DOI: <https://doi.org/10.21003/ea.V161-09>

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Статистичний підхід до розрахунку ПДВ та проблеми податкового кредиту й експортного відшкодування

Анотація. Теорія національних рахунків (НР) відкриває нові можливості для вдосконалення ПДВ оподаткування. Вводяться нові терміни: статистичні податкові ставки, що дорівнюють поточній податковій ставці, помноженій на частку валової доданої вартості для ПДВ або на частку товарів (послуг), що надходять для експортного відшкодування (ЕВ) у випуску продукції, які розраховуються для різних галузей економіки на основі НР. Статистичні податкові ставки дозволяють розрахувати ПДВ і ЕВ, виходячи з обороту по реалізації, що мінімізує податкове шахрайство. При цьому мова йде саме про ПДВ, а не про податок з обороту. Часові обмеження, пов'язані з тривалістю розрахунку НР, у багатьох випадках оцінюються як незначні. Пропонується алгоритм обліку податкових пільг у базі даних НР. Підхід «витрати-випуск» до розрахунку ПДВ може застосовуватися як для аналізу дотримання чинного законодавства, так і безпосередньо для розрахунку ПДВ.

Ключові слова: база даних Національних рахунків; таблиці «витрати-випуск»; податок на додану вартість; податкова ставка; експортне відшкодування ПДВ.

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Статистический подход к расчету НДС и проблемы налогового кредита и экспортного возмещения

Аннотация. Теория национальных счетов (НС) открывает новые возможности для совершенствования НДС налогообложения. Вводятся новые термины: статистические налоговые ставки, равные текущей налоговой ставке, умноженной на долю валовой добавленной стоимости для НДС или на долю входящих товаров (услуг) для экспортного возмещения (ЭВ) в выпуске продукции, которые рассчитываются для различных отраслей экономики на основе НС. Статистические налоговые ставки позволяют вычислить НДС и ЭВ, исходя из оборота по реализации, что минимизирует налоговое мошенничество. При этом речь идет именно об НДС, а не о налоге с оборота. Временные ограничения, связанные с длительностью расчета НС, во многих случаях оцениваются как незначительные. Предлагается алгоритм учета налоговых льгот в базе данных НС. Подход «затраты-выпуск» к расчету НДС может применяться как для анализа соблюдения действующего законодательства, так и непосредственно для расчета НДС.

Ключевые слова: база данных Национальных счетов; таблицы «затраты-выпуск»; налог на добавленную стоимость; налоговая ставка; экспортное возмещение НДС.

1. Introduction and Brief Literature Review. Value added tax (VAT) provides about one third of budget revenues for those countries that apply this tax. The share of VAT in GDP is from 7% to 10%. Since the second half of the 20th century till the present,

VAT has been adopted in most countries of the world, which corresponds to 160 independent UN member states out of 189 [1].

The VAT calculation theory begins with the definition of value added as either a sum of salaries of employees and the

company's profits, including depreciation of capital, or as a difference between the total output and intermediate input. There are *four methods* by which we can calculate VAT:

1. (Wages + profits) * *R* - direct addition method (accounting method);
2. Wages * *R* + profits * *R* - indirect addition method;
3. (Output - input) * *R* - direct subtraction method (accounting method);
4. Output * *R* - input * *R* - indirect subtraction method (invoice or credit method) [2].

Here *R* means the tax rate. Indirect methods are called so because value added itself is not calculated, however tax liability (credit) relevant to the components of value added is. The term «input» denotes raw materials or purchases for production other than labour. The term «output» means final goods and services sold or consumed for non-commercial purposes. Comparison of the methods leads to the following conclusions.

Method 4 attaches tax liability to a particular transaction (the main advantage) and leaves good tracks for the audit, although today this barrier against manipulations is not sufficient.

Method 3 does not give certainty that inputs are deducted only when tax is paid. It is harder for tax payers to get a tax credit in full. Also, it is inconvenient to identify value added of different products each month as sales may greatly change.

For methods 1 and 2, it is necessary to determine the profit. Usually it is not broken down into individual products of the company, which may be taxed differently and inputs are never divided depending on VAT rates. Besides, calculation of profit requires considerable time.

Ultimately, method 4 is the best according to the fiscal economists, which is why we will use it hereinafter.

The main advantage of the value added tax, if compared with the sales tax, is that there is no double taxation since the subject is not final consumption but only value added [3]. Due to the fact that each processing stage is levied, the tax is evenly distributed between companies. VAT is charged in most cases in accordance with the technique common in the world and meets the recommendations of the International Monetary Fund. The unification of the method has contributed to the spread of VAT and improvement of tax legislation by studying the experience of different countries. Following the same logic, the European Union has obliged its member states to harmonise their policies in the field of VAT. However, along with the positive trends, there appear negative ones over time.

The disadvantages of VAT include inflation of tax credit by fictitious transactions, understatement of import prices and overstatement of export tax refund by unscrupulous taxpayers [3].

The current algorithm for VAT has been functioning in Ukraine since 1997, when tax accounting was separated from accounting. Taxation procedures have become more complex, it takes more working time from taxpayers. Since electronic administration was introduced in 2015, it has been required to transfer money in advance to a special VAT account. For a long time VAT has been calculated on the same theoretical basis and tax administration has been constantly improved, nevertheless, it has not solved the problems. Today, scientists consider the ineffective tax administration, including the tax base erosion, to be a threat to economic security of Ukraine [4]. Therefore, further development of the theory is relevant. This view has been shaped as a connection of twenty-year experience of VAT calculations for different enterprises from the part of one author and fifteen-year experience of scientific work from the part of the other author.

For many years, the accumulated problems have often been solved at the crossroads of several scientific disciplines. In the second half of the 20th century National Accounts developed along with taxation. Currently, most of the UN member states compile «input–output» tables on the basis of financial and statistical reporting. Such calculations are of great importance, therefore they are done by skilled professionals in the field of modern math, as it is the basis for the calculation of GDP and the structure of the economy which are indicators that determine the financial strategy of the state [5].

The Statistical Office of the European Union compiles the summary tables of National Accounts in Euros and in national currencies using special codes according to data of the national statistical offices. Thus, data used above are encoded as follows: CP_MNAC, B1GQ, UK is GDP including taxes less subsidies on products at current prices in million national currency; CP_MNAC, B1G, UK is GVA no taxes less subsidies on products at current prices in million national currency; CP_MNAC, D21X31, UK are taxes less subsidies on products at current prices in million national currency, etc. This grouping is carried out at several levels: for example, for 10 aggregated economic activities and to all available separately: A * 10 and A * 64 by NACE [6]. There are other input-output databases, for example, Eora, GTAP and WIOD, Differences between them were analyzed by Owen, Wood, Barrett and Evans (2016) [7].

At present, the National Accounts statistics are increasingly applied by scientists for solving different economic problems [8; 9].

2. Purpose. The purpose of this article is to connect the achievements in the field of taxation and National Accounts in order to create an alternative method for calculating VAT.

3. Results. The authors' approach is based on invariability of the tax and export tax refund amounts as we transit from one mode of calculation to another:

$$R_{\text{current}} * \text{GVA} = R_{\text{statist}} \text{VAT} * \text{Op} \text{ and } R_{\text{current}} * \text{Ip} = R_{\text{statist}} \text{ETR} * \text{Op}, \quad (1)$$

$$\text{then } R_{\text{statist}} \text{VAT} = R_{\text{current}} * \text{VA} / \text{Op} \text{ and } R_{\text{statist}} \text{ETR} = R_{\text{current}} * \text{Ip} / \text{Op}, \quad (2)$$

$$\text{VAT}_{\text{new}} = R_{\text{statist}} \text{VAT} * \text{SR} \text{ and } \text{ETR}_{\text{new}} = R_{\text{statist}} \text{ETR} * \text{SR}, \quad (3)$$

where GVA - gross value added; Ip - input (intermediate consumption); Op - products (services) output in basic prices; R_{current} - valid VAT rate (for example, it is 20% in Ukraine); R_{statist} - statistical VAT or export tax refund rates; ETR - export tax refund; SR - sales revenue.

Then GVA/Op is the key to solving the problem of overestimation of tax credit and Ip/Op is the key to solving the problem of overestimation of export tax refund.

There are new terms introduced: the statistical VAT rate and the ETR rate. The statistical VAT rate is a rate of taxation of the sales revenue in order to obtain value added tax. It is equal to the current VAT rate adjusted for the share of value added in products output which is calculated for selected economy sectors on the basis of statistical data from National Accounts.

Similarly, the statistical ETR rate is rate of the taxation of sales revenue to obtain the export tax refund. It is equal to the current VAT rate adjusted for the share of intermediate consumption in products output, which is calculated for the selected economy sectors on the basis of statistical data from the National Accounts.

The proposed method saves import VAT at the current rate.

The method originates from Ukraine and calculations of the statistical VAT rates are performed by Afanasieva (2016) [10]. In order to illustrate her approach to foreign colleagues, the authors refer to statistical data related to the United Kingdom of Great Britain. Table 1 shows the statistical VAT and the ETR rates for selected economy sectors. The statistical ETR rates are more for industries with a high share of exported products (NACE 24, 29 - Nomenclature of Activities for Community of Europeans), which may be a feature of this activities or evidence of the discussed problems. It can be developed in further researches. Annual changes of statistical rates for whole economy are shown in Table 2. The absolute numbers are the same for the export tax refund, but with the opposite sign. Changes are less significant in the macroeconomic stability periods and vice versa. The results are approximate: they do not take into account tax exempts and some features of pricing, as detailed below.

Advantages of the method. The application of the statistical rates deprives market subjects of personal interest in fraud. Blurring of the tax base by the tax credit stops. The tax is calculated with regard to the sales revenue. It is not necessary to precalculate the tax base. It is only required to document income via cash registers or the banking system. This results in value

Tab. 1: Statistical VAT rate and ETR rate in 2013

NACE	Activities	Output, basic prices	Intermediate consumption	Gross valued added, basic prices	Ip/Op	GVA/Op	Statistical ETR rate	Statistical VAT rate
		£ million			%			
24.1-3	Manufacture of basic iron and steel	10,103	7,861	2,242	77.81	22.19	15.56	4.44
24.4-5	Manufacture of other basic metals and casting	10,226	8,382	1,844	81.97	18.03	16.39	3.61
25 other	Manufacture of fabricated metal products, excluding weapons	28,379	14,678	13,701	51.72	48.28	10.34	9.66
26	Manufacture Of Computer, Electronic And Optical Products	22,581	11,919	10,662	52.78	47.22	10.56	9.44
27	Manufacture Of Electrical Equipment	13,771	8,503	5,268	61.75	38.25	12.35	7.65
28	Manufacture Of Machinery And Equipment N.E.C.	32,062	19,979	12,083	62.31	37.69	12.47	7.53
29	Manufacture Of Motor Vehicles, Trailers And Semi-Trailers	48,409	37,283	11,126	77.02	22.98	15.40	4.60
30.3	Manufacture of air and spacecraft and related machinery	23,925	16,733	7,192	69.94	30.06	13.99	6.01
x	Other
[5-39]	Total Production	681,483	443,283	238,200	65.05	34.95	13.01	6.99

Note: Only the standard operating rate of 20% is taken into account

Source: Calculated by the authors based on data by the Office for National Statistics [UK] (2016) [11]

Tab. 2: Tempo of change in the statistical VAT rates to the previous year, %

Year	2013	2012	2011	2010	2009	2008
Index, %	-0.40	0.66	0.29	0.53	-1.54	0.56

Source: Calculated by the authors based on data by the Office for National Statistics [UK] (2016) [11]

added tax. It provides all the advantages if compared with the sales tax. Similarly, it becomes possible to calculate the export tax refund. It should be added that money transfer to offshore zones begins with unaccounted cash, which can be formed as a result of bogus transactions to obtain overestimated loans.

Assessing the advantages of the proposed method, it is useful to take into account the results of the corruption study in Ukraine conducted by Ukrainian authorities along with international organisations, such as Transparency International (2015) [12], Gesellschaft für Konsumforschung and PricewaterhouseCoopers Ukraine. The survey was conducted among 2,741 corporate directors. The companies were chosen according to the regional criteria, turnover and type of activity for the sample to be representative. Opinions about the corruption centers of all the respondents who experienced that in August-October, 2015, are given in descending order: 26.7% - tax authorities, especially VAT authorities; 6.3% - Customs; 6.0% - the State Agency of Land Resources; 3.5% - the Prosecutor General's Office of Ukraine, etc.

Testing and development. It is required to obtain information about tax exemptions and turnovers when VAT is not charged on small taxpayers and those who pay taxes with regard to special tax incentives grouped by industry. We also need the actual VAT data by those sectors of economy which are not published. National Accounts by branches of industry contain information which includes VAT and excise duties and taxes on imports, yet this enables making only rough qualitative estimates. The new algorithm can be considered justified when calculating VAT for all industries and the whole economy will have a permissible deviation from the actual values.

Directions and scope of use. The proposed algorithm can be applied differently. It is logical to apply statistical as the check figures in the analysis of compliance with the current tax legislation. Small deviations from the actual amounts of the tax burden (VAT/SR) and share of the export tax refund (ETR/SR) from the statistical rates (average values) for a specific industry indicate that the company works on an equal basis. Consequently, significant deviations are likely to indicate tax fraud (Formula 3). It should be noted that the percentage the tax burden (VAT/SR) for honest taxpayers is higher than the average value equal the statistical rate in this activity type and for unscrupulous taxpayers it is lower than the statistical rate.

The next step can be recalculation of the statistical VAT and ETR rates for those businesses that have shown a significant deviation from the check figures of the previous period. Finally, if the new algorithm proves its validity, it may completely replace the existing method completely, especially in those countries where violations of the current legislation are essential.

The existence of input-output databases makes it possible to spread the proposed algorithm to other countries.

Limitations. As the practice of National Accounts is labour-intensive and time-consuming, it is possible to calculate the statistical rate for the current year according to the data of the most recently processed year. Currently, the delay in the EU is three years. The 36-month interval is formalised in legislation. It is meant that the statistical rates are calculated by the Fiscal Service on the basis of data obtained from the State Statistics Service. After obtaining data for the year under review, it becomes possible to recalculate rates and taxes for separate payers by the Fiscal Service, if necessary. Obviously, the tax limitation period should exceed the formation of the National Accounts data period. For example, the limitation period is three years in Ukraine now. It would be reasonable to increase it to four years. Table 3 shows the results of calculation of VAT changes for aggregate industries for 2013 with regard to statistical rates in 2013 and 2010, and for the year 2012 they should be calculated according to the data of 2012 and 2009, etc.

Annual VAT changes for the whole UK economy range from 0.57% to 2.78%. Stable minor changes are in the sector of trade, transport, hotels and restaurants. The sectors of real estate and agriculture show big changes throughout the study period. This corresponds to the logic that statistical rates depend on macroeconomic stability and achievements of the scientific and technical progress.

Another limitation of the new algorithm is that National Accounts take intermediate consumption at purchaser's prices, i.e. including VAT, whereas the International Accounting Standards account raw materials excluding VAT. This may be the reason why Blades (1989), thinking of a revision of the system of National Accounts, wrote: «The new version will need to provide explicit guidelines on the treatment of value-added taxes [13].» This task remains important.

Excluding VAT from intermediate consumption is not so simple. The point is that while transitioning from the VAT levying Method 3 to the VAT levying Method 4, the total tax is no longer related to the value added, but to the total turnover, which is deducted on the amount of taxable turnover for every separate company. If the company uses tax-exempt goods or services, then, while selling products, it will have to pay VAT on such consumption. The situation with the imports is similar. This change was probably taken in favour of simplifying the pricing, when VAT at the standard rate is either charged to the output at the basic price or deducted from the output at a market price. The differences between the two pricing orders (let us call them the VAT order and the NA order) are clearly shown in Table 4. For example, when the consumption includes taxable turnover 45 plus VAT 20% = 9 plus tax exempted turnover 15 in a currency unit. How do the differences in the pricing procedure affect the proposed algorithm? Statistical rates change as follows: 40/109 is less than 40/100 and 69/109 is more than 60/100, as shown in the example.

Besides, you must add VAT to exempt consumption or subtract it from export tax refund. All this leads to some underestimation of VAT and overestimation of export tax refund. To eliminate this difference, the intermediate VAT consumption should be subtracted before calculating statistical rates. Finding the solution to this task is a subject for further research. By using information about tax exemptions by industries (15), we need to distinguish the taxable turnover from intermediate consump-

Tab. 3: VAT change in statistical rate (approximately)

NACE Activities	2013/2010				2012/09	2011/08	2010/07	2009/06
	VAT 13 by 2013 rate	VAT 13 by 2010 rate	absolute deviation	relative deviation				
	£ million		%		%			
Agriculture 1-3	2,147	2,309	-162.28	-7.03	11.25	-8.42	4.28	-16.27
Production 5-39	47640	47,467	172.69	0.36	-5.36	-5.25	-3.25	-2.19
Construction 41-43	18 206	18 563	-356,85	-1,92	1,35	2,58	-4,43	-8,44
Distribution, transport, hotels & restaurants 45-56	55,615	56,283	-668.08	-1.19	0.53	1.55	1.47	-0.52
Information and communication 58-63	19,470	19,123	347.40	1.82	-0.12	-0.81	-2.11	1.08
Financial and insurance 64-66	-	-	-	-	-	-	-	-
Real estate 68.1-68.3	34,906	32,851	2055.84	6.26	1242	-9.50	-6.98	-9.11
Professional and support activities 69.1-82	36,628	36,425	203,38	0.56	1.16	0.55	-0.82	-2.06
Government, health & education 84-88	-	-	-	-	-	-	-	-
Other services 90-97	13,026	13,325	-298.58	-2.24	3.35	3.23	7.96	4.25
Total	227,639	226,345	1,294	0.57	1.32	-2.01	-1.61	-2.78

Note: Only the standard operating rate of 20% is taken into account. It is expected that the activities of NACE 84-88 and 64-66 are completely exempt from tax

Source: Calculated by the authors based on data by the Office for National Statistics [UK] (2016) [11]

Tab. 4: Differences in the pricing orders in the VAT taxation and the National Accounts

Summand	VAT-order	Summand	NA-order
Input, basic price	60 = 45+15	Input, purchaser's price	69 = 45+9+15
GVA	40	GVA	40
Output, basic price	100	Output, basic price	109
VAT liability	20 = 100*20%	VAT payable	11 = (40+15)*20%
Output, market price	120	Output, market price	120
Incl. VAT payable	11=20-9	Incl. VAT liability	20 = 120:1,2

Source: Compiled by the authors

tion (69-15=54), then we are to exclude VAT from the taxable turnover (54:1.2=45) and determine the adjusted input and output (45+15=60; 60+40=100) and then calculate the statistical rates (60/100 & 40/100). To do this, it is necessary to obtain information about VAT exemptions by industries from the

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Received 20.09.2016

Література

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Стаття надійшла до редакції 20.09.2016