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Modeling Value Added Tax (VAT) Revenues in a Transition Economy: Case of Ukraine

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Abstract

VAT is one of the major sources of public revenues in Ukraine. In contrast to the majority of countries that administer VAT, the administration of this tax in Ukraine is problematic. The major problems are VAT refund debt, numerous tax exemptions and extremely low VAT compliance. These problems certainly complicate the forecast of the VAT public revenues. That is why, the major objective of the paper has been to test different methodologies for forecasting VAT revenues. Specifically, employing effective rate approach we found that actual VAT revenues are less than a half of potential VAT revenues. Moreover, using econometric method we established stable empirical long-run relationship between VAT revenues and VAT base. Finally we developed appropriate ARIMA model for forecasting VAT revenue in the short run. The ARIMA model has given us a reasonable forecast of VAT revenues for 2003 that is fully consistent with government projections for the budget 2003.

1 Introduction

VAT is the major source of public revenues in many European countries and the most stable one. About 120 countries in the world administer VAT. In many of Central and Eastern European countries, the most important structural weaknesses of the tax lie in exemptions and lower tax rates for certain products.

As in many transition countries, Ukraine changed its turnover tax by VAT at the start of the transition process, to be more exact in 1993. However, the new Law on VAT was approved in 1997. Consumption-type, destination based and credit-invoice VAT is administered in Ukraine. Since 1998, the performance of the VAT system in Ukraine has been deteriorating. The business sector has accumulated large arrears to the government, a huge amount of tax exemptions have been approved, firms are unable to recover VAT refunds, and the whole situation is obscured by fraud and corruption.

At present, though VAT continues to be the major source of the public revenues, its share in the tax fiscal revenues and in percent of GDP has been declining since 1997[1]. The growth in VAT refunds contributed much to this tendency. The share of the VAT refunds in gross VAT collections increased from 49% in 2000 to 56% in 2001. Most of the VAT arrears are those of the fuel and energy companies, while the overdue and current VAT refunds should be returned to steel, grain and other exporters. Almost half of the VAT refunds is owed to non-exporters, e.g., domestic and foreign investors. VAT payment discipline is undermined by frequent tax write offs and restructurings. Tax exemptions are another huge problem of Ukraine's VAT administration. Besides, the tax authorities often report tax evasion and refund fraud cases.

As a result of the above and other factors, VAT revenues have never been executed in the full amount, except for 1999 and 2002 when the execution rates stood at 101% and 105%, respectively. In other years from 1998 to 2002 the execution rate varies from 85% in 1998 to 89% in 2001 (in 2000 – 94%). The variability of the execution rates testifies that VAT revenue planning should be improved. The execution rates could be even lower if to take into account the amount of the overdue VAT refunds, which has increased considerably in the last several years.

One should note that the execution of VAT revenues from domestically produced goods was much poorer than the execution of VAT revenues from imported goods (e.g., in 2002 for domestically produced goods – 86%, and for imported goods – 133%, in 2001 – 82% and 99%, respectively). The worrisome trend is that the share of VAT revenues on imported goods in total VAT revenues increased from 32% to 50% by the end of 2002[2]. That may be a sign of worsening tax administration for domestic operations and increasing amount of VAT refunds and VAT refunds fraud for exports operations.

The major objective of the research project is to provide an analytical framework and develop a most relevant methodology for estimating VAT revenues for a transition economy, in case of Ukraine. Four major methodologies for estimating tax revenues can be generally pointed out: effective rate approach, elasticity approach, model based approach and trend and autocorrelation approach. All these methodologies are tested for Ukraine's situation. It is rather difficult to point out one unique best methodology, which should be applied in Ukraine's case. All of the methods have their merits and drawbacks. Thus, the major recommendation is to compare and combine the results of all methods to come up with an estimate of VAT revenue for a particular period of time. As many transition and more developed economies face the same challenges in VAT forecasting as Ukraine does, Ukraine's experience could be taken into account while using these methodologies for VAT forecasting in those countries.

The given paper is organized in the following way. In Part 2 we present the literature review on the estimation of VAT base, VAT revenue forecasting

[1] For more detail, see Appendix, Table 1. Summary of VAT Performance Statistics in Ukraine.

[2] Import was relatively stable over that period, so the increase in share of VAT revenues collected on import indicates in this case poorer VAT administration of domestic operations than of import operations

and international comparison of VAT performance. Part 3 discusses general methodological issues concerning VAT revenue forecasting and their application to Ukrainian situation. In Part 4 the empirical results of applying different methodologies to Ukraine are presented. The paper ends with some conclusions and policy recommendations.

2 Literature review

Looking though the literature on VAT issues, the most widely discussed topics comprise tax evasion, origin-based versus destination-based principles of VAT administration, VAT harmonization in EU, VAT refund fraud, estimation of VAT base, etc.

The topic of VAT revenue modeling though extremely important has not been widely discussed in modern public finance literature. This can be due to the fact that VAT is being treated as one of the most stable taxes, thus, the one that would be relatively easy to forecast based on the most simple methods and past experience. Besides, fiscal sector modeling is a part of general equilibrium models applied in developed countries. Nevertheless, some relevant works have been found.

One of the most comprehensive works on VAT issues is the book 'The Modern VAT' by Liam Ebrill, Michael Keen, Jean-Paul Bodin and Victoria Summers, published by the IMF in 2001. The contents of the book cover VAT nature, revenue performance, discussion of rates and exemptions, VAT administration and audit, VAT refunds and a number of other issues.

In particular, the authors present the summary measures of VAT performance. The usual way to measure VAT effectiveness is through 'efficiency ratio'. This is a ratio of VAT revenue to GDP divided by standard VAT rate[3]. Since GDP can have errors in its measurement, a more appropriate benchmark would be total consumption, which is ideal VAT base. 'C-efficiency ratio' is the ratio of VAT revenue to consumption, divided by standard tax rate. C-efficiency ratio of 100% is an indicator of a very good VAT system. The comparison of VAT efficiency and C-efficiency across various regions of the world is given in Table 2 in the Appendix. The highest efficiency and C-efficiency ratios are observed in the countries of EU, Norway and Switzerland. The lowest ratios are recorded in less developed countries, in particular in Africa and Asia.

VAT revenue usually depends on three sets of factors: structural aspects of the tax (rates, bases, threshold, etc.), scale of taxable activities and tax compliance. In the most general form, VAT revenue can be modeled as a function R (ι, α), where ι - variables of the tax rules (rates, base, threshold, etc.) and α - economic environment variables (which influence tax base and rules enforcement). Further, the authors distinguish between the tax variables that are observed and those, which are not. In the model the dependent variable is the ratio of VAT revenues to private consumption, or actually C-efficiency. The independent variables (which differed in various specifications) were standard rate, openness variable

3 This is also very often called VAT productivity.

(average of imports and exports shares in GDP), age of VAT, literacy variable, regional dummies, threshold variable, range variable (the difference between highest and lowest non-zero VAT rate), a dummy which takes up 1 if VAT extends to the retail stage and zero otherwise, a dummy that takes up 1 if VAT is levied on a broad base of goods and services and 0 if otherwise. The cross-sectional data for 99 countries that met the requirements for VAT revenue and other data were used in the IMF model.

The results of the revenue modeling were as follows. Revenues increase with standard rate. However, higher standard rates are associated with narrower VAT bases. C-efficiency is a bit higher, the more important the trade in the economy is: the gain of collecting VAT at border while imports exceeds the possible losses from refund fraud during exports operations. The number of years since VAT introduction is associated with higher revenue, as VAT administration and compliance possibly increase with years. Literacy variable was included as a rough proxy for record keeping and other administrative capacities of taxpayers and tax authorities, which showed that less literate economies have lower revenue. The only significant regional dummy was small islands dummy. The threshold was never significant. The wider the range was, the higher VAT revenue was (this, however, contradicts to the World Bank findings of Bogetic and Hassan of 1993).

To sum up, significant variation of revenue performance across countries is observed. The factors that usually contribute to high C-efficiency ratio and, thus, strong revenue performance are a high ratio of trade to GDP (it is easier to collect VAT while imports than domestically), high literacy rates and the age of VAT. The authors failed to find the firm evidence for the influence of VAT structure peculiarities.

The authors also discussed an important topic of VAT refunds. Under consumption-type VAT, two major categories of taxpayers that receive VAT refunds could be differentiated: exporters (as long as destination principle to VAT administration is being applied) and investors (their investment amounts are large as compared to their current sales, the group may also include new enterprises). Both groups are very important for economic development. The refunds are expected to be higher in fast-growing economies and in more open economies. In practice they often lead to fraud and corruption.

One of the major advantages of the value-added tax is its broad tax base. However, in many countries the tax base was significantly narrowed as a result of the existence of VAT exemptions, evasion, etc.

The methodology for calculating the theoretical VAT base has been developed for Mexico using Mexican national accounts and input-output tables (Aguirre, Shome, 1988). The authors found that there was a gap in literature concerning VAT base calculation and tried to fill in the gap. They suggest starting with production data and modifying them through adjusting for exports, imports, capital transactions, changes in stocks, exemptions and all intermediate users to obtain taxable consumption (with the help of the input-output table). The authors made a conclusion that this method could be applicable to other countries as well.

VAT revenue simulation model was developed for the economy of Nepal (Jenkins, Kuo, 1995). The major purpose of this research paper was to develop an analytical framework that could be used for estimating potential tax base and associated VAT revenues for a typical developing country. The approach is based on the national accounts and input-output tables and on the equivalence of VAT base to retail sales tax imposed on the final sales price of all goods and services.

Econometric modeling of the fiscal sector was developed for Slovak Republic (Olexa, 1997). Conditional OLS method was used to model VAT revenues. In the linear form, VAT was modeled in the following way:

VAT = f (GDP + Imports - Exports, lag of VAT, seasonal filters for 1st and 4th quarters and dummy variables for the explanation of the extreme shifts in the development of VAT which does not correspond to the development of the exogenous variables).

In the lin-log form, VAT was modeled as a function of the same variables, except for a seasonal factor for 1st quarter and adding seasonal filters for the 2nd and 3d quarters. Both models have got statistically significant results. The model does not present the influence of exports and imports separately; to avoid the problem of multi-collinearity, their impact combined with GDP is presented.

In general, there exist very few empirical papers that study VAT from the point of view of a revenue-raising instrument. The results of the World Bank study (Bogetic, Hassan, 1993) concerning the determinants of VAT revenue in a simple cross-country framework for 34 countries supported the conventional view concerning the determinants of VAT revenue performance: rate, base and difference in rates. The general model was constructed as VAT-to-GDP ratio (REV) dependent on rate, base and rate differentiation:

REV = F (Rate+, Base+, Range-)

REV variable is defined as VAT revenue in percent of a country's GDP. Rate is VAT standard rate (%). Base is defined as a VAT base variable, which takes up a value of 1 if the base includes all consumer goods and services, and 0 otherwise. Range is defined as the difference between highest and lowest VAT rates.

The rate and base coefficients turned out to be significant with a positive sign. Rate differentiation has a negative impact on the budget revenues. The model could be used for predicting revenue potential. Another finding of the paper is that under all other equal conditions, VAT revenues are higher in those countries with a single rate rather than with multiple tax rates.

Finally, we would like to compare VAT performance across transition economies and European Union countries. Tax performance across regions was described as very uneven at the beginning of the chapter. The VAT performance across transition countries, as shown by country studies, is also not even (See Table 3 in the Appendix). Slovak Republic VAT system could be named among the most successful ones. However, VAT systems in many transition economies need to address a lot of problems. Polish VAT system suffers from a huge amount of VAT exemptions. For Russia VAT refund problem is actual: many domestic and foreign companies in Russia engaged in export operations complained that they failed to receive VAT refund; at the same time VAT refund fraud problem emerges rather sharply. VAT arrears to the budget are large because of the enterprises' non-payments. VAT collections in Russia are subjected to fluctuations (Menshikov, 1999). VAT refund problem is also actual for Bulgaria (Gancheva, Bogdanov, 2001). In general, the fiscal effectiveness of VAT in CIS countries is lower as compared to that in Central European countries (Dabrowski, Tomczynska, 2001). There has been a considerable difference between general VAT rate and VAT revenues in percent of GDP, which could be attributed to the following drawbacks in VAT legislation and administration in the CIS countries: tax exemptions, VAT refund, cash principle of VAT payments instead of accrual principle as in market economies, large dependence of some economies on agriculture, small scale trade, services in GDP that may lower effective VAT collection base, political and administrative ability to collect taxes.

The statutory standard and effective VAT rates are different in EU countries as well (See Table 4 in the Appendix). In 1998 the EU average statutory standard VAT rate was 19.4%, while effective VAT rate was 10.5%. The highest VAT productivity was recorded in Austria, Denmark, Finland, Germany, Luxembourg, Netherlands and Portugal – about 60% (Joumard, 2001).

To summarize, according to public finance literature, VAT revenues will depend upon tax base, number and levels of tax rates, tax administration capacity (quality and efficiency of tax administration) and taxpayer compliance. In practice, these variables are especially challenging to incorporate into econometric models, especially for one-country studies. This topic will be discussed further in the paper.

3 Methodology

Four major approaches to revenue forecasting are usually distinguished (IMF, Manual on Fiscal Transparency):

3.1 Effective rate approach

In order to forecast tax revenue in future periods we first calculate effective tax rate by dividing the tax collection amount by the estimated tax base. Usually effective tax rate is lower than statutory tax rate. This difference can be attributed to exemptions or taxpayer compliance problems. Then we forecast tax revenue by multiplying tax base forecast for next period by effective tax rate for current period.

Under effective rate approach, the major challenge will be to estimate the ***potential tax base (or gross VAT revenue potential)***. Usually one starts with the most relevant broad measure of tax base (e.g., GDP) and adjusts it for VAT type and legislative description of objects and base of taxation. As a rule, operations, which are administratively expensive to tax, will be excluded from the tax base (e.g., housing, finance, insurance) as well as operations, which are exempted because of social reasons (health, education, social service) or public sector activities. However, it may turn out to be difficult to adjust for such operations and one could be made to stay with the broader tax base.

Net VAT revenue potential would account for all exemptions (those rather granted on ad hoc basis, e.g., sector-specific: agriculture, etc.).

Application of standard VAT rate to the net VAT potential base will give us the estimate of ***VAT potential revenues,*** that is actually the amount, which should be received by tax authorities. The difference between VAT potential revenues and ***gross VAT collections*** will be attributed to VAT arrears and tax evasion/avoidance.

Gross VAT collections will be in their turn different from the ***actual VAT collections*** (those recorded in the Treasury reports) due to VAT refunds.

3.2 Elasticity approach

This approach is based upon establishing a stable empirical relationship between the tax revenue growth and the corresponding tax base growth, which is known as elasticity. The revenue increase is obtained by multiplying the forecast increase in the tax base by elasticity. Besides, the estimated impact of the changes in the tax structure and tax administration/compliance is added.

In order to have readily available estimates of elasticity, one should estimate the following log-linear model:

$$\ln \text{VATrevenue} = \alpha + \beta * \ln \text{VATbase} + u_i.$$

Normally, the elasticity β is approximately 1% or slightly below.

3.3 Model-based approach

Revenue forecasts can be produced by using general-equilibrium models or micro simulation models based on a sample of tax returns. Since the application of such models for Ukraine is hardly possible, we will apply a simple econometric OLS model to study VAT revenue performance.

VAT revenues will depend upon macroeconomic variables, first of all, those that will form the tax base, and tax specific variables such as number and levels of tax rates, tax administration capacity and taxpayer compliance.

Tax base will depend upon the type of VAT that is being administered in the country: consumption-based (i.e., tax base does not include investment), income-based (i.e., tax base includes investment but excludes depreciation amount for each period) or product-based (i.e., all is included into tax base). Since consumption-type VAT is administered in Ukraine, the first approximation for the tax base should be consumption. The coefficient near the tax base will be some kind of indicator of VAT productivity or efficiency.

Complexity of any VAT system is determined by the existence of tax exemptions and multiple tax rates[4]. Since effective VAT rate is certainly different from the standard, it would be reasonable to include into the model either effective tax rate or VAT productivity or efficiency that may be defined as effective/statutory rates ratio = e/t, where e – effective tax rate and t – statutory tax rate. This variable will present the indirect combined influence of such administrative and legislative drawbacks of VAT administration as exemptions, arrears, refunds and non-compliance. High revenue productivity ratios will be associated with higher levels of compliance. A country for which the ratio approaches 0.5% can be said to be performing at a high VAT effort. Although this is a perfect variable in description, in practice it is not that easy to incorporate this variable into the econometric model, since it automatically leads to the problem of endogeneity and multicollinearity.

Tax administration efficiency can be usually measured by the ratio of gross VAT collections to gross VAT potential revenues. Low tax rate indicates that tax administration works inefficiently (unable to fight VAT arrears and tax evasion/avoidance). If to include the variable of tax administration efficiency into the model, we could again encounter the same problem of endogeneity. Besides, this variable is extremely difficult to construct on a monthly or quarterly basis.

VAT taxpayer compliance can be also measured as the difference between VAT potential revenues and gross VAT collections. The difference will be attributed to the existence of tax arrears and evasion/avoidance. By subtracting the amount of VAT arrears (tax authorities record this information), we would be able to come up with the estimate of tax evasion/avoidance. Although one could try to construct such a variable on a yearly basis, the construction of such a variable on a monthly basis would be difficult in practice.

One might also consider the possibility to incorporate separately the influence of ***tax exemptions and VAT refunds arrears***. However, this leads to the problem of multicollinearity.

Seasonal character of VAT payments should be taken into account. VAT revenues usually can be lower in the first month or quarter of the year and somewhat higher in the last month or quarter of the year.

Having discussed the theoretically possible variables and related problems in practice, the general form of equation for VAT revenues will be as follows:

$$VAT = f\ (EV_j,\ SF_i),$$

where VAT – VAT revenues, EV_j – explanatory variables, SF_i – seasonal factor.

[4] In Ukraine there are two basic tax rates: 20% and 0% (0% rate is applied for exports, sales of works and services for use and consumption outside of Ukraine, free-duty shops in the zones of customs control, transport services for conveyance of passengers and goods, sales of milk and meat by agricultural producers to processing enterprises, sales of works and services of playing business and by enterprises and funds of disabled persons).

3.4 Trend and autocorrelation approach

Past trends together with specific information related to each revenue source can be used for forecasting. ARIMA models are quite frequently applied in empirical works, in particular for forecasting.

4 Empirical part

4.1 Data description

The primary sources of empirical data are regular reports on budget execution released by the State Treasury of Ukraine (VAT revenue plan and execution) and reports of State Tax Administration (VAT exemptions). Furthermore, we use the data from the State Statistics Committee (on GDP) and the data of the National Bank of Ukraine (on exports and imports) for VAT base calculation. The data from the input-output tables is used to estimate the effective VAT rate. To build an econometric model, the readily available data for 1998-2002 (on a monthly basis) is used.

4.2 Empirical results

4.2.1 Effective rate approach

Estimation of VAT base

The most important thing in the effective rate approach is to estimate the tax base. We will start with a broad base of GDP according to the expenditure method of GDP calculation and further adjust it to get a narrower tax base.

GDP can be measured at both basic and at consumer (or market) prices. GDP at consumer prices includes taxes less subsidies on products as compared to GDP at basic prices. That means that while calculating GDP at consumer prices, consumed goods and services are evaluated at purchasing prices, accounting for accrued VAT. Thus, the broad base for VAT should be GDP at basic prices.

Since consumption-based VAT is administered in Ukraine, VAT base may be first approximated by ***private consumption***. Private consumption as the base for VAT may be a bit overestimated as VAT is paid only on those products that are produced for commercial purposes but is not paid on the products for personal consumption (shadow economy calculations that are included into GDP estimation).

Government consumption is mainly out of the VAT system: government expenditures are not objects of taxation or are exempted from taxation as in most countries. As a rule, such services as health care, education, social and financial services are not taxed. However, a part of operations may be still taxable, e.g., intermediate goods that are used in the production of government goods and services and which would stay in the tax base of the government sector.

Under consumption-type VAT, ***investment*** should not be a part of VAT base. According to the VAT Law (Article 7), VAT that was paid or accrued by the tax-payer in the reporting period while purchasing or constructing fixed assets that are to be amortized is included into the tax credit of this reporting period, independently of the time of putting the fixed assets into operation. Thus, very often investors are to receive VAT refunds[5]. New or expanding enterprises may pay a larger amount of VAT while purchasing investment goods than the amount of their sales. Thus, they are also due to get VAT refunds. Investment, however, may contribute to higher VAT revenues and higher C- efficiency. First, for exempt items taxes paid on business inputs (investment) will not be creditable (firms that get tax exemptions will be out of the VAT system and will be not registered as tax-payers). Second, investment may appear to be taxed because of overdue VAT refunds to investors.

Exports should be excluded from the tax base. VAT in Ukraine is administered on destination-based principle, that is, exports are 0-rated. Although exports are excluded from the tax base, they contribute to lower budget revenues not only because of 0-rate on such operations, but also because of the refund amount that should be repaid to exporters.

Since Ukraine is a major exporting country with the ratio of exports to GDP of about 60%, exports volumes will certainly impact VAT budget revenues. Huge VAT refunds can be a problem for any large exporting country. The problem is aggravated by the fact that Ukraine is a major exporter of raw materials or half-finished products, that is products with low value added, but which are very material- and energy-intensive.

Imports should be also excluded from the tax base to avoid double counting. Domestic private and government consumption as well as investment comprises purchases of imported current and capital goods.

In general, imports should be taxed under the standard 20% VAT rate. Usually VAT revenues from imported goods account for a large proportion of VAT revenues (Ebrill, Keen, Bodin and Summers, 2001). It is conventionally considered that ability of VAT to tax international trade transactions is one of the major merits of this tax. The tax should be paid at the customs control. In Ukraine there is a high discrepancy between the collected VAT revenues from imports and potential VAT revenues on imported goods (20% of the total value of imports of goods). VAT on imports revenues made up 3.7% and 4.1% of the potential base in 2000 and 2001, respectively. The VAT on imports efficiency (VAT revenues from imported goods divided by potential tax base and divided by standard VAT rate of 20%) is extremely low: 18.5% and 20.5% in 2000 and 2001, respectively. Such poor performance could be attributed to VAT exemptions on imported goods, arrears, mutual settlements (use of exports-imports operations for getting VAT refunds), etc.

5 Many countries introduced administrative restrictions for VAT refund on investment goods because of fear of fraud.

To sum up, the narrower tax base for applying effective rate approach for estimating VAT revenues should consist of government consumption and private consumption at retail prices. In addition, extra charge for trade and transport from input-output tables should be added. It would be also necessary to account for excise tax, paid on consumed goods, and import duty[6]. To arrive at the net potential VAT base, the full value of operations, which fall under zero-rate and exemptions provisions, as well as the amount of the non-taxable objects needs to be removed.

Estimation of effective VAT rate

Since we did not have such detailed data, we were made to stay with a rather broad VAT base. We had readily available data on GDP at basic prices for 2000 and would like to illustrate the application of this method for this year (see Table 1).

Table 1
Effective rate calculation for 2000

VAT base (at basic prices, private consumption+ government consumption +extra charge for trade and transport + excise tax and import duty), UAH bn	119.9
VAT revenues, UAH bn	9.4
Effective tax rate (VAT revenue/VAT base), %	7.9
C-efficiency (effective tax rate/statutory tax rate), %	40
Revenues from VAT on domestic goods, UAH bn	6.4
Revenues from VAT on imports, UAH bn	3.0
Imports of goods, UAH bn	81.3
Effective tax rate for imported goods (tax collections from imports/imports of goods), %	3.7

Source: own calculations

According to the effective rate approach, we should multiply the forecast VAT base for a subsequent year by the effective rate of 7.9% to get forecast VAT revenues. Then, we should make necessary adjustments to the forecast concerning VAT arrears and granted or removed tax exemptions. The application of the effective rate approach is rather time consuming and needs a lot of statistical data.

Estimation of efficiency and C-efficiency ratio

In Ukraine efficiency ratio (VAT revenues to GDP divided by standard VAT rate) worsened from 36% in 1998 to 26% in 2001 and then again improved to 31% in 2002 (See Table 1 in the Appendix). Ukraine’s efficiency ratio is lower that the efficiency ratio for Central Europe and former Soviet Union states (36%) and is in between efficiency ratio for Sub-Saharan Africa (27%) and Asia and Pacific countries (35%).

6 According to VAT Law, tax base is defined as the contract value of sold goods and services, calculated on the basis of market or set prices (tariffs) accounting for excise tax, import duty, other state taxes and fees (obligatory payments), except for value added tax, which are included into the price of goods and services according to Ukraine’s tax laws.

C-efficiency ratio (based on consumption at basic prices) is one of the lowest in the regional comparison. In 2000 it amounted to 40%, which means that the country performs at a low VAT effort. This indicator of C-efficiency can be overestimated as VAT revenue may include revenue from VAT on investment goods in the cases described above. C-efficiency ratio of 100% is an indicator of a very good VAT system.

Estimation of tax exemptions

Some implications could be drawn from the above analysis concerning the estimation of VAT exemptions (see Table 2).

Table 2
Estimation of tax preferences, arrears and evasion

VAT revenues, UAH bn	9.4
VAT refunds, UAH bn	9.1
Gross VAT collections, UAH bn	18.5
Potential revenues (20% of VAT base), UAH bn	24.0
Difference between potential revenues and gross VAT collections (estimate for tax preferences, arrears and evasion), UAH bn	5.1

Source: own calculations

As can be seen from the table above, the estimated amount of tax preferences, arrears and tax evasion is about UAH 5 bn. There is a certain difference between our estimates of tax exemptions and the amount of the tax exemptions calculated by the State Tax Administration (see Table 3).

Table 3
Tax preferences for 2000: official estimates, UAH bn

Tax preferences	Revenue loss, UAH bn
Non-taxable operations (Article 3 of VAT Law)	7.0
Exemptions (Article 5 of VAT Law)	3.4
Zero-rate operations	14.8
Free economic zones	0.022
Agricultural preferences	1.0
Branch preferences	0.151
VAT refunds (mainly exporters)	4.5
Exemptions on imports from Russia	1.2
Exemptions on operations concerning services of transit of passengers and baggage through the territory of Ukraine	2.5
Other tax preferences	3.2
Total	37.9

Source: State Tax Administration

There are several major reasons for such a large discrepancy in the estimates of tax preferences. First, our estimate of tax preferences accounts only for those exemptions that have been granted on the final stage of consumption. State Tax Administration accounts for preferences at both final and intermediate levels. However, one should note that VAT exemptions at the intermediate production stages will not result in the budget revenue losses, since this amount will be included into the taxable amount of the taxpayer at the next stage of the production chain. Second, we do not account for exemptions on zero rate operations, amount of VAT refunds and imports exemptions.

4.2.2 General model

The general model for econometric estimation (based on monthly time series data for 1998-2002) takes up the following form (very similar to the described above Olexa model):

VAT= (BASE+, D1298+, u_i), where

VAT – VAT revenues to the Consolidated budget (flow),

BASE – GDP plus imports minus exports. The *BASE* variable (actually this is a sum of private consumption, government consumption and investment) was constructed in such a way in order to avoid the problem of multicollinearity.

D1298 is a dummy variable, which assigns the value of 1 to last month of 1998 (an outlier). The intuition behind this is that there was unusually high VAT revenue in December 1998. This can be explained by factors that are not included in the regression (for example, enormous administrative pressure at the end of 1998). This effect can be captured by including the dummy variable into the regression. For other years no significant outliers were observed.

The major problem with time-series data is that it very frequently shows non-stationarity. The nominal time-series for VAT revenues and VAT base exhibit a clear upward trend. Therefore, in order to remove it we used the real values of all quantitative variables. Nominal values were deflated by CPI index in order to get real values (all variables are expressed in January 1998 values).

The next step was to check real VAT revenues and VAT base variables for stationarity. Employing Augmented Dickey-Fuller (ADF) test for unit root we reject the null hypothesis about unit root at 10% level of significance for VAT base variable and at 1% level for VAT revenues variable. Therefore, both VAT revenues and VAT base real variables are stationary that is also confirmed by the inspection of the graphs of these variables. Since, the variables, which enter the regression, are stationary, we perform the regression in levels. The regression results for the model are presented below:

Table 4
Regression results for general model

Dependent Variable: VAT			
Method: Least Squares			
Sample: 1998:01 2002:12			
Included observations: 60			
Variable	**Coefficient**	**t-Statistic**	**Prob.**
C	2.21	3.46	0.00
BASE	0.03	4.75	0.00
D1298	8.32	9.33	0.00
R-squared		0.65	
Durbin-Watson statistic		1.45	
Ramsey-RESET test (p-value)		0.26	

As we can see, all the variables turned out to be statistically significant. We have got positive signs near *BASE* variable and a dummy variable for December 1998, as we have originally expected. R^2 is quite high, Durbin-Watson statistic falls into indecisive region, or region of ignorance, where it is difficult to conclude whether autocorrelation exists or not. Moreover, Ramsey-RESET test of specification error fails to reject the null hypothesis that there are no omitted variables in the model (p-value is greater than 10%).

The coefficient near the BASE variable can be interpreted in the following way: if VAT base expands by UAH 1 m, VAT revenues increase by UAH 30 000. This may be quite realistic, taking into account very low VAT productivity in Ukraine: even if VAT base expands, the revenues from VAT rise insignificantly due to the high amount of exemptions, zero-rated operations and arrears.

The model can be further used for forecasting. Having the forecast of the tax base for the coming month, one can easily estimate the forecast monthly amount of VAT revenues.

4.2.3 Elasticity approach

In order to establish a stable empirical relationship between VAT revenue growth and VAT base growth, we use elasticity approach, running a regression with log of VAT revenue as a regressand and log of VAT base as a regressor. The logarithmic transformation of variables allows us to obtain the elasticity of VAT revenue to VAT base that equals the coefficient of VAT base variable.

Since we deal with time series data, we again first check quantitative variables for stationarity through employing ADF test. This test gives the same results as above: both variables are stationary; therefore, we proceed with the regression in levels. The results of the estimation are the following:

Table 5
Regression results for elasticity model

Dependent Variable: LN VAT			
Method: Least Squares			
Sample: 1998:01 2002:12			
Included observations: 60			
Variable	**Coefficient**	**t-Statistic**	**Prob.**
C	-1.24	-2.19	0.03
LNBASE	0.64	5.06	0.00
D1298	0.99	5.87	0.00
R-squared		0.51	
Durbin-Watson statistic		1.42	
Ramsey-RESET test (p-value)		0.11	

The regression analysis produced a reasonable result: there is a strongly significant positive relationship between logs of VAT revenue and VAT base. Goodness of fit of the regression is quite high, while Durbin-Watson test fails to find autocorrelation in the regression and Ramsey-RESET test fails to find any specification error.

The value of the coefficient (0.64) indicates that VAT revenue is inelastic to VAT base: if VAT base increases by 1%, VAT revenue goes up by 0.64%. Therefore, the monthly revenue increase can be obtained by applying the forecast increase in the monthly tax base by the estimated elasticity.

4.2.4 ARIMA modeling

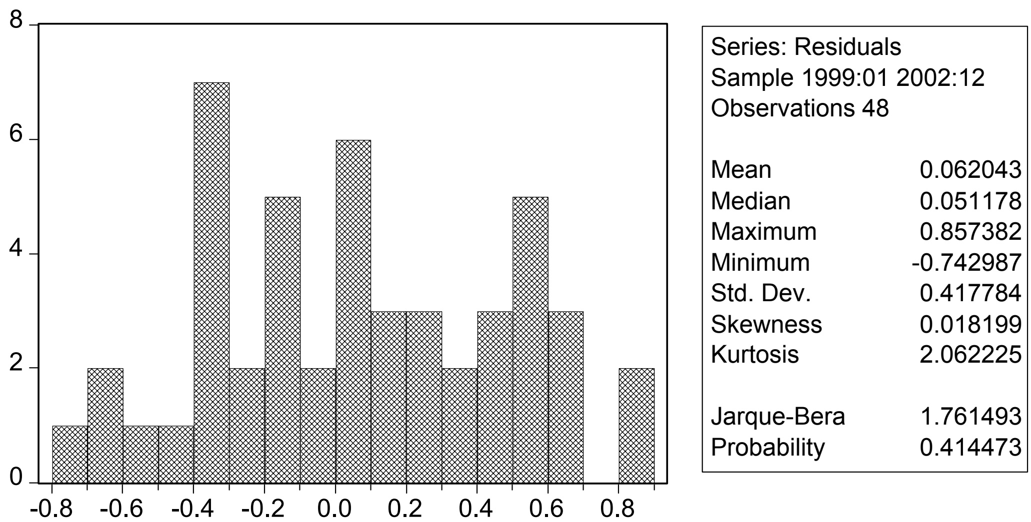
Having identified the main factors that explain the behavior of VAT revenues in Ukraine in the last five years, we try to forecast the revenues from VAT in 2003. In order to perform this short-term forecast, we use ARIMA model. The essence of this model is that the forecast of a time-series variable is based on the past values of this variable, analyzing its probabilistic or stochastic properties. Specifically, VAT revenues can be explained by AR and MA processes, where, for example, AR(1) process means that VAT revenue in the current period is correlated with VAT revenue in previous period (first-order autocorrelation); and MA(1) process means that the disturbance (random shock) in previous period affects the disturbance in the current period. Following the procedure, described in the literature, we first identify the model, checking for the order of integration of VAT variable and choosing the right number of AR and MA terms, and then proceed with forecasting monthly VAT revenues in 2003.

Identification

As we have found before, VAT revenues is a stationary variable. Therefore, we have ARMA (p, q) model. Proceeding with identification of the ARMA model, we specify p and q terms, thus, obtaining ARMA (2,6) model that contains AR(1), AR(12), MA(3), MA(4), MA(5), MA(7), MA(8) and MA(18) terms.

The strongest requirement to ARMA model is that residuals of the regression should be white noise, i.e., they are uncorrelated and normally distributed. Therefore, we check obtained ARMA (2,6) model for normality and serial correlation (see Graph 1).

Graph 1
Jarque-Bera test of normality



P-value of Jarque-Bera normality test is 0.41, which is quite high, therefore, we do not reject the normality assumption. Then, in order to check for the autocorrelation among residuals, we run Breusch-Godfrey test for serial correlation with 12 lags included (see Table 6).

Table 6
Breusch-Godfrey serial correlation LM test

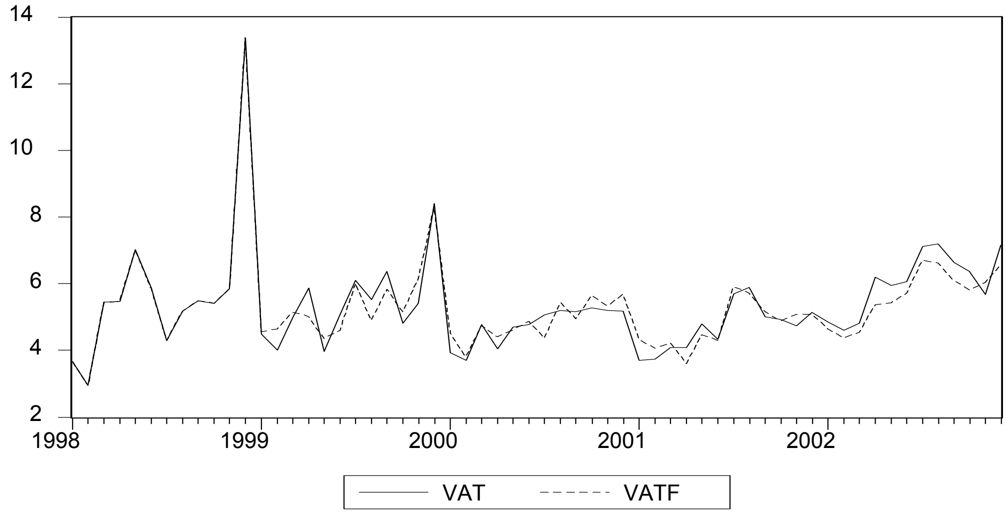
F-statistic	1.68	Probability	0.13
Obs*R-squared	19.89	Probability	0.07

The p-value of the test is 0.07, which means that we can adopt the null hypothesis about uncorrelated disturbances at 5% significance level. Moreover, the correlogram of the residuals confirms our conclusion about the absence of autocorrelation among disturbances.

Forecasting

Having identified ARMA (2,6) model, we proceed with forecast of VAT revenues for 2003. First, we present the graph of actual and fitted (based on estimated ARMA model) values of VAT revenues (see Graph 2).

Graph 2
Actual and fitted values of VAT revenues



As we can see from the above graph, the model provides quite a good approximation of the actual data. In particular, forecast values are similar to actual values at peak points that indicates the accuracy of the forecast. In addition, Mean Absolute Percent Error is rather low: 6.85%.

Table 7 presents forecast values of the real VAT revenues for 2003, obtained by static forecast of the ARMA model.

Table 7
Monthly forecasted of VAT revenues for 2003 (in January 1998 hundreds UAH m)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
VAT revenue	6.5	5.2	5.5	6.1	6.0	5.8	6.1	6.2	5.8	5.0	5.2	5.5

As we see from the table, real VAT revenues in 2003 will be rather stable and fluctuating around UAH 600 m (in January 1998 prices). The annual VAT revenues for 2003 are projected to be UAH 6.89 bn (in January 1998 prices). If we transform it to nominal values, using projected inflation rate for 2003 (5.2%), we obtain the annual nominal VAT revenues of around UAH 13.5 bn that is comparable with government's forecast of VAT revenues of UAH 13.64 bn.

Therefore, having built ARMA (2,6) model of real VAT revenues and applying it for forecasting VAT revenues, we got reasonable results that furthermore confirm the Government's estimates of VAT revenues in 2003.

5 Conclusions

This research project tested different methodologies for estimating VAT revenues that could be further used by the Ministry of Finance for revenue forecast. We failed to develop any econometric model that would account for macroeconomic factors and VAT administrative issues. Any attempt to incorporate such variables into the model led to the econometric problems such as multicollinearity, endogeneity, etc. Thus, we were made to stay with simple econometric models.

Effective rate approach is the most burdensome of all methods to estimate VAT revenues and requires a huge amount of statistical information. The use of VAT base at basic prices allowed us to estimate a more exact effective VAT rate of 8% and more exact C efficiency of 40% for 2000, which means that Ukraine performs at a low VAT effort. The more general recommendation is that measures of VAT performance should be rather related to VAT base at basic prices.

The general econometric model was developed for forecasting monthly VAT revenues. We got the result that if VAT base goes up by UAH 1 m, VAT revenue will increase only by UAH 30000 (ideally, if there are no any tax exemptions and VAT compliance is perfect, VAT revenue should increase by UAH 200000, if VAT base rises by UAH 1 m).

The elasticity model gave us an estimate of VAT revenue elasticity of 0.64%, which is generally consistent with a priori expectations: the elasticity is usually 1% (in developed countries) or below.

From estimating ARIMA model, we got a reasonable yearly VAT revenue forecast for 2003 that is in accordance with government's estimate proscribed in the budget. This number shows that there will be no significant positive changes in VAT performance in 2003.

In general, it would be preferable to apply these methodologies simultaneously. All estimates should be compared and combined to come up with a reasonable forecast number in order to account for all merits and drawbacks of each of the methods. These econometric methodologies do not account for the discretionary government policies, which could influence the revenue forecast.

The outcomes of all models are rather similar. On their basis we can conclude that VAT collection in Ukraine is very far from perfect. The main contributors to such situation are tax exemptions, arrears and evasion that can be explained by weak VAT administration and low taxpayer compliance, which should be certainly enhanced. VAT has been administered in Ukraine since 1993. Usually the number of years since VAT introduction is associated with higher revenues, as VAT administration and compliance improve with years. The opposite situation is unfortunately observed in Ukraine. VAT administration while imports and exports operations needs also to be improved. Ukraine has a high ratio of trade to GDP, which usually contributes to higher C efficiency, and the country should benefit from this in terms of higher public revenues.

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Appendix

Table 1
Summary of VAT performance statistics in Ukraine

	1994	1995	1996	1997	1998	1999	2000	2001	2002
VAT revenues, UAH bn	1.3	4.5	6.3	8.2	7.5	8.4	9.4	10.4	13.5
VAT revenues, % of GDP	10.8	8.3	7.7	8.8	7.3	6.4	5.5	5.1	6.1
VAT revenues, % in Consolidated public revenues	30.3	27.5	27.3	29.3	25.8	25.6	19.5	19.2	22.2
VAT efficiency or productivity[7], %	54.0	41.5	38.6	44.1	36.4	32.2	27.7	25.6	30.5
VAT C efficiency, %	79.6	54.4	48.3	54.1	44.6	41.8	36.9	33.1	39.9
VAT revenue execution, %		95.3	95.3	97.5	85.2	101.3	93.8	89.0	104.5
Share of VAT revenues from domestic operations in total VAT revenue, %							68.0	62.3	49.6
Share of VAT revenues from import operations in total VAT revenue, %							32.0	36.4	50.4

Source: Ministry of Finance; State Treasury; State Statistics Committee; own calculations

Table 2
Efficiency ratio by region, %

	Sub-Saharan Africa	**Asia and Pacific**	**America**	**EU (plus Norway and Switzerland)**	**Central Europe and BRO***	**North Africa and Middle East**	**Small islands**
Efficiency ratio	27	35	37	38	36	37	48
C-efficiency ratio	38	58	57	64	62	57	83

Source: IMF staff calculations; Ebrill, Keen, Bodin and Summers (2002)

[7] GDP and consumption have been taken at consumer prices to calculate the VAT efficiency and C efficiency.

* Baltic states, Russia and other countries of the former Soviet Union.

Table 3
VAT performance in selected transition countries, 1999

Country	General VAT rate, %	VAT revenue in % of GDP, %	VAT productivity, or efficiency, %
Czech Republic	22	7.5	34.1
Estonia	18	8.5	47.2
Georgia	20	8.5	42.5
Hungary	25	4.4	17.6
Kyrgyz Republic	20	4.1	20.5
Poland	22	8.2	37.3
Russia	20	4.8	24.0
Ukraine	20	6.6	33.0

Source: Dabrowski, Tomczynska, 2001

Table 4
VAT performance in European Union countries, 1998

	Statutory standard VAT rates, %	*Effective VAT rates[8], %*	*Effective VAT rates in percent of standard rates or VAT productivity, %*
Austria	20.0	12.2	61.2
Belgium	21.0	10.3	49.0
Denmark	25.0	14.6	58.3
Finland	22.0	12.9	58.5
France	20.6	10.9	53.0
Germany	16.0	9.4	59.0
Greece	18.0	9.5	53.0
Ireland	21.0	12.2	58.2
Italy	20.0	8.5	42.7
Luxembourg	15.0	8.9	59.2
Netherlands	17.5	10.5	60.1
Portugal	17.0	10.5	61.5
Spain	16.0	8.0	49.7
Sweden	25.0	10.0	40.1
United Kingdom	17.5	8.8	50.1
EU average	***19.4***	***10.5***	***54.2***

Source: Joumard (2001)

8 Effective VAT rates are calculated by dividing VAT revenue by its base (i.e., consumption exclusive of consumption taxes).