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TOPIC 5: AN ANALYSIS OF VAT COMPLIANCE

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I. INTRODUCTION

The public finance literature points to many factors that are thought to affect taxpayer compliance with respect to the value-added tax (VAT). While many of these references are treated as axioms by policymakers, few studies have been undertaken to formally assess their validity. This paper attempts to fill the void in the literature by empirically analyzing the experiences of twenty countries in administering the VAT. The study uses a consistent methodology to measure the level of compliance in each country and then applies multivariate regression methods to examine the determinants of compliance.

In conducting the study, data were collected from 20 countries with experience in administering a VAT. Data on compliance were prepared by the national authorities following a standard methodology supplied by the authors. Data on various economic variables have been extracted from a number of statistical publications, including the *International Financial Statistics* of the

¹ The opinions expressed in this paper are those of the authors and not necessarily those of the International Monetary Fund.

IMF and the World Bank's *World Tables*. The *International Bureau for Fiscal Documentation* and *The VAT Monitor* provided useful information on the provisions of the VAT in the countries under consideration.

The study consists of five sections which are organized as follows. After this brief introduction, Section II describes two measures of VAT compliance and discusses their relative advantages and disadvantages. Section III presents the main independent variables to be analyzed and explains the relationship that each variable is expected to have with compliance. In Section IV, the relationship between compliance and the independent variables is examined through the use of multivariate regression methods. Section V presents the results and conclusions of the paper.

The study also contains three appendices. The full set of data used in the study is presented in Appendix 1 and 2. The methodology used to calculate the compliance indicators is described in Appendix 3.

II. MEASURING VAT COMPLIANCE

The point of departure for this multi-country analysis of VAT compliance is the development of a reliable method of measuring compliance which can be applied on a consistent basis to each country in the study. In its essence, compliance can be thought of as the extent to which the amount of revenue actually collected from taxpayers corresponds to the amount of revenue that would have been collected had taxpayers fully complied with the tax code. The gap between actual and potential revenue is accounted for by different types of non-compliance such as delinquency, tax evasion, and avoidance. This study does not seek to distinguish among these various types of non-compliance but instead focuses on the factors that explain its overall level.

Various indicators have been developed to measure compliance. Two of the more common measures—the revenue productivity ratio and the compliance coefficient—are discussed below. Because of its greater precision, the compliance coefficient will be used as the basis for the study.

1. Revenue productivity ratio

A simple method for estimating compliance is to calculate the amount of VAT revenue collected as a proportion of gross domestic product (GDP) per point of the VAT rate. This ratio is commonly referred to as the revenue productivity ratio. According to this measure, high revenue productivity ratios are associated with high levels of compliance. Mathematically, the revenue productivity ratio is defined as follows:

$$RP = (VAT/GDP)/t$$

where:

RP = Revenue productivity ratio

VAT = VAT revenue collected

GDP = Gross domestic product

t = Average VAT rate (weighted).

The main advantage to using this measure of compliance is that all of the components of the calculation are based on actual or observable data; no estimation is required. Because the data requirements for the revenue productivity ratio are modest and easily satisfied, the calculation can be made with a minimum of effort.

Despite this advantage, the revenue productivity ratio has its limitations as a measure of compliance. The primary limitation is that while the ratio adjusts revenue collections for differences in VAT rates it does not make a similar adjustment for differences in potential VAT bases. Therefore, countries may have high revenue productivity levels not so much because compliance is high, but because the level of the potential base is high. One may argue that the GDP term, in part, adjusts for differences in potential bases. However, GDP does not provide a very accurate approximation of the size of the potential base. Substituting consumption for the GDP term would be an improvement, but would still leave the calculation highly biased against countries with narrowly defined VAT bases.

The issues raised above demonstrate that the revenue productivity ratio is a poor indicator of compliance. However, the potential usefulness of the revenue productivity ratio should not be overlooked. As will be shown in Section IV, the calculation of average revenue productivity ratios for different groups of countries can serve as a useful rule of thumb for estimating the level of VAT revenue collection.

2. Compliance coefficient

Another measure of compliance is the compliance coefficient which is defined as the ratio of actual VAT revenue to potential VAT revenue. The compliance coefficient can be cumbersome to calculate because it requires making an estimation of potential revenue. Despite this limitation, the

compliance coefficient will serve as the basis for the study because it accurately represents the definition of compliance discussed at the beginning of this section. Mathematically, the compliance coefficient is defined as follows:

$$CC = \text{VAT} / (t \times \text{PB})$$

where

CC = Compliance coefficient

VAT = VAT revenue collected

t = Average VAT rate (weighted)

PB = Potential VAT base

The key to making the compliance coefficient operational centers on estimating potential revenue which can be expressed as the product of the average VAT rate and the potential VAT base. The calculation of the average VAT tax rate is straightforward and only requires data on the amount of VAT revenue collected from each VAT rate. The calculation of the potential VAT base, however, can be cumbersome because of the need to estimate taxable sales as well as purchases of intermediate inputs and investments generating tax credits. In the case of multi-rate VATs, the calculation of the potential base can be particularly difficult requiring extensive use of input-output tables. The methodology used by the national authorities to calculate the compliance coefficient is described in detail in Appendix 3.

III. Factors Affecting VAT Compliance

This section describes the independent variables used in the study to explain VAT compliance. We were particularly interested in analyzing the significance of the design of the VAT as a determinant of compliance. Therefore, three variables related to VAT design are included: the number of VAT rates, the level of the average rate, and the size of the potential base. These variables were contrasted with factors that are exogenous to the design of the VAT such as the level of economic development and the structure of production. The justification for including each variable in the study is presented below.

1. Number of rates

The relationship between the number of VAT tax rates and taxpayer compliance has been discussed in various studies. As Tait (1988) points out, the amount of information required to administer a VAT increases geometrically with the number of tax rates. Multiple-rate VATs complicate compliance because firms are required to account separately for each different rate category when filling out tax returns (Choi, 1990). Additional complications may arise because the rate structure may not be sufficiently defined, leading to products which can fit into more than one rate category. Inadequately defined rate structures provide incentives for firms to intentionally misclassify goods in order to reduce their tax liability (Sandford and Goodwin, 1990). Moreover, multiple-rate VATs inevitably require the tax administration to make arbitrary decisions in classifying the rates applied to different goods, a practice that frequently leads to legal disputes to divert the attention of the tax administration (Cnossen, 1982).

2. Average rate

Another potentially important, and often cited, determinant of compliance is the level of the average VAT rate. It is frequently claimed that high average tax rates reduce compliance by holding out the prospect of additional gain through understating sales or overstating purchases.

3. Potential base

Exemptions reduce the size of the potential tax base. In doing so, exemptions have been observed to both increase the cost of compliance and provide additional opportunities for evasion. Exemptions increase compliance costs by complicating the record keeping required to complete the tax return. As in the case of multiple-rate VATs, exemptions provide an avenue for evasion by opening the door to intentional misclassification of goods by taxpayers (Bird, 1992).

4. Other factors

A second broad group of variables included in the study relate to the structure of production (as measured by the agriculture to GDP and imports to GDP ratios) and the level of economic development (as measured by per capita income, literacy rates, and degree of urbanization). Compliance can be affected by the economy's structure of production because as the formal sector expands taxation tends to be increasingly determined by a more readily measurable and verifiable tax base, thereby reducing opportunities for

non-compliance (Bird, 1992). The level of economic development can also be expected to influence compliance to the extent that tax administrations operating in wealthier countries have access to more advanced technological resources and more skilled staff to identify and control non-compliance.

IV. Analysis of VAT Compliance

Previous sections discussed the relationships between compliance and its determinants. These relationships are tested in this section. In subsection 1, we show how the revenue productivity ratio can be used as a tool to estimate VAT revenue. In subsection 2, we re-introduce the compliance coefficient and use multivariate regression to assess its determinants.

1. Using the revenue productivity ratio to estimate VAT revenue

In Table 1, the revenue productivity ratio is calculated for 20 countries which are separated into four groups based on each country's level of compliance and the size of its potential VAT base. An average revenue productivity ratio is then calculated for each group. These group averages can be used as a basis for predicting revenue by countries planning to introduce a VAT. For example, Table 1 shows that a country planning to implement a 10 percent VAT, with a potential base of over 55 percent of GDP and an anticipated compliance rate of under 70 percent, can expect to raise approximately 4 percent of GDP in tax revenue.

Table 1. VAT Revenue Productivity Averages
(as a percent of GDP)

Potential VAT Base (as a percent of GDP)	Compliance Coefficient	
	Over 70 percent	Under 70 percent
Over 55 percent	0.58	0.40
Under 55 percent	0.34	0.26

An attractive feature of Table 1 is that it concisely conveys a great deal of information on compliance, the potential base, and the level of the average rate ² which can be used to estimate VAT revenue. Although one must be careful in drawing conclusions from relatively small samples, it should be

² It should be recalled from Section II that the revenue productivity ratio adjusts for different levels of the average VAT rate.

pointed out that the group averages are based on a fairly compact range of values which strengthens our confidence in the usefulness of the estimates. While not a substitute for a more thorough analysis, the averages presented in Table 1 can be used as a rough gauge for estimating VAT revenue, particularly in countries where detailed data is either unavailable or unreliable.

2. Econometric analysis of VAT compliance

In the preceding subsection, we demonstrated that the average revenue productivity ratios, combined with assumptions about the size of the potential base and the level of compliance, can be used to estimate VAT revenue. In this subsection, we turn to an analysis of the factors that determine the level of compliance. The equations presented below are estimated using the ordinary least squares method of estimation.

As a starting point, a comprehensive relationship was specified relating the compliance coefficient to a number of variables. Specifically, the compliance coefficient (CC) was regressed on a constant term (C); several variables related to the design of the VAT, the structure of production, and the level of economic development. The variables related to the VAT design consisted of the average VAT rate (AVGRATE), the number of VAT rates (NRATES), the size of the potential VAT base (PBASE), and the number of years the VAT had been in operation (YEARS). The agriculture to GDP ratio (AGGDP) and imports to GDP ratio (MGDP) were used to represent the structure of production. The dollar denominated value of per capita income (PCI) was selected as a measure of the level of economic development. This equation led to the following results:

$$(1) \text{ CC} = 59.0 + 0.43 \text{ AVGRATE} + 1.19 \text{ NRATES} - 0.10 \text{ YEARS} + 0.21 \text{ PBASE} \\ (2.10) (0.39) \qquad (0.40) \qquad (-0.13) \qquad (0.67) \\ - 0.84 \text{ AGGDP} - 0.11 \text{ MGDP} + 0.001 \text{ PCI} \\ (-1.04) (-0.45) \qquad (1.42)$$

$$^2 = 0.25 \quad \text{F-statistic} = 2.26 \qquad \text{Observations} = 20$$

The figures in parenthesis are the t-statistics.

² is the adjusted R-squared value.

The low value of the F-statistic indicates that the above equation, overall, is insignificant. To improve the equation, we calculated a covariance matrix and determined that the agriculture to GDP ratio was highly correlated with the level of per capita income and that the average VAT rate was highly correlated

with the number of years. To correct for multi-collinearity, some of the regressors were eliminated and two additional equations (2a and 2b) were estimated. This yielded the following results:

$$(2a) \quad CC = 80.0 + 0.32 \text{ AVGRATE} + 1.60 \text{ NRATES} - 1.49 \text{ AGGDP}$$

$$(6.12) \quad (0.48) \quad (0.57) \quad (-2.98)$$

$$R^2 = 0.32 \quad F\text{-statistic} = 3.95 \quad \text{Observations} = 20$$

$$(2b) \quad CC = 53.2 + 0.48 \text{ AVGRATE} + 1.12 \text{ NRATES} + 0.002 \text{ PCI}$$

$$(5.55) \quad (0.75) \quad (0.38) \quad (3.01)$$

$$R^2 = 0.32 \quad F\text{-statistic} = 4.02 \quad \text{Observations} = 20$$

Finally, in the last two equations (3a and 3b) presented below we regressed the compliance coefficient separately on the level of economic development (as measured by dollar denominated per capita income) and the structure of production (as measured by the agriculture to GDP ratio). This resulted in our only significant equations:

$$(3a) \quad CC = 87.7 - 1.58 \text{ AGGDP}$$

$$(14.4) \quad (-3.5)$$

$$R^2 = 0.37 \quad F\text{-statistic} = 12.29 \quad \text{Observations} = 20$$

$$(3b) \quad CC = 60.6 + .002 \text{ PCI}$$

$$(15.6) \quad (3.5)$$

$$R^2 = 0.37 \quad F\text{-statistic} = 12.22 \quad \text{Observations} = 20$$

Three main findings may be inferred from the analysis presented in this section. First, the structure of the VAT appears to have no clear relationship with the overall level of compliance. Second, compliance tends to improve with shifts in the structure of production away from the agriculture sector and with increases in a country's level of economic development. Other indicators of the level of economic development such as the literacy and urbanization rates also proved to be significant but did not perform as well as per capita income. A third finding is that the factors included in the above equations account for less than 40 percent of the variation in VAT compliance indicating that other important variables have been omitted from the study. This point is discussed further in the concluding section of the paper.

V. CONCLUSIONS

This paper set out to explore the factors that affect VAT compliance. In doing so, it was postulated that compliance is influenced by the structure of the VAT as well as by factors related to the level of economic development and the structure of production. Indicators of compliance were then developed and used to evaluate our hypotheses. The results of this analysis are summarized below.

First, the main lesson to emerge from this study is that a well-designed VAT is not always a sufficient condition to ensure compliance. Many countries in the sample exhibited low levels of compliance even though they maintained VAT features that are administratively "desirable" (i.e., a single, low VAT rate applied to a broad potential base). At the same time, many countries in the sample were able to achieve high levels of compliance despite possessing VAT features that complicate administration (i.e., multiple rates, high average rate, and narrow base). The latter set of countries hold out the prospect that good tax administration can overcome the constraints imposed by policy.

Second, the study suggests that the structure of production and the level of economic development contribute significantly to the level of compliance. These results validate the assumption that shifts in the structure of production toward more easily measurable economic sectors leads to improvements in compliance. The results also confirm the notion that as countries increase in wealth they are able to achieve higher levels of compliance. This may occur because wealthier countries possess more sophisticated technology and skilled tax administration staff. It may also occur because increases in income are associated with other factors that promote compliance such as higher levels of literacy and urbanization.

Third, the variables included in the study accounted for less than half of the variance in the level of compliance. Other factors, excluded from the study, clearly play an important role in determining compliance. Tanzi and Shome (1993) summarize many potentially significant variables, such as attitudes and social ethics, the structure of the business sector, the cost of compliance, and the effectiveness of the tax administration. Although these factors are difficult to measure, it is important nevertheless to recognize that compliance is affected by many varied and complex factors. This last point suggests that in designing strategies to improve compliance, policymakers should avoid blanket prescriptions and quick fix solutions. Instead, priority should be given to developing policies that are tailored to specific conditions facing each country.

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APPENDIX 1. VAT/Data Series

Country	Year	Compliance Coefficient I/	Revenue Productivity	VAT Revenue-GDP ratio	Number VAT Rates	Average VAT Rate	Potential Base-GDP ratio	Per Capita Income (\$)	Agriculture GDP ratio	Imports-GDP ratio	Years VAT
Argentina	1992	-	0.33	5.9	1	18.0	47.6	2790	15	8.0	17
Bolivia	1990	-	0.28	3.1	1	11.1	49.9	650	21	19.6	17
Canada	1991	-	0.32	2.2	1	7.0	41.3	20440	3	25.4	1.5
Chile	1991	-	0.49	8.8	1	18.0	59.8	2160	8	30.5	16
Colombia	1991	-	0.19	2.4	5	12.2	30.4	1260	17	15.2	16
Ecuador	1991	-	0.31	3.1	1	10.0	50.9	1000	15	24.9	21
Guatemala	1992	-	0.36	2.5	1	7.0	76.2	930	26	21.7	9
Honduras	1992	-	0.42	3.1	2	7.3	65.2	580	22	35.4	16
Hungary	1991	-	0.44	6.1	2	14.0	68.5	2720	10	33.4	3
Israel	1992	-	0.54	9.7	1	18.0	58.4	11950	3	46.0	17
Mexico	1992	-	0.30	3.0	1	10.0	48.3	3030	9	17.0	12
New Zealand	1992/93	-	0.67	8.4	1	12.5	70.7	12350	9	27.5	6.5
Panama	1991	-	0.36	1.8	1	5.0	76.4	2130	10	98.8	14
Peru	1992	-	0.17	3.1	1	18.0	53.3	1070	13	12.7	16
Philippines	1992	-	0.24	2.4	1	10.0	40.4	730	21	31.9	4
Portugal	1991	-	0.71	6.4	3	9.0	82.3	5930	9	45.0	5
South Africa	1992/93	-	0.52	5.2	1	10.0	61.3	2560	5	19.8	1.5
Spain	1989	-	0.52	5.4	4	10.5	69.6	12450	6	21.2	3
Sweden	1992	-	0.35	8.0	2	23.2	36.5	25110	3	27.0	23
Uruguay	1991	-	0.34	7.4	2	21.6	49.0	2840	10	20.1	23
Average		69.2	0.4	4.9	1.7	12.6	56.8	5634.0	11.8	29.1	12.1

Notes: 1/Data omitted to preserve confidentiality. See APPENDIX 2.

APPENDIX 2

VAT Compliance Coefficients

Country	Compliance Coefficient
1	94.9
2	94.6
3	92.2
4	86.0
5	85.4
6	81.8
7	77.0
8	74.0
9	70.3
10	68.5
11	64.6
12	64.2
13	63.7
14	62.9
15	61.8
16	59.2
17	56.1
18	47.5
19	46.5
20	31.8
Average	69.2

1/ The order of the countries in this appendix does not correspond to the order of the countries presented in Appendix 1.

APPENDIX 3

Methodology for Estimating VAT Compliance Coefficient

Calculating the compliance coefficient requires estimating: (1) taxable sales; (2) purchases which generate tax credits; and (3) investments which generate tax credits. These values will then be used as a basis to estimate the potential taxable base (4). Potential revenue will then be calculated by applying the general rate to the theoretical taxable base (5). ^{1/} Finally, the compliance coefficient is calculated as the ratio of actual to potential revenue (6). The appendix concludes with an arithmetic summary of the methodology (7).

1. Estimation of taxable sales

Taxable sales are estimated based on the total supply figure. Total supply equals gross production plus imports. Taxable sales (which generate a VAT debit) are obtained by subtracting exemptions, exports, and changes in inventories from total supply.

2. Estimation of net purchases

Total purchases are defined as intermediate consumption reported in national accounts. Net purchases (which generate VAT credit) are obtained by subtracting from total purchases the purchases of exempt inputs (which do not generate credit) and of taxable inputs intended for the production of exempt goods and services (because the good or service produced is nontaxable, the taxpayer cannot recover the VAT paid for those inputs).

3. Estimation of net investments

Net fixed capital investments (which generate VAT credit) are estimated using the gross fixed capital formation figures in the national accounts. Net exempt investments are calculated by subtracting from gross fixed capital formation exempt investments (because these investments are nontaxable, they do not generate a VAT credit) and taxable investments intended for the production of exempt goods and services (because the good or service produced is nontaxable, the VAT in these investments cannot be recovered).

4. Estimation of the taxable base

Subtracting net purchases and net investments from taxable sales yields the potential taxable base plus VAT revenue. This amount less VAT revenue yields the potential taxable base (Net of VAT).

5. Calculation of potential revenue

Potential or theoretical revenue is calculated by applying the VAT rate z to the potential taxable base.

6. Calculation of compliance coefficient

The compliance coefficient can then be calculated by dividing actual VAT revenue collected (net of refunds and allowances) by potential revenue.

7. Summary of the Methodology

Sales		
+ gross production		
+ imports		
= Total supply		
- exemptions		
- exports		
- change in inventories		
= Taxable sales	(1)	
Purchases		
+ total purchases (intermediate consumption)		
- purchases of exempt inputs		
- purchases of taxable inputs for production of exempt goods and services		
= Net purchases	(2)	
Investments		
+ total investments		
- exempt investments		
- taxable investments for the production of exempt goods and services		
= Net investments	(3)	
Potential taxable base (includes actual VAT revenue) =		
(1) - (2) - (3)	(4)	
Actual VAT revenue	(5)	
Potential taxable base (net of VAT) = (4) - (5)	(6)	
Potential revenue = Average VAT rate x (6)	(7)	
Compliance Coefficient = (5)/(7)	(8)	

Notes to Appendix 3

- 1/ This methodology considers a single-rate VAT. If there is more than one rate, the estimation of the taxable base should be applied to each rate individually. See "Uruguay: El sistema tributario y su administración," Silvani, dos Santos, Medina, Fiscal Affairs Department, International Monetary Fund, (1990).
- 2/ The average VAT rate should be calculated in those countries which have multiple VAT rates. The average rate can be calculated as follows:

$$t = t_i * (B_i/B)$$

where

t = average VAT rate

t_i = tax rate i

B_i = tax base i = (VAT_i/t_i)

B = total tax base = $\sum B_i$

and

VAT_i = VAT revenue collected under t_i

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