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Equivalence of the Production and Consumption Methods of Calculating the Value-Added Tax Base: Application in Zambia */

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Abstract

Two methods of calculating the value-added tax (VAT) base, using production and consumption data, respectively, have been applied in different countries to estimate VAT revenue. It is not apparent that these methods should produce the same result for a particular country because each method requires different adjustments for exemptions. This paper establishes analytically the equivalence of the two methods. Both methods are applied to Zambia. Given the limitations of data, the two methods produce different results, yielding an estimated range for VAT revenue of 2-3 percent of GDP in 1995. Actual VAT revenue collected fell within this range.

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Summary

The shift from a sales tax to a value-added tax (VAT) raises concern about the impact on revenue collections. The credit system under the VAT, while essential for avoiding tax cascading, complicates the determination of the base. This paper examines two methods of calculating the VAT base, one based on production data and the other on consumption data, that have been applied in different countries. That these methods should produce the same result for a particular country is not apparent, given the different adjustments required under each for intermediate sales when certain goods and services are exempt from the tax. This paper establishes analytically the equivalence of the two methods in the presence of exemptions.

This paper presents an application of both the production and consumption methods of calculating the VAT base to Zambia, where a VAT replaced an existing sales tax on July 1, 1995. Because of the limitations of available data and the approximations required in estimating categories of exempt and zero-rated goods defined in the VAT law, the two methods produce different results: the VAT base is estimated to be 20 percent of GDP in 1995 by the consumption method, and 30 percent by the production method. Applying Zambia's 20 percent VAT rate, these results yield an estimated range of 2-3 percent of annual GDP for VAT revenue in the second half of 1995. Actual VAT revenue collected in this period fell within this range.

I. Introduction

The reform of a country's tax system, especially the substitution of one type of tax for another, is cause for considerable uncertainty and concern regarding the implications for revenue collection. For example, the shift from a sales tax to a value-added tax (VAT) entails a fundamental change in the tax base. Specifically, the credit under the VAT for the tax paid on inputs, while essential for avoiding cascading of the tax, makes the estimation of the tax base more complicated than under a sales tax. Further, the input tax credit implies the payment of refunds to taxpayers whose credits exceed their VAT liability. Consequently, government officials are concerned about the impact on the tax base of a shift from a sales tax or turnover tax to a VAT.

As a result of the uncertainties and concerns with revenue in countries shifting to a VAT, the estimation of its base and revenue is of considerable importance to policy makers. For a particular country, this estimation has generally followed one of two alternative methods. 1/ One method starts with GDP, which represents the aggregate of value-added from production and distribution activities in the economy, and makes the adjustments for imports, exemptions, and zero rating needed to arrive at the value-added included in the base of the VAT. 2/ 3/ Another method, taking advantage of the fact that the VAT is ultimately paid by consumers, starts with final consumption and adjusts for exempted and zero-rated goods and services to arrive at the base of the VAT. 4/

The first method follows the production side of the economy by constructing the VAT base from the increments to value-added through the production and distribution process. The second method focuses on the consumption side and concentrates on final sales of goods and services which incorporate total value added from all stages of production and distribution in the economy. In principle, these two methods should arrive at the same result. However, this is not immediately apparent when certain goods and services are exempt from the VAT, as is normally the case, because different adjustments for intermediate sales are required under each method. One objective of this paper is to demonstrate this equivalence analytically in the presence of exemptions.

In most countries, one or the other of the two methods has been applied to estimate the VAT base and expected revenue. Another purpose of this paper is to apply both methods to one country, Zambia, where the VAT was

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1/ One exception is Gandhi, et al., (1990) in which both methods were applied to Malta.

2/ Exemptions and zero rating and their importance in the calculation of the VAT base are described in the next section.

3/ An example of the application of this methodology is given by Aguirre and Shome (1988).

4/ A presentation of this methodology is provided by Mackenzie (1992).

introduced on July 1, 1995, and demonstrate how these two methods can produce different results and provide some explanation as to why. Many aspects of this exercise are applicable to many countries and can help practitioners facing the task of VAT revenue estimation.

Chapter II presents a demonstration of the equivalence, analytically, between the two methods of calculating the VAT base. Chapter III describes the key aspects and data requirements of the calculation under both methods for Zambia. Results of the two methods and reasons for different outcomes are also discussed. The paper is briefly summarized and concluded in Chapter IV.

II. The Production and Consumption Methods of Calculation of the VAT Base and their Equivalence

The production and consumption methods for calculating the VAT base are described using a common notation that is then used to demonstrate their equivalence. The starting point of the production method is GDP to which adjustments are made for imports, exports, investment expenditure, exemptions, zero rating, and intermediate transactions to arrive at the base of the VAT. A VAT based on consumption would exclude investment expenditure (I) from the base, include imports (M), and exclude exports (X). If there are no goods and services exempt from the tax, the VAT base (B) would be:

$$B = GDP - I + M - X \tag{1}$$

In the case of a consumption-type VAT with no exemptions, it is useful to note that the above base is the same as final consumption (C):

$$B = GDP - I + M - X = C \tag{2}$$

Differences between the two methods arise with the adjustments that have to be made for the exemptions and zero rating normally allowed under the VAT. Exemptions refer to goods on whose sale VAT is not imposed. 1/ Exemptions are made primarily because of political concerns over the application of the tax to certain necessities, especially food and medical supplies likely to be important to low-income households, and administrative difficulties in collecting the tax in certain sectors, especially the small retail and financial services sectors. 2/ Because there is no VAT liability on sales, credit is not given for VAT paid on inputs purchased for

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1/ For convenience, the term "goods" will refer to both goods and services.

2/ The exemption of small businesses is normally achieved by requiring businesses to register as a VAT taxpayer when their gross sales exceed a certain threshold. Businesses whose gross sales are below this threshold do not apply the VAT to their sales. The exemption of small businesses raises the same issues as the exemption of particular goods and services.

the supply of exempt goods. Consequently, an exempt good bears VAT to the extent tax is paid on inputs.

To see the impact of exemptions on the tax base, it is useful to start with an expression for the total value of sales in the economy: 1/

$$\text{Total value of sales} = C + I + X + IS \qquad (3)$$

where IS represents intermediate sales. When there are no exemptions, intermediate sales drop out of the base because the tax generated by these sales is offset by the credit taken by purchasers. If investment expenditure is treated as an intermediate purchase (of capital goods), which is the case under a consumption-type VAT, the tax paid on this expenditure is taken as a credit and, therefore, I is not in the base. If exports are zero rated, which is the standard practice, the VAT base equals consumption only. Once certain goods are exempt, however, some of the VAT paid on intermediate sales cannot be taken as a credit. For example, the intermediate sale of a taxed good as an input to an exempt supplier results in the payment of tax with no offsetting credit and, therefore, is included in the base. In other words, some intermediate sales remain in the tax base.

Zero-rating refers to goods that are taxed under the VAT at a zero rate, implying a zero tax liability. Because these goods are not exempt, credit for VAT paid on inputs purchased for their supply is allowed. This implies, given the zero VAT liability on sales, that the supplier is entitled to a refund under the VAT for the tax paid on inputs. Although both exemption and zero-rating do not impose VAT on sales, input tax credit is only granted under zero-rating, resulting in complete removal of VAT paid on inputs from the price of the good. Strictly speaking, zero-rating is only completely effective in removing VAT from the price of the good if the supplier does not buy any inputs from exempt suppliers; as mentioned, an exempt input would bear VAT to the extent tax is paid on inputs to its supply. Exports are normally zero-rated so that the VAT does not reduce the international competitiveness of domestic businesses.

The adjustments posed for the two methods by the presence of exemptions can be illustrated by example. First consider a good that is exempt and used as an input in the production of a second good. The supplier of the exempt input does not charge VAT on its sale. If the second good is not exempt, the producer must charge VAT on its sale and does not receive credit for the purchase of the exempt input because no tax was charged. For the production method of calculating the VAT base, the full value of the exempt input is, from a tax point of view, transferred to the value added of the taxed sector. Thus, after subtracting the value-added of all exempt goods from the VAT base, the full value, not just the value-added, of sales of exempt goods to the taxed sector must be added back. Consequently, it is

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1/ As proposed by Mackenzie (1992, p. 260).

possible to have a larger VAT base with exemptions than without, although this is unlikely in practice. 1/ For the consumption approach, the only thing that matters is whether the sale of the second good is a final sale and taxed. In other words, intermediate sale of an exempt good does not enter in the consumption method's calculation of the VAT base.

Next consider the sale of a taxed good as an input in the supply of an exempt good. Under the consumption approach, this is equivalent to a final sale because VAT is charged to a buyer who cannot take a credit, as is the case with a final consumer. Consequently, in order to compute the VAT base under the consumption approach, intermediate sales from the taxed sector to exempt sector must be added to final consumption. Under the production approach, the value added of the taxed input is already included in GDP and, therefore, no adjustment is needed for the intermediate sale of taxed goods.

Intermediate sales within the exempt sector do not enter the calculation of the VAT under either the production or consumption method because VAT is neither charged nor credited as a consequence of these sales. Intermediate sales between taxed sectors also do not affect either method because the VAT charged on the sale is subtracted as a credit by the buyer. This cancellation of VAT charged and credited is the reason intermediate sales do not enter the calculation of the VAT base under either method when there are no exemptions, as shown in equation (2).

In order to examine the effect of intermediate sales on both methods when there are exempt goods and demonstrate the equivalence of these methods at the aggregate level, the expression for the VAT base under each method is expanded to explicitly account for intermediate sales. Adopting the notation presented by Mackenzie (1992) and adjusting for exempt goods, the VAT base, assuming only exports are zero rated, is calculated following the production method as:

$$B = GDP - VA_{exempt} - I + I_{exempt} + M - M_{exempt} - X + X_{exempt} + IS_{exempt,taxable} \quad (4)$$

where VA_{exempt}, I_{exempt}, M_{exempt}, and X_{exempt} denote the total value added of exempt domestic production, investment expenditure of exempt sectors, exempt imports, and exempt exports, respectively. 2/ Exempt exports must be added back, so as not to double count the loss in the base from exports of exempt goods. 3/ $IS_{exempt,taxable}$ denotes the total value of

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1/ This possibility is discussed by Zee (1995).

2/ Because exempt sectors do not receive input tax credits, their investment expenditure must be added back to the VAT base. This includes investment in residential housing as tax credits are not available to consumers.

3/ Exempt exports are subtracted in VA_{exempt} and again in total exports. Adding X_{exempt} back to the base avoids double counting.

intermediate sales of exempt goods to the taxable sector, which are added to the base as discussed above.

To examine this more precisely, it is helpful to express intermediate sales as:

$$IS = \sum_{i=1}^{n} \sum_{j=1}^{n} a_{ij} \cdot VG_j \tag{5}$$

where VG_j is the value of gross output of good j, a_{ij} is the amount of good i used as an input in producing one unit of good j, and n is the number of all goods produced in the economy. Letting A represent the input-output matrix for production in the economy, of which a_{ij} is the ijth element, and VG is the vector of gross output values of all goods produced, IS is expressed as:

$$IS = A \cdot VG \tag{6}$$

In order to isolate the effect of intermediate sales between the taxed and exempt sectors, the vector VG is partitioned into two segments: the first k elements representing all taxed goods and the next n-k representing all exempt goods. The input-output matrix A is partitioned in a similar manner:

$$A = \begin{bmatrix} A_{11} & A_{12} \\ A_{21} & A_{22} \end{bmatrix} \tag{7}$$

where subscripts 1 and 2 refer to the taxed and exempt sectors, respectively. Given this notation, equation (5) can be restated as:

$$IS = \begin{bmatrix} A_{11} & A_{12} \\ A_{21} & A_{22} \end{bmatrix} \begin{bmatrix} VG_1 \\ VG_2 \end{bmatrix} \tag{8}$$

where VG_1 is the subvector of VG of k taxed goods, VG_2 is the subvector of n-k exempt goods, A_{11} is the k by k matrix of amounts of each taxed good used as an input in the production of one unit of each taxed good, A_{12} is the k by n-k matrix of amounts of each taxed good used as an input in the production of one unit of each exempt good, A_{21} is the n-k by k matrix of amounts of each exempt good used in the production of one unit of each taxed good, and A_{22} is the n-k by n-k matrix of amounts of each exempt good used in the production of one unit of each exempt good. Equation (8), the partitioned product of the input-output matrix and vector of gross outputs, can be expressed in the following detail:

$A_{11} \cdot VG_1 = \sum_{i=1}^{k} \sum_{j=1}^{k} a_{ij} \cdot VG_i$ = intermediate sales of taxed goods to taxed sectors

$A_{12} \cdot VG_2 = \sum_{i=1}^{k} \sum_{j=k+1}^{n} a_{ij} \cdot VG_j$ = intermediate sales of taxed goods to exempt sectors

$A_{21} \cdot VG_1 = \sum_{i=k+1}^{n} \sum_{j=1}^{k} a_{ij} \cdot VG_i$ = intermediate sales of exempt goods to taxed sectors

$A_{22} \cdot VG_2 = \sum_{i=k+1}^{n} \sum_{j=k+1}^{n} a_{ij} \cdot VG_j$ = intermediate sales of exempt goods to exempt sectors

Substituting equation (8) into equation (4), the base of the VAT following the production approach becomes:

$$B = GDP - VA_2 - I + I_2 + M - M_2 - X + X_2 + A_{21} \cdot VG_1 \qquad (9)$$

As discussed above, the only adjustment for intermediate sales in the production method is the addition of the full value of all exempt sales to taxed sectors, which corresponds to the third term, $A_{21} \cdot VG_1$, of the partitioned product of A and VG; the other three terms drop out.

Turning to the consumption method, the formula for the VAT base (B'), adjusting for consumption of exempt goods and intermediate sales, is:

$$B' = C - C_2 + IS_{taxable,exempt} \qquad (10)$$

where C_2 is the value of final sales of exempt goods. 1/ As before, equation (8) is used to obtain:

$$B' = C - C_2 + A_{12} \cdot VG_2 \qquad (11)$$

Again, following the discussion of the impact of intermediate sales on the two methods, the only adjustment in the consumption method is the addition of the full value of sales from the taxed to the exempt sector. These sales are represented by the second term, $A_{12} \cdot VG_2$, of the partitioned product of A and VG.

1/ For more discussion of the development of this formula, see pp. 262-263 of Mackenzie (1992).

Showing that equations (9) and (11) are equivalent would demonstrate the equivalence of the production and consumption methods of calculating the VAT base. Recognizing that GDP - I + M - X = C, this can be demonstrated by showing that:

$$- C_2 + A_{12} \cdot VG_2 = - VA_2 + I_2 - M_2 + X_2 + A_{21} \cdot VG_1 \qquad (12)$$

The equality in equation (12) can be shown by expressing C_2 and VA_2 in more detail as follows:

$$C_2 = \left(\sum_{j=k+1}^{n} VG_j - I_2 + M_2 - X_2 \right) - (A_{21} . VG_1 + A_{22} . VG_2) \qquad (13)$$

where the first term in parenthesis represents gross domestic sales of exempt goods and the second term in parenthesis represents intermediate sales of exempt goods as inputs in the production of both taxed and exempt goods (see the detailed presentation of equation (8)).

Next, VA_2 is expressed as:

$$VA_2 = \sum_{j=k+1}^{n} VG_j - (A_{12} . VG_2 + A_{22} . VG_2) \qquad (14)$$

where VG_2 is the value of gross output of exempt goods and the term in parenthesis represents the value of both taxed and exempt goods used in the production of exempt goods (see equation (8)).

Substituting equations (13) and (14) into (12) yields:

$$= - \sum_{j=k+1}^{n} VG_j + I_2 - M_2 + X_2 + A_{21} . VG_1 + A_{22} . VG_2 + A_{12} . VG_2 \qquad (15)$$

$$= - \sum_{j=k+1}^{n} VG_j + A_{12} . VG_2 + A_{22} . VG_2 + I_2 - M_2 + X_2 + A_{21} . VG_1$$

The equality shown in equation (15) establishes, as intended, the equivalence of the production and consumption methods of calculating the VAT base. In a sense, this is not surprising given that both methods are designed to calculate the same thing. However, their equivalence is not apparent as exemptions pose adjustments in one method that are opposite to the adjustments in the other; specifically, the production method requires the addition of the total value of sales of exempt goods to taxed sectors but not of sales of taxed goods to exempt sectors, while the consumption method requires the reverse. The analysis presented above clearly establishes this equivalence when there are exemptions.

III. Application to Zambia

Zambia provides an interesting example of a country shifting from a traditional sales tax to a VAT. Zambia replaced its tax on gross sales, which had been operating since 1970, with a VAT on July 1, 1995. This change was adopted to overcome the severe shortcomings of the sales tax, which encompassed the inefficiencies of a cascading tax and poor administration. In its place, a VAT was introduced that is designed to cover a broad base at a single positive rate. A reduction in the tax rate from 23 percent under the sales tax to 20 percent under the VAT was intended to generate support for base broadening. To further enhance support, the VAT was structured so that it would raise the same amount of revenue as the sales tax it was replacing; that is, the introduction of the VAT was cast as an improvement in the structure of the tax system, not an increase in revenue. Clearly a crucial task in the deliberations on the design of the VAT was the calculation of its base and revenue.

In order to take advantage of both production and consumption data to cross-check estimates and obtain a better sense of the range of possible outcomes for projected revenue, the VAT base was estimated using both the production and consumption methods.

1. Production method

The production method begins with aggregate GDP, which is the total value added from domestic production of goods and services. Because Zambia's VAT is applied to imports, the value of imports must be added to aggregate GDP in the computation of the base. The VAT adopted in Zambia, which is intended to fall on consumption but not investment, requires, given the credit for purchases of capital goods, the subtraction of gross domestic capital formation (GDCF) from the base. However, the component of GDCF in residential construction is taxed and, therefore, must be added to the base. Also, because the exempt sectors will not receive credit for purchases of capital goods, the share of GDCF in exempt sectors is added to the base. Government expenditure on wages and salaries, which is part of GDP, is not taxable and has to be subtracted from the base. Sales tax revenue that is included in GDP and to be replaced by the VAT must be removed from the base. Zambia's VAT has 13 exempt categories of goods and services and 6 zero-rated categories, of which the most important is exports. Exempt and zero-rated goods and services (listed in Table 1) have to be subtracted from the base. Exempt imports are also subtracted from the base, while exempt exports must be added back to avoid double counting, as noted in the discussion of equation (4).

Table 1 presents the computation of the VAT base for 1995 based on the production method and shows all additions and subtractions to GDP in column (2). The calculations in column (2) were based on the revised GDP data for 1994 provided by the Central Statistics Office of Zambia. The proportions of exempt and zero-rated supplies in GDP were computed for 1994 and applied to

Table 1. Zambia: Estimate of VAT Base in 1995--Production Method

(In billions of kwacha)

(1)	(2)	(3)
GDP	3038.0	
+ Imports	1240.9	
- Exempt imports	110.7	
+ Exempt exports	33.1	
- Gross domestic capital formation	486.1	
+ Residual building	72.9	
+ Capital formation in exempt sectors	78.5	
- Government wages and salaries	130.0	
- Sales tax replaced by VAT	96.8	
Exempt sectors	- Value added	+ Output sold to taxed sectors
Food and livestock supplies	858.5	159.8
Pesticides and fertilizers	6.5	9.0
Health supplies	16.8	0.3
Educational supplies	55.3	1.7
Books and newspapers	22.9	56.8
Transport services	32.3	63.6
Conveyance of real property	78.2	18.4
Financial and insurance services	45.0	26.1
Gold	0.0	0.0
Funeral services	4.7	10.8
Gaming and betting	0.0	0.0
Privileged supplies	0.0	0.0
Travelers' effects	0.0	0.0
Total	1,120.3	345.5
- Zero-rated sectors		
Exports	974.9	
Services linked to exports	0.0	
Duty free	0.0	
Aircraft stores	0.0	
Aviation kerosene	4.1	
Exported services	0.0	
Total	979.0	
Base net of exemptions and zero-rating	1,886.0	
- Loss from turnover threshold	64.5	
- Loss from noncompliance (50 percent)	910.8	
ESTIMATED VAT BASE	910.8	
Share of GDP	0.3	

Sources: Central Statistics Office and authors' estimates.

the IMF's projection of GDP in 1995 to compute the VAT base in 1995. The computation also relies on the IMF's projections for imports, exports, GDCF, government wages and salaries, and sales tax revenue in 1995.

It is important to emphasize that categories of exempt and zero-rated supplies specified in a VAT usually do not correspond exactly to sectors in GDP data. This is a common problem in the calculation of the VAT base, not only in Zambia but in many countries. Often a detailed breakdown of GDP sectors, if available, is needed to calculate the proportions of exempt and zero-rated supplies in GDP. For example, in Zambia, the category of food and livestock supplies exempt under the VAT comprises the agriculture sector in the GDP data plus one-half of the food and beverage component of the GDP sub-sector for food, beverage, and tobacco products. One-half of the food and beverage components is an approximation of the exempt portion. This approximation was necessary because a more detailed breakdown of GDP that would permit a closer match with exempt food supplies in the VAT law was not available.

In order to complete the computation of the VAT base, it is necessary to calculate the value of exempt sales to the taxed sector--the last term, $A_{21} \cdot VG_1$, in equation (9). The information needed for this calculation was obtained from the 1985 input-output table prepared by the Central Statistics Office. While the 1985 input-output table may not represent the structure of the Zambian economy today, it, nonetheless, provides the best available data on the transactions between the exempt and taxed sectors. The value of sales to the taxed sector for each exempt sector was scaled up to 1995 by the growth in value added of that sector between 1985 and 1995.

As with the GDP data, categories of goods exempt under the VAT often do not match sectors in the input-output table. For example, only 80 percent of the sector for pesticides, fertilizers, and industrial chemicals is estimated to be exempt. Consequently, the entries in the input-output table for this sector were multiplied by 0.8 on the assumption that 80 percent of the output of this sector used for production in other sectors was exempt. It is important to recognize that the input-output table for transactions among taxed and exempt sectors, denoted by the matrix A in Chapter II, is not constructed by simply aggregating sectors from a basic input-output table for Zambia. Because sectors in the input-output table did not match the exempt supplies in the VAT law, it was necessary to combine percentages of entries from the input-output table, utilizing informed estimates of exempt portions of certain sectors. In other words, the basic task is to build up each row and column in the matrix A from the more detailed input-output table for Zambia, which entails combining percentages of sectors in the input-output table that represent exempt portions of these sectors.

The 14 x 14 input-output matrix for all taxed supplies and the 13 exempt sectors under the VAT is presented in the Appendix. The 13 categories of exempt supplies were constructed by aggregating and weighing sectors from the basic input-output table as discussed above. The remaining sectors comprised all taxed supplies and were aggregated into the first sector in the matrix.

It should be pointed out that the entries in the Appendix are not input-output coefficients but, instead, actual values of goods used in production. As such, they represent the product of input-output coefficients, a_{ij} in equation (5), with levels of gross output, VG_j. In particular, an entry in column 1 represents the total value of sales from an exempt sector to the taxed sector, that is, $a_{i,1}$, where i can equal 2 through 14.

The sales of exempt goods to the taxed sector shown in the Appendix are added to the VAT base (column (3) of Table 1). These sales are added because, as discussed in Chapter II, they are incorporated in the VAT base for the taxed sector.

An adjustment is made for the effect on the base of the threshold for registration as a taxpayer under the VAT in Zambia. This threshold is K 30 million on an annual basis, meaning that businesses with annual gross sales less than this amount do not have to register and, therefore, pay the VAT to their sales. This was assumed to reduce the VAT base by 10 percent from the level already calculated excluding imports. This yields a potential base of K 1,821.5 billion or approximately 60 percent of GDP (not shown in Table 1).

The potential base was adjusted for the level of tax compliance in Zambia. Tax compliance is very low in Zambia for a variety of reasons including failure by businesses to register as taxpayers or to file tax returns, under-reporting of sales for tax purposes, failure to collect taxes on imports because of smuggling and other forms of evasion. Informed speculation of individuals familiar with Zambia's tax collection system is that only one-third to one-half of potential sales tax revenue is collected. The compliance rate was assumed to be 50 percent so that the loss in potential VAT due to noncompliance is 50 percent. 1/ This yields a final estimated VAT base under the production method of K 910.8 billion, or 30 percent of GDP, in 1995. 2/

1/ This assumption pertains to noncompliance out of measured activity, that is, activity captured in the national accounts. The effects of smuggling and other activities not captured in the national accounts are not covered by this assumed noncompliance rate.

2/ The assumption of a compliance rate based on experience with the sales tax carries over from the exercise of projecting VAT revenue before the tax became effective. Now that the tax is operating, a compliance rate can be inferred by comparing the potential base with the actual yield of the tax.

Table 2. Zambia: Estimate of VAT Base in 1995--Production Method

(In billions of kwacha)

	Private final consumption expenditure	2,509.7
	Government purchases of goods and services	85.0
-	Exempted expenditure	
	Private final consumption expenditure	1,505.8
	Government purchases of goods and services	21.4
+	Taxable gross domestic fixed capital formation	
	Residential sector	72.9
	Capital expenditure in exempt sectors	78.5
+	Taxable inputs into exempted expenditures	170.1
-	Sales tax	96.8
-	Loss from turnover threshold	64.5
-	Loss from noncompliance (50 percent)	613.9
	ESTIMATED VAT BASE	613.9
	Share of GDP	0.2

Sources: Central Statistics Office and authors' estimates.

2. Consumption method

The consumption method for calculating the VAT base uses equation (11). The calculations for 1995 are presented in Table 2. Private consumption is taken from the IMF's GDP projections for 1995. Government expenditure on goods and services is taken from the Government's budget for 1995. Purchases of goods and services are a component of recurrent departmental charges.

Total budgeted government expenditure on goods and services for 1995 is K 85 billion. Using the household expenditure survey, approximately 60 percent of private consumption is for exempt goods. The budget breaks down government purchases of goods and services in enough detail to identify exempt purchases. For 1995, approximately K 21.4 billion is budgeted for government consumption expenditure on exempt items. According to the budget, a significantly smaller share of government consumption than of private consumption is for exempt goods. This is to be expected because many goods were exempted to eliminate some of the tax on items that are important in the consumption of low-income households. These items account for a smaller share of government consumption expenditure.

The adjustment for VAT paid on residential investment and gross fixed capital formation in the exempt sectors is identical to that in the production method. The adjustments for sales tax paid and loss on turnover threshold are also the same.

As discussed above, it is necessary to calculate the value of taxable inputs sold to the exempt sectors, the term $A_{12}VG_2$ in equation (11). The information for this calculation comes from the same source for computing the sales of exempt goods to the taxed sector under the production method, specifically the input-output matrix presented in the Appendix.

The potential base of K 1,227.7 billion (not shown in Table 2) was reduced by 50 percent to adjust for noncompliance, as was done in the production method. The final estimated VAT base equals K 613.9 billion in 1995, which is 20 percent of GDP.

3. Key differences between the production and consumption methods

Both methods rely heavily on the consumption share of GDP in calculating the base. The major differences arise in the adjustments to the base that result from exemptions. The adjustment in the production method for the value added of exempt goods is significantly smaller than the adjustment made based on the household expenditure data. Both sets of data have problems. The GDP data are based on the 1985 input-output table. The production data will be biased to the extent changes in the structure of the economy from that given by the 1985 input-output table alter the total value of sales of exempt goods to the taxed sector. For example, an increased share of food and livestock supplies would imply a higher value of sales of exempt goods to the taxed sector, which would increase the VAT base calculated using the production method.

In the household survey, expenditure categories are not detailed enough to assure that the shares assigned to exempt goods are in fact entirely exempt. This method may therefore overstate expenditures on exempt items.

A discrepancy between the two methods is also introduced by the way government consumption is handled. In the production method, the base includes government consumption (through C = GDP - X + M -I), from which government wages and salaries are subtracted. In the consumption approach, government expenditure on goods and services, obtained directly from the budget, is explicitly included in the base. For 1995, government consumption reported in the GDP accounts does not equal government expenditure on goods and services plus wages and salaries. There exists a discrepancy of K 32.6 billion, which contributes to the difference in the estimates obtained using the two methods.

An important difference between the methods remains. Although a compliance rate of 50 percent was assumed, a change in the compliance rate yields a different magnitude of adjustment of the VAT base under each method. For example, if the compliance rate is 10 percentage points lower, the estimated VAT base declines by the 6 percentage points of GDP under the production method and 4 percentage points under the consumption method. Uncertainty about compliance introduces considerable variation in the estimate of the VAT base.

4. Comparison with actual VAT collection in 1995

As mentioned, Zambia introduced a VAT on July 1, 1995. Because the tax was in effect for half of 1995 at a 20 percent rate, half-year revenue under either the production or consumption method is taken to be 10 percent of the base. Given the estimated VAT bases presented in Tables 1 and 2, VAT revenue for the second half of 1995 is estimated to range from 2 percent of GDP based the consumption method to 3 percent based on the production method. This range is wide and somewhat disappointing given the need for as much precision as possible in projecting government revenue. However, this is to be expected given the deficiencies in data used for both methods, the approximations made to compute categories of exempt and zero-rated goods, and the consequent empirical differences between the two methods discussed above.

In the second half of 1995, that is, the first six months of operation of the VAT, revenue collection totaled K 76.3 billion, which is 2.5 percent of GDP. 1/ This falls in the middle of the range obtained from the two methods of calculating the VAT base. 2/ A benefit of calculating the VAT base using two methods that are supposed to be equivalent is that, even when the two methods in fact produce different estimates for the various reasons discussed here, an estimated range for the outcome is obtained. 3/

IV. Conclusion

The two main objectives of this paper were: (1) to describe the production and consumption methods of calculating the VAT base, which have been presented and applied separately in technical work on the VAT, using a common framework, and demonstrate their equivalence analytically; and (2) apply these methods to Zambia and compare the results with the actual outcome in 1995.

The production and consumption methods of calculating the VAT base were described using the framework provided by Mackenzie (1992). Formulas for each method were presented which highlighted the differences in the two approaches, especially with regard to the treatment of intermediate sales. Nonetheless, when these formulas were examined further, the equivalence of the two methods was demonstrated analytically.

Both methods were applied to Zambia where a VAT became effective on July 1, 1995. The two methods, although equivalent in principle, produced different results for a variety of reasons related to data limitations and approximations that had to be made to estimate categories of exempt and zero-rated goods defined in the VAT law. Specifically, the VAT base was estimated to be 30 percent of GDP in 1995 using the production method and 20 percent by

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1/ This figure excludes estimated collection of VAT on inputs purchased by the state copper company, Zambia Consolidated Copper Mines (ZCCM). Copper and cobalt were added to the VAT exempt list as a temporary revenue measure in mid-1995. To adjust for this measure, an estimated K 30 billion of VAT paid by ZCCM on its inputs was subtracted from actual VAT collections of K 106.3 billion in the second half of 1995. As of April 1, 1996, copper and cobalt are no longer exempt.

2/ Actual collections may incorporate transitional losses as it took some months into the second half of 1995 before the VAT became fully operational. Given no estimate of these losses, actual VAT revenue performance in this period may have been better than indicated by comparison with the estimated range.

3/ Given that actual VAT revenue collection fell in the middle of the estimated range, the assumed compliance rate of 50 percent can be taken as a reasonable approximation of the actual rate. Conversely, a compliance rate of about 50 percent can be inferred from a comparison of actual VAT revenue collection with the estimated range.

the consumption method. Given that a VAT rate of 20 percent was applied for half of 1995, these results imply an estimated range of 2 percent to 3 percent of GDP for VAT revenue in 1995.

Actual VAT revenue collected in the second half of 1995 was 2.5 percent, thus falling in the middle of the estimated range implied by the two methods. A benefit of applying two methods that are supposed to be equivalent is that, even when they in fact produce different estimates for the various reasons discussed, an estimated range for the outcome is obtained.

Zambia: Input-Output Matrix for Taxed and Exempt Goods Under the VAT, 1985 1/

Sector	1	2	3	4	5	6	7	8	9	10	11	12-14 2/
1. Taxed goods	3,614.2	153.8	12.3	7.9	6.7	9.5	220.8	26.5	53.8	0.0	29.8	0.0
2. Food and livestock supplies	138.6	144.3	0.0	0.0	2.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3. Pesticide and fertilizers	138.4	70.7	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4. Health supplies	10.2	0.6	1.5	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5. Educational supplies	7.9	0.0	0.0	0.0	0.9	0.0	4.3	0.0	4.9	0.0	0.0	0.0
6. Books and newspapers	170.6	6.5	0.5	0.0	1.4	0.0	1.9	0.1	10.8	0.0	0.0	0.0
7. Transport services (inc. bus, air & rail)	254.7	7.3	0.5	0.2	0.0	0.4	21.2	1.1	4.6	0.0	0.0	0.0
8. Conveyance of real property	97.8	3.2	0.2	0.0	0.0	0.5	0.5	2.6	19.0	0.0	0.8	0.0
9. Financial & insurance services	96.3	16.6	0.4	0.4	0.0	0.4	0.3	0.0	11.0	0.0	0.0	0.0
10. Gold	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
11. Funeral services	51.7	5.0	0.2	0.1	0.0	0.2	0.2	0.0	0.0	0.0	6.5	0.0
12. Gaming and betting supplies	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
13. Supplies of privileged persons	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
14. Travelers' effects	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Source: Zambia Central Statistics Office and estimates by authors.

1/ Corresponds to matrix A in the text where element a_{ij} is given in row i and column j in the table. Based on this notation, the following are calculated:

$A_{11} \cdot VG_1$ = Intermediate sales of taxed goods to taxed sector;

$\sum_{j=2}^{14} a_{1j} \cdot VG_j$ = Intermediate sales of taxed goods to exempt sectors;

$\sum_{i=2}^{14} a_{i1} \cdot VG_1$ = Intermediate sales of exempt goods to taxed sector;

$\sum_{i=2}^{14} \sum_{j=2}^{14} a_{ij} \cdot VG_j$ = Intermediate sales of exempt goods to exempt sectors.

2/ Columns 12, 13 and 14 contain zeros.

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