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The Efficiency of VAT Implementation: A Comparative Study of Central and Eastern European Countries in Transition

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Abstract

This paper presents calculations of the efficiency with which value-added taxes are collected in five transition economies in Central and Eastern Europe. Actual VAT revenues in 1994 are compared with those that would have resulted if the statutory VAT rates had been applied without any revenue leakage. The five countries fall into two broad groups, one exhibiting relatively high collection efficiency, and the other relatively low efficiency. While lack of detailed information on tax rules and consumption patterns makes definitive conclusions difficult, the impact of exemptions is shown to likely strengthen the comparative results.

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Summary

Many countries in Central and Eastern Europe have undertaken significant tax reforms since 1989 as part of the move from centrally planned to market-based economies. One of the most common newly introduced tax instruments has been the value-added tax (VAT), advocated by some commentators as an economically efficient revenue source that, if properly designed, imposes few distortions on the decisions of private economic agents. However, the administrative costs of calculating, collecting (including refunding), auditing, and enforcing the tax may be high. This paper attempts to calculate the efficiency with which five transition economies--the Czech Republic, Hungary, Poland, Romania, and the Slovak Republic--have implemented the VAT.

As a general method, the paper measures efficiency by comparing the actual tax collections in 1994 with those that would have resulted if the statutory VAT rates had been applied without any revenue leakage. Because of sparse production data at the microeconomic level, the calculations use final consumption data, coupled with the assumption that the economic incidence of the tax is on the consumer, to estimate collection efficiency. Using this method, the five countries fall into two broad groups: three countries (the Czech Republic, Poland and the Slovak Republic) exhibit roughly equal and relatively high efficiency, while the other two (Hungary and Romania) have roughly equal but relatively low efficiency levels.

The results are tentative, owing to a number of problems associated with the measurement of both household and government consumption, and because of imprecise information on specific VAT rules. Therefore, the absolute measures of efficiency are unlikely to be definitive. However, for comparative purposes, the relevant issue is whether the relative ranking of countries is robust to the measurement problems. For the broad groupings of high and low efficiency mentioned above, the results are probably fairly robust.

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I. Introduction

Many countries in Central and Eastern Europe have undertaken significant tax reforms since 1989 as part of the move from centrally planned to market-based economies. Major components of the reforms have included the introduction of new taxes such as personal income taxes, corporate profits taxes, and broad-based consumption taxes. As a result, the form of public revenue mobilization has become more transparent and less distortionary. Long-term benefits from such reforms are undisputed: over time, these should provide sufficient resources for necessary government operations while exerting minimal disincentives on the operation of a market economy. However, individual economic agents and government administrators must adapt to the new institutional environment, and transitional adjustment costs may impede speedy convergence to an efficiently functioning new system.

Of particular interest in this regard is the efficiency with which economies in transition collect value-added tax (VAT) revenues. This tax has been advocated by some commentators as an economically efficient revenue source which, if properly designed, imposes few distortions on the decisions of private economic agents. ^{1/} On the other hand, administrative costs of calculating, collecting (including refunding), auditing, and enforcing the tax may be high. For example, as a tax on each stage of production, the number of registered taxpayers can be large compared with other forms of consumption taxes. ^{2/}

This paper examines the efficiency of VAT collections in five Central and Eastern European countries in 1994, viz., the Czech Republic, Hungary, Poland, Romania, and the Slovak Republic. With the exception of Hungary, which has had a VAT since 1988, VAT systems in these countries have been established only recently. The general method of measuring efficiency is to compare the actual tax collections in 1994 with those that would have resulted if the statutory VAT rates had been applied without any revenue leakage. This approach, while conceptually simple and appealing, is in practice, subject to a number of constraints. Since the VAT is levied at

^{1/} See, for example, Lindholm (1980). Note, however, that this claim is often overstated for two reasons. First, in a static setting, it is unlikely that uniform taxation of all consumption goods is optimal. Second, it is generally not the case that preserving the inter-temporal marginal rate of substitution between consumption at different dates at its tax-free rate (by exempting capital income from the tax base) is optimal. (See Atkinson and Stiglitz (1980).) However, the calculation of optimal tax rates is sufficiently complicated and open to argument that uniformity may be an nth-best approach.

^{2/} Kay and King (1986) report that, when the VAT replaced the single-stage wholesale tax in the United Kingdom, the number of tax payers rose from 74,000 to 1.4 million, and the number of collectors rose from 2,000 to 12,500.

each stage of production, calculating the amount of tax that should be collected based on the statutory tax rates requires detailed knowledge of the production process (for example, in terms of an input-output table). ^{1/} However, because of the lack of such information, an alternative method using final consumption data is employed in this study. This method makes use of the fact that the economic incidence of the VAT is on final consumption, and involves the comparison of the average statutory tax rate and the average effective tax rate, using household consumption data. One problem is that differences between VAT systems in terms of exemptions, etc. are difficult to incorporate accurately. However, this is not believed to alter the general findings of the analysis.

The main result is that the five countries fall into two broad groups: three countries (the Czech Republic, Poland and the Slovak Republic) exhibit roughly equal and relatively high efficiency, while the other two (Hungary and Romania) have roughly equal but relatively low efficiency levels. These findings remain, however, somewhat tentative because of the difficulties involved in estimating the underlying average statutory and effective tax rates. First, survey data on consumption are typically reported for categories which do not match identically those to which VAT rates apply, thus hampering the precise calculation of average statutory VAT rates. Second, the effective tax rate is difficult to calculate due to problems associated with measuring domestic consumption. Whether this is best approximated by consumption as measured in the national accounts, retail sales, or some other number, is debatable.

Given these measurement problems, the results should be interpreted with caution. However, for comparative purposes, the relevant issue is whether the relative ranking of countries is robust to the measurement problems. For the broad groupings of high and low efficiency mentioned above, the results are probably fairly robust.

^{1/} This is the approach taken by Aguirre and Shome (1988) in studying the Mexican VAT.

II. Brief Overview of VAT Systems

In accordance with the European Union (EU) norm, the VAT systems in the five countries are generally of the consumption-based credit-invoice type. 1/ The general characteristics of the VAT systems, including rates and broad exemption rules, are presented in Table 1. In addition to the standard and reduced rates, each country zero-rates certain goods and services, in particular, exports. There are important differences among countries with respect to exemptions, both for particular categories of productive units in the economy, and for specific goods. 2/ In particular, the Polish and Romanian systems contain relatively many exemptions for specific goods and services, while the base of the Hungarian system is broadest, and the Czech and Slovak systems are intermediate. The exemption thresholds existing in 1994 for each country have been expressed in local currency and in U.S. dollars using average annual market exchange rates. Firms that have annual turnover less than these thresholds are not required to register in the VAT system. If they choose not to register, they neither pay VAT on sales, nor collect refunds for VAT paid on inputs. Clearly, the usefulness of the single currency measure is limited, for there might be differences among countries in the structure of production across firms of varying sizes. However, the general pattern is that Hungary and Romania have much lower exemption thresholds than the other three countries.

III. Methodology

As mentioned above, the general approach to measuring efficiency of VAT collection is to compare the effective tax rate with the average statutory tax rate. This methodology necessitates: (i) a measure of revenue collections; (ii) an estimate of the consumption base on which the VAT is effectively levied; and (iii) a calculation of the average statutory rate.

1/ VATs are often thought to be by definition consumption taxes. However, income-based VATs are also possible. The main difference is in the treatment of capital investment purchases for purposes of calculating the tax base. Under a pure consumption-based VAT, the total amount of tax paid on any capital purchases is immediately creditable, while under an income-based VAT, the input tax is creditable on an accrual basis over the useful life of the investment. Thus, the income-based VAT retains some of the administrative problems of the income tax system.

A credit-invoice VAT is implemented by basing VAT liabilities on total sales less VAT already paid on creditable inputs. This method accommodates multi-rate systems more easily than two other alternatives (known as the addition and subtraction methods). Japan, which has a single VAT rate, is the only industrial country with a VAT that does not use the credit-invoice method. It uses the addition method.

2/ The difference between zero-rating and exemption is that VAT paid at an earlier stage is creditable on zero-rated sales, but not on exempt sales.

Table 1. VAT System Characteristics in 1994

	Czech Republic	Hungary	Poland	Romania	Slovak Republic
Tax rates					
Standard rate	22	25	22	18	25
Reduced rate	7	10	7	--	6
Exempted goods and services					
Health	x		x	x	x
Science/culture			x	x	
Finance	x		x	x	x
Food			x	x	
Social services	x	x	x	x	x
Communications	x	x	x	x	x
Turnover thresholds					
Millions of local currency	2	1	12	10	2
Thousands of U.S. dollars	80	9	49	6	72

Sources: International Bureau of Fiscal Documentation; and staff estimates.

1. The effective VAT rate

The effective tax rate (ETR) is measured as total VAT revenues as a proportion of final consumption. The base on which the ETR is defined is not determined by the legal definition of the tax system, but should correspond with the perceived economic incidence of the tax. It is assumed that the tax is passed on to final consumers, so that a natural tax base is final consumption. Three issues that arise in this context are: (i) the data source that should be used to measure consumption; (ii) whether government consumption should be included; and (iii) whether the base should be defined net or gross of tax collections. The answers to these questions depend in part on the analytical use to which the ETR is to be put, in particular, its comparison with the average statutory rate (defined below).

The two main data sources for estimating aggregate consumption are the national income accounts and reports of retail sales. Since VAT payers are required to be registered, the use of retail sales may appear to be prudent. However, this may mask the objective of revealing low levels of compliance from retail establishments that escape registration and inclusion in any

particular data survey. On the other hand, national accounts data include estimates of activities of nonregistered entities, and so any inefficiency due to evasion of this kind (as opposed to that due to administrative laxity for example) may be identified using that source. In addition, certain components of consumption (particularly services) may not be included in retail sales data.

Government purchases are generally subject to VAT. 1/ The ETR is then ideally calculated as the ratio of total VAT revenues to total final consumption (both private and public). However, due to the lack of detailed information regarding the commodity structure of government consumption, the average statutory tax rate is estimated using surveys of private consumption patterns only. Since collection efficiency is measured by comparing the ETR with the average statutory rate, the definitions must be consistent. Therefore, the ETR used here relates only to direct final consumption by individuals, and is the ratio of VAT paid on nongovernment purchases to final private consumption. 2/

Because statutory VAT rates are defined on a net basis, the ETR is calculated in a similar fashion. 3/ That is, the consumption base used to measure the ETR is net of VAT paid. Because VAT is usually levied on a good's price inclusive of other excise taxes (such as specific taxes on alcohol, tobacco, and fuel), the base is not reduced by revenues from such taxes in the calculation.

2. Average statutory tax rate

Because detailed production data such as input-output tables are unavailable for the countries considered in this study, it is not possible to calculate an average statutory VAT rate on the legally defined base.

1/ There is, in principle, no net revenue impact of exempting government purchases from tax. However, administration is generally easier, and the scope for fraud narrower, if suppliers must remit tax on all sales independent of the identity of the purchaser.

2/ That is, if C_p is private consumption, C_g government consumption, T_p VAT revenues collected on private purchases, and T_g that collected on government purchases, then the "ideal" measure of the ETR is $(T_p + T_g) / (C_p + C_g)$, and the ETR on private consumption only is T_p / C_p . Another reason for calculating the ETR exclusive of government consumption is that this approach could sharpen the ability of the study to detect inefficiency. In general, one expects a smaller incentive for government purchasers of VAT-able goods and services to evade the tax, so including them would reduce the power of any efficiency measure to detect evasion in general.

3/ Taxes on goods and services are nearly always on a net basis--that is, if the tax rate is t and the pretax price is p , then the after-tax price is $p(1+t)$. This is different to the income tax, which is typically levied on a gross basis--that is, if the tax rate is τ and the pretax wage is w , then the after-tax wage is $w(1-\tau)$.

However, under the reasonable assumption that the VAT is passed forward to consumers, it can be assumed that the economic base is final consumption. Under a credit-invoice VAT with refundable credits 1/ and no exemptions (e.g., for small businesses, etc.), the structure of taxation at each stage of production is irrelevant to the determination of the ultimate incidence. Any taxes paid on intermediate products would be credited against taxes paid at later stages, and the final tax liability for a particular consumption good would just be given by the statutory rate on that good. Thus, for such a tax system, it is not necessary to have information about production processes, and household consumption patterns are sufficient to estimate the average statutory VAT rate.

When exemptions exist and credits are not always refundable, the average statutory rate is more difficult to calculate from consumption data alone. For example, if some sellers of a good are exempt from filing VAT returns, then the implicit tax paid on purchases from such firms is the unrefunded portion of any input taxes paid at earlier stages of production. The tax paid on purchases of the same good from VAT-registered sellers is the statutory rate, which may be higher or lower than the implicit tax paid on purchases from exempt sellers. 2/ In this case, applying the statutory rate to total purchases of the particular good will give an inaccurate measure of the actual average VAT rate on that item, which is a weighted average of the explicit tax on purchases from registered sellers and the passed-forward input tax on purchases from exempt sellers. However, with little information on the share of consumption of particular goods that is purchased from exempt and nonexempt firms, it is difficult to adjust for this factor.

It should be noted, however, that this drawback is a result of the exemption of certain productive units in the economy (e.g., small retailers) and is not caused by the exemption of particular goods and/or services from the tax base. In theory, any pattern of tax rates (including zero rating) on goods and services can be accommodated within the current framework, since private consumption patterns are used to calculate average statutory rates. It is only when a particular good or service faces more than one

1/ A credit is refundable if, when the credit is larger than the gross tax liability, the taxpayer receives a net payment from the Government. If the credit is non-refundable, the taxpayer would pay zero net tax, but would also receive zero net refund, in this situation.

2/ If there is a single VAT rate, the tax on purchases from registered sellers will be higher than the implicit tax on purchases from exempt sellers, as long as there is some value added at the retail stage. However, if there are multiple rates and the rate applied to the final consumption good is less than that applied to some of its inputs, purchases from registered sellers may be subject to a lower tax rate than the implicit rate on purchases from exempt sellers.

rate, due either to the exemption of sales from certain producers or exemption of purchases by a particular group of individuals (e.g., pensioners), that this method is problematic.

The approximation methodology employed here is to assume that the effective statutory tax rate on goods that are not exempt is equal to their actual statutory rates under law. This is not exactly correct as some nonexempt goods are sold by exempt businesses. On the other hand, it is assumed that the effective statutory tax rate on exempt goods is zero, which is inaccurate to the extent that inputs in the production of such goods have been taxed. To address the quantitative impact of these approximations, the appendix to this paper examines the effect of exemptions of certain goods and productive units on the estimation of the average statutory tax rate. In general, the higher the threshold for exemption, the larger the share of total value added that is exempt, and the higher the unadjusted estimate of the average statutory rate. This, in turn, means that the efficiency estimate described below will be underestimated. On the other hand, the larger the number of goods for which all sales are exempt, the lower the unadjusted average statutory rate estimate. In this case, the measured average statutory tax rate will be too low, and the measured efficiency level will be overestimated. The implications for the interpretation of the results are discussed in Section IV.

The average net statutory VAT rate is defined as

$$\tau_s = \sum_{i=1}^n \sigma_i \frac{t_i}{1+t_i} \quad (1)$$

where t_i is the VAT rate on good i , and σ_i is the share of gross expenditures on good i in total household spending. 1/ Clearly, the larger the share of consumption expenditures that are exempt from VAT, the smaller the net statutory rate. Information on consumption shares is drawn from household surveys and other official statistical sources. These sources do not use the same categorical breakdown of goods as is used in defining the VAT rules, so accurate estimation of τ_s is difficult. It should be noted, however, that Table 1 (which is based on the VAT rules) provides limited guidance in assessing the share of consumption that is exempt, as consumption weights are obtainable only from the household survey data. 2/

1/ In the two-good case, if pretax prices are 1, and if X_1 and X_2 face tax rates t_1 and t_2 , respectively, then $\sigma_i = (1+t_i)X_i/E$, where E is total expenditure. The average tax rate is $\tau_s = (t_1X_1+t_2X_2)/E$, which reduces to the expression in the text.

2/ For example, the household survey data suggest that the share of consumption that is exempt from VAT in Poland is not very different to that which is exempt in Hungary, contrary to the impression given in Table 1.

3. Collection efficiency

To measure the efficiency with which VAT laws are implemented, the effective VAT rate, τ_e , is compared with the average statutory rate, τ_s . Specifically, efficiency is defined as

$$\epsilon = \tau_e / \tau_s \quad (2)$$

In a comparative study, an important issue is the extent to which possible errors in measurements of efficiency are common to all countries. If the efficiency measures are equally biased in all countries, then comparative ratings are unaffected, and the information derived is useful. However, if the measures are biased independently, not much confidence can be placed in either the comparative or absolute results, unless these biases are small. Based on the information available, it is difficult to know the extent to which the biases are correlated.

IV. Results

1. General findings

Table 2 below presents the results of the empirical exercise, and shows that the countries fall into two broad groups. One group, consisting of the Czech Republic, Poland, and the Slovak Republic, shows relatively high efficiency levels, while the other, comprising Hungary and Romania, exhibits relatively low efficiency. The two main concerns with the reported statistics relate to the accuracy of measuring the statutory rate, and the proper treatment of VAT paid on government purchases in calculating the ETR. There is some uncertainty about the average statutory tax rate because the categories used in household budget surveys do not match exactly those used for the purposes of defining tax liabilities. Also, information on government-paid VAT is not generally available. As a rough calculation, if the calculated average statutory VAT rate in the Czech Republic was applied to government non-labor and non-transfer expenses, government purchases would account for roughly 30 percent of total VAT revenues. In the absence of more detailed information, it is assumed that the same ratio of total VAT revenues is collected from government purchases in each country.

As long as the proportion of VAT paid on government purchases is the same in each country, the relative efficiency rankings are unaffected. On the other hand, if the share of government-paid VAT varies across countries, those in which the share is higher (lower) will have lower (higher) efficiency rates than reported in Table 2. Despite this caveat, it seems likely that even with more accurate country specific estimates, Hungary and

Romania would continue to appear relatively inefficient, while the Czech Republic, Poland, and the Slovak Republic would remain relatively efficient. ^{1/}

Table 2. Statutory and Effective Tax Rates
and Implied Efficiency Levels

(in percent)

	Czech Republic	Hungary	Poland	Romania	Slovak Republic
Average statutory rate	12.2	12.8	8.9	9.3	15.6
Effective rate	11.3	8.5	8.7	5.5	14.2
Efficiency	92.6	66.4	97.8	59.1	91.0
Relative efficiency vis-à-vis Poland	94.7	67.9	100.0	60.4	93.0

Source: Staff estimates.

2. Impact of exemptions

As discussed in section 3, the efficiency results for countries with high general exemption/threshold levels are probably understated, while those for countries with many explicitly exempt goods and services are likely to be too high. For a thorough investigation of the importance of these approximations, data on the share of value added produced by exempt firms, the share of exempt goods in total value added, and the underlying production processes are necessary. In the absence of such data, the information presented in Table 1 is used to qualify the general results above.

First, the rather striking pattern observed is that exemption thresholds are much higher in the group of more efficient countries (as measured above), than in the pair of less efficient countries. To the

^{1/} The (simple) average efficiency level of Hungary and Romania is two thirds that of the Czech Republic, Poland and the Slovak Republic, suggesting that the proportion of VAT paid on private consumption in the first pair would have to be 1.5 times that in the second group for the ordering to be reversed. Such a divergence seems unlikely.

extent that higher threshold registration rules suggest that the efficiency measures underestimate the true levels of collection efficiency, the preliminary results are strengthened.

Second, the impact of exempt goods and services can also be gauged. We concentrate here only on health care and food, in which the countries' rules differ most clearly, and which constitute relatively large shares of value added. Notwithstanding the cautionary note of footnote 2 on page 7, the evidence suggests that the efficiency estimates for Poland and Romania (which have relatively many exemptions) are probably too high, particularly if inputs into the production of exempt goods are fully subject to tax. In particular, Poland's average statutory tax rate of 8.9 percent seems likely to be understated, considering the large number of exemptions reported in Table 1. A qualitatively similar correction is probably required for the estimates of the Czech and Slovak rates. On the other hand, it seems reasonable to expect that the true average statutory tax rate in Hungary is not significantly higher than that estimated by assuming, as the methodology does, that exempt goods face a zero statutory rate. However, it seems likely that the relative ranking of the countries' efficiency ratings should not be altered by the effect of the exemptions. The relatively large number of exemptions in Romania reinforces the conclusion that that country's VAT system is relatively inefficient.

V. Further Issues

This paper has attempted to measure the efficiency with which revenues from value-added taxes are collected in selected transition economies. Clearly, for the purpose of policy making, it is important to have some idea of the sources of any divergence in performance that is observed using the measures derived above. Without providing specific evidence on the nature and strength of these sources, some proximate causes of inefficiency can be suggested. These include: (i) the size of the informal sector and the number of small firms; (ii) the proportion of total consumption satisfied by imports (if it is thought that border taxes are more easily enforced than domestic taxes); (iii) inappropriately set penalty rates; (iv) low staffing levels, or poorly motivated/paid staff in tax collection and/or auditing offices; (v) poorly implemented computerization; and (vi) the unfamiliarity of the new system compared with previous practices.

A determination of which of these effects are at work is crucial for designing and implementing a reform of VAT administration. However, an examination of this issue in detail is beyond the scope of this paper. An interesting final observation is that Hungary implemented its VAT in 1988--well before the other countries of the study. Its relatively low efficiency level suggests that, as well as the possibility that familiarity could improve the performance of tax collectors, it may also breed contempt--on the part of taxpayers, who over time devise more effective methods of tax avoidance.

Data Sources

Czech Republic

Tax revenue: Ministry of Finance

Aggregate consumption: National income accounts

Individual consumption patterns: From "Statistická Ročenka, 1994" Czech Statistical office--shares based on 1993 data.

Hungary

Tax revenue: Ministry of Finance

Aggregate consumption: National income accounts

Individual consumption patterns: From household budget survey (Családi Költségvetés), 1991, including data on 12,000 active and inactive households.

Poland

Tax revenue: Ministry of Finance

Aggregate consumption: National income accounts

Individual consumption patterns: Polish Statistical Bulletin, December, 1994.

Romania

Tax revenue: Ministry of Finance

Aggregate consumption: National income accounts

Individual consumption patterns: From "Anuarul Statistic Al României," National Commission for Statistics, 1993, pp. 110-11 and 206-7.

Slovakia

Tax revenue: Ministry of Finance

Aggregate consumption: National income accounts

Individual consumption patterns: From June 1993 CPI weights, in "Štatistické Číslo a Grafy," Statistical Office of the Slovak Republic.

Impact of Exemptions

As discussed in section II, the exemption of certain goods and services or sellers of such items from the tax base has an effect on the average statutory rate, which is difficult to measure without detailed information on the tax rates levied at earlier stages of production, and on the share of consumption purchased from exempt sellers. This appendix presents an example of the adjustments that must be made to the average statutory tax rates calculated in the text, in the presence of exemptions.

Let X_i denote the quantity of good i purchased by an individual at the retail level. This good faces a VAT rate of t_i if sold by registered taxpaying retailers, and zero if sold by exempt retailers. The share of purchases of good i made from registered taxpayers is γ_i , with a share of $(1-\gamma_i)$ being purchased from exempt sellers. Assume for simplicity that, apart from labor and capital, all inputs are subject to their statutory VAT rates--that is, no intermediary inputs are exempt. If ϵ_{ij} is the input of good j used in the production of a unit of good i , then the total tax revenue from sales of good i to final consumers is

$$R_i = X_i[\gamma_i t_i + (1-\gamma_i) \hat{t}_i] \quad (\text{A.1})$$

where $\hat{t}_i = \sum_j t_j \epsilon_{ij}$. Note that if there is a single statutory VAT rate, then $\hat{t}_i < t_i$ as long as there is some value added in the production of good i . If, on the other hand, nonexempt purchases of good i face a reduced statutory VAT rate, then it is possible that $\hat{t}_i > t_i$.

Total expenditures by the individual on good i amount to

$$S_i = X_i[\gamma_i(1+t_i) + (1-\gamma_i)(1+\hat{t}_i)] \quad (\text{A.2})$$

so the average statutory tax rate on good i is

$$\tau_i = \frac{R_i}{S_i} = \frac{[\gamma_i t_i + (1-\gamma_i) \hat{t}_i]}{[\gamma_i(1+t_i) + (1-\gamma_i)(1+\hat{t}_i)]} \quad (\text{A.3})$$

When $\gamma_i = 0$, all purchases of the good are exempt, and the average statutory tax rate is $\tau_i = \hat{t}_i/(1+\hat{t}_i)$, which is smaller, the larger is the share of labor and capital in production of the good. In the estimates in the main body of the paper, average statutory tax rates of exempt goods were assumed to be zero. For many exempt goods, such as dairy products and other primary foods, this may be a close approximation, although it is less accurate for goods such as medical services which may require larger proportionate shares of intermediate inputs. Thus, for countries that exempt many goods that use significant quantities of intermediate inputs,

the efficiency estimates of the text will be somewhat high (since the calculated average statutory tax rates will be biased downwards).

Exemption of certain retailers--most usually those with small turnovers--is reflected in values of γ_i between zero and one. For example, the value of γ_i for services provided mostly by small businesses (e.g., home gardening) will be close to zero, but that for goods which are mainly sold by large establishments will be close to one. As is clear from (A.3), as $\gamma_i \rightarrow 1$, the average statutory tax rate on good i is as included in equation (1) in the main text. Under the assumption that $\hat{t}_i < t_i$, a higher general level of exemption (as would result for example from a higher threshold level for registration) leads to a lower average statutory tax rate on good i . Thus, the calculation of equation (1) in the main text overstates the average statutory tax rates by omitting the effect of the exemption of sales by certain (small) businesses. The overestimation is greater the larger is the amount of value added that is exempt (e.g., the higher the turnover threshold). This means that the estimated efficiency of collection for countries with relatively generous exemption thresholds will be understated relative to those with lower thresholds.

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