A Note on Enforcement Spending and VAT Revenues

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Abstract

Tax compliance studies usually focus on the effect of enforcement spending on tax evasion. Reliable estimates are difficult to obtain because evasion data are often suspect. This note shows how tax revenues can be used instead of evasion data to estimate the impact of changes in enforcement spending. Applying our method to Chilean data we find that \$1 of additional enforcement spending increases VAT revenues by \$31. Moreover, current levels of spending could increase by 40% and still be within sample values. Hence, a 10% increase in spending could reduce evasion from its current rate of 23% to 20%.

JEL Classification: H25, H26.

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1 Introduction

One of the main fiscal problems in developing countries is the high level of tax evasion. For example, in the case of Chile, where evasion levels are low by developing country standards, studies suggest that currently about 50% of the Income Tax and 23% of the Value Added Tax (VAT) are evaded.[1] All in all, it is estimated that evasion amounts to about 6% of GDP, which is quite high when compared with tax revenues of approximately 18% of GDP.

A recurrent explanation for these high levels of evasion is that enforcement is lax because agencies in charge of collecting taxes are understaffed, underpaid, and poorly equipped. Quite often it is argued that their budgets should be increased. Yet whether that is a good idea depends, among other things, on the yield of the additional expenditures, and thus is an empirical question. Furthermore, in developing countries data on evasion is often not available or suspect, so that it is difficult to evaluate the effect of changes in enforcement spending or any other policy intervention aimed at reducing evasion.

The purpose of this note is to show how revenue data can be used instead of evasion data to estimate the impact of changes in enforcement spending. This is important because revenue data are regularly collected in most countries and are far more reliable than evasion estimates. The idea is to exploit the elementary accounting identity that relates revenues and evasion to obtain a simple equation that can be estimated with observable data. An estimate of the elasticity of evasion with respect to enforcement spending follows from estimating the coefficients of this equation.

We use the method proposed in this note to quantify the effect of enforcement spending on VAT revenues in Chile, showing that the yield of increasing enforcement spending is substantial. Other things equal, had the budget of the IRS in 1997 been $1 higher, VAT revenues would have increased by $31.2. In other words, the cost of raising an additional $1 of VAT revenues was slightly more than 3 cents at the margin. Moreover, these figures are not valid only at the margin: the IRS budget (as a fraction of GDP) would have remained within the sample range even if it had been 40% larger in 1997, which suggests that VAT evasion could be significantly reduced by increasing enforcement spending.

This note is related to Agha and Haughton (1996) who studied the determinants of VAT compliance in a cross section of 17 OECD countries and found that increasing administrative expenditures by $1 raises revenues by $12. Our study differs from theirs in that we use VAT *revenues* instead of an estimate of compliance as left-hand side variable. By doing so we avoid using evasion estimates.

This note is also related to Dubin et al. (1990), who studied the effect of audit rates on reported federal income tax per return in different U.S. states over time. They found that the audit rate has an economically large impact on reported taxes per return, concluding that additional dollars spent on tax audits appear to have substantial marginal productivity. We differ from their study in that we examine a proportional tax rate, thereby making the dependent variable much easier to interpret. We also develop a simple theory on which we base our estimates.

In the rest of the note we describe the model (section 2) and present an application to Chile (section 3).

2 Model

In this section we present a simple model that shows how revenue data can be used to estimate the impact of enforcement spending.

By definition, VAT revenues and evasion are linked through the identity

$$\frac{R}{Y} \equiv \tau(1-e)\frac{B}{Y}, \tag{1}$$

where Y, R, τ, e and B denote, respectively, GDP, VAT revenues, the statutory VAT rate, the evasion rate and the tax base, and we have omitted time subindices. The evasion rate $e \equiv (\tau B - R)/\tau B$ could reflect, for example, misreporting of sales, inflated costs or illegal deductions. When there is a unique tax rate (as is the case in Chile) identity (1) is exact.

Taking logs on both sides of (1) leads to

$$\log\frac{R}{Y} = \log\tau + \log(1-e) + \log u, \tag{2}$$

where $u \equiv B/Y$ denotes the tax base as a fraction of GDP.

The evasion rate e can be expected to increase with the tax rate τ and decrease with the level of enforcement spending, denoted by S.[2] This motivates assuming

$$\log(1-e) = \alpha + \beta\log\frac{S}{Y} - \gamma\log\tau, \tag{3}$$

where α, β and γ denote constants and time subindices have been omitted. Some authors have also argued that e may vary systematically along the cycle.[3] Thus, we will also posit that

$$\log(1-e) = \alpha + \beta\log\frac{S}{Y} - \gamma\log\tau + \delta\log\frac{Y}{Y(-1)}, \tag{4}$$

where $Y(-1)$ denotes lagged GDP.

Substituting equation (3) or (4) into (2) and rearranging terms leads to, respectively

$$\log\frac{R}{Y} = c + (1-\gamma)\log\tau + \beta\log\frac{S}{Y} + \varepsilon, \tag{5}$$

and

$$\log\frac{R}{Y} = c + (1-\gamma)\log\tau + \beta\log\frac{S}{Y} + \delta\log\frac{Y}{Y(-1)} + \varepsilon, \tag{6}$$

with $c \equiv \alpha + \overline{\log u}$, and $\varepsilon \equiv \log u - \overline{\log u}$, where $\overline{\log u}$ denotes the mean of $\log u$.

Equations (5) and (6) are the central equations of the paper. All variables are observed, except the tax base as a fraction of GDP (ε), which plays the role of the error term. Several observations follow. First, normalization by GDP prevents the possibility of spurious correlation between usually trending variables R and S. Second, since γ is positive but not necessarily less than 1, the sign of the coefficient multiplying the tax rate is ambiguous and depends on which side of the Laffer curve the economy stands. Third, since evasion may be expected to be countercyclical, δ should be positive. Fourth, it can be easily shown in a simple expected utility model that evasion is decreasing in the probability of detection.[4] If this probability is increasing in enforcement spending normalized by GDP, β is unambiguously positive.

Fifth, β can be used to estimate the impact of enforcement spending on tax revenues at the margin, since both (5) and (6) imply

$$\frac{\partial R}{\partial S} = \beta \frac{R}{S}. \tag{7}$$

Last, β can also be used directly to estimate the impact of changes in enforcement spending on the evasion rate, an important policy question. When e is sufficiently small, then $\log(1-e) \simeq -e$, and it follows from equation (3), that

$$\Delta e \simeq -\beta \Delta \log \frac{S}{Y} + \gamma \Delta \log \tau. \tag{8}$$

Moreover, the analogue for equation (4) is

$$\Delta e \simeq -\beta \Delta \log \frac{S}{Y} + \gamma \Delta \log \tau - \delta \Delta \log \frac{Y}{Y(-1)}. \tag{9}$$

Note that in this specification changes in the evasion rate are a function of enforcement spending *normalized* by GDP. This facilitates use of equation (8) or (9) for policy evaluation, because it can be judged whether changes in enforcement spending fall within sample values (see the next section for an application to Chile).

3 An application to Chile

In this section we estimate equations (5) and (6) with Chilean data. We first describe the data, then present the results and finally provide some robustness checks.

3.1 Data

Sample period The data is annual. Reliable information on enforcement expenditures and VAT revenues is only available beginning in 1981. For this reason the sample period is 1981–1997.

VAT revenues Corresponds to yearly VAT revenues. The source is the IRS. As a percentage of GDP, VAT revenues range from 6.9% (in 1989) to 9.6% (in 1981) with a mean of 8.3%, which is close to the 8.4% rate in 1997, the last year in the sample.[5]

VAT rate The source is the IRS. The rate ranges from 16% (1988 through 1990) to 20% (1981 through 1988). In years where the rate was changed the simple average of the beginning and end-of-year rates is considered.

Enforcement spending Since a measure of IRS spending on VAT compliance is not available we consider two proxies. First, total expenditures by the IRS. Second, IRS expenditures on salaries. The source of this data is the IRS. As a percentage of GDP total spending ranges from 0.063% (in 1990) to 0.121% (in 1982) with a mean of 0.085%, which is close to the 0.091% figure in 1997, the last year in the sample. Spending on personnel ranges from 0.044% (in 1990) to 0.084% (in 1982) with a mean of 0.063%, which also is close to the 0.065% of the last year in our sample.

GDP and GDP deflator The source are Chile's *National Accounts* published by the Central Bank of Chile. The 1998 revised series are used.

3.2 Results

Columns 1 through 4 in Table 1 show the result of the OLS estimation of equations (5) and (6). Columns 1 and 2 report the results obtained using the IRS budget as a measure of enforcement spending while columns 3 and 4 used IRS expenditures on salaries. Standard errors are in parenthesis. The Durbin-Watson statistics suggest the presence of autocorrelation in the residuals. Thus, columns 5 through 8 report the estimates obtained for equations (5) and (6) with an AR(1) correction. The discussion that follows is based on the latter four columns. In any case, it is noteworthy that the coefficients and standard errors change very little after correcting for autocorrelation.

Comparing the goodness-of-fit measures, both in the case with and without corrections for correlation, proxying IRS expenditures by the corresponding budget leads to a better fit than when personnel salaries are used.

It can be seen that the estimated elasticities with respect to total IRS spending are 0.47 (when the cyclical variation of GDP is included as a right-hand side variable) and 0.34 (when it is not). Thus, the coefficient of enforcement spending is significant, both economically and statistically. For example, taking the more conservative estimate of 0.34 and assuming all other things equal, direct application of expression (7) suggests that a \$1 increase in the IRS' 1997 budget would have raised \$31.2 in additional VAT revenues. Using the elasticity estimate from column 6 the figure is \$43.2. These estimates are conservative since they ignore any effect of additional enforcement spending on the revenues of taxes other than VAT. Since 45% of taxes collected in Chile in 1997 corresponded to VAT, that effect should not be negligible.

Note also that only in column 6 of Table 1 the estimate obtained for the coefficient of $\log \tau$ is significantly positive, even though its sign in all regressions suggests that higher tax rates lead to higher revenues. In any case, the magnitude of the estimated elasticity is relatively small: considering the largest estimate (column 6) we have that increasing the VAT rate from 18 to 19% would have increased tax revenues by approximately 0.2% of GDP in 1997 (VAT revenues were equal to 8.4% of GDP in 1997). Also, the cyclical coefficient is positive and significant, thereby suggesting that the evasion rate is countercyclical.

Last, it should be mentioned that our results do not necessarily imply that the IRS budget should be increased. To assess such a recommendation, one would need to know the value of substituting public for private spending.[6] Nevertheless, since current levels of spending could increase by 40% and still be within the sample range, our results suggest that important reductions in tax evasion can be achieved with additional expenditures on enforcement. For example, the IRS estimates that the VAT evasion rate was about 23% in 1997. Equation (8) and the estimates of column 5 in Table 1 then imply that a 10% increase in the IRS budget in 1997 would have reduced that rate to approximately 20%.

3.3 Robustness checks

Small sample bias Given that our sample is small (17 observations), one may be concerned with the possibility of spurious inference. To asses the small sample properties of our estimators we estimated both their bias and confidence intervals running a nonparametric bootstrap. The estimated bias of coefficients is very small (of the order of 0.01) and estimated confidence intervals are very close to those reported in our regressions.

Estimating β without normalizing by GDP Our normalization of tax revenues and enforcement spending by GDP may raise some concerns. The most important one is that GDP may be viewed as an imperfect estimate of the tax base, so that using R/Y as dependent variable is not that different from working with the evasion rate.

The best way to lay to rest such concerns is to avoid the use of GDP altogether and still estimate β. To do this we note that the rationale for positing (3) also justifies

$$\log(1-e) = \alpha + \beta \log \frac{S}{B} - \gamma \log \tau \tag{10}$$

which combined with our basic identity (1), rewritten as $R \equiv \tau(1-e)B$, leads to

$$\log R = c + \beta \log S + (1-\gamma) \log \tau + \mu$$

where $\mu \equiv (1-\beta)\log B$. Now R, S, and B all exhibit an upward trend that can be removed by first differencing, thus estimating

$$\Delta \log R = \beta \Delta \log S + (1-\gamma)\Delta \log \tau + \Delta \mu; \tag{11}$$

or, if evasion has a cyclical component, by

$$\Delta \log R = \beta \Delta \log S + (1-\gamma)\Delta \log \tau + \delta \Delta \log \frac{Y}{Y(-1)} + \Delta \mu. \tag{12}$$

Where β continues estimating the impact on revenues of changes in the IRS budget.

Table 2 shows the estimated coefficients for equations (11) and (12). As before, columns 1 and 2 report the results using total IRS budget as a measure of enforcement spending and columns 3 and 4 use IRS spending on salaries instead. Standard errors are in parenthesis.

The impact of IRS spending is even stronger than in our base regressions: 0.59 (instead of 0.47) when the cyclical variation of GDP is included as a right-hand side variable and 0.52 (instead of 0.34) otherwise. Estimated coefficients when IRS spending on salaries is used are also much larger.

Summing up, the results of our robustness checks support the main findings in the paper.

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Endnotes

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1. For estimations of the evasion rates of the value added and income taxes see, respectively, Jorrat and Barra (1998) and Engel, Galetovic and Raddatz (1999).

2. Expected utility models of the tax evasion decision yield ambiguous predictions on the relation between tax rates and evasion (see Andreoni, Erard and Feinstein [1998] for a recent survey of the literature). Nevertheless, Agha and Haughton (1996) find evidence that higher VAT rates are associated with lower compliance.

3. Fishlow and Friedman (1994) present a model where tax evasion increases during downturns. Also, during recessions the underground economy typically expands, and with it VAT evasion. By contrast, Engel and Hines (1999) show that optimal intertemporal behavior by taxpayers may lead to procyclical evasion. Yet their assumptions are more relevant for the income tax they consider, than for the value added tax we work with here.

4. See Allingham and Sandmo (1972) for the seminal contribution.

5. VAT was introduced in Chile in 1974. It is levied on most commercial transactions at a uniform rate (18% in 1997). In 1997 it accounted for 42% of total tax revenues. Some goods and services are exempt from VAT, notably professional, educational and health services, cultural and sports events, exports, and transportation. For a description of VAT in Chile see Marcel (1986).

6. The desirability of increasing enforcement spending at the margin depends on its shadow value. It is quite likely that the socially optimal shadow value exceeds one due to the deadweight loss associated with tax collection and enforcement; see Andreoni et al. (1998).

TABLE 1
REGRESSION RESULTS.
DEPENDENT VARIABLE: LOG(VAT REVENUE/GDP)

	1	2	3	4	5	6	7	8
	OLS	OLS	OLS	OLS	AR(1)	AR(1)	AR(1)	AR(1)
Constant	−0.92	−0.41	−1.09	−0.84	−1.13	−0.39	−1.92	−1.18
	(1.09)	(0.84)	(1.27)	(1.17)	(1.26)	(0.94)	(1.71)	(1.42)
$\log \tau$	0.31	0.39	0.32	0.40	0.36	0.42	0.46	0.46
	(0.21)	(0.16)	(0.24)	(0.22)	(0.24)	(0.17)	(0.30)	(0.26)
$\log(S_1/Y)$	0.35	0.46			0.34	0.47		
	(0.19)	(0.07)			(0.10)	(0.08)		
$\log(S_2/Y)$			0.32	0.39			0.26	0.36
			(0.10)	(0.09)			(0.14)	(0.11)
$\log(Y/Y(-1))$		0.61		0.45		0.62		0.43
		(0.18)		(0.23)		(0.18)		(0.25)
$\widehat{\rho}$					0.14	0.13	0.35	0.14
					(0.23)	(0.14)	(0.32)	(0.30)
Adj. R^2	0.73	0.84	0.66	0.72				
$\log L$					30.83	36.5	29.2	31.1
D-W	1.24	1.33	1.12	1.05	1.54	1.56	1.43	1.14
No. obs.	17	17	17	17	17	17	17	17

Note: The dependent variable is the log of the quotient of total VAT revenues and GDP in Chile between 1981 and 1997. The first four columns report estimated coefficients from OLS regressions; columns five through eight describe regressions that include estimated AR(1) corrections ($\widehat{\rho}$). Finally, τ denotes the average between beginning and end-of-year VAT rate, S_1 IRS' total expenditures, S_2 IRS' expenditures on salaries, Y: GDP, $Y(-1)$: lagged GDP, and $\log L$ the log-likelihood. Standard errors are in parentheses.

TABLE 2

REGRESSION RESULTS.

DEPENDENT VARIABLE: ΔLOG(VAT REVENUE)

	1	2	3	4
	OLS	OLS	OLS	OLS
Constant	0.023	0.021	0.023	0.021
	(0.021)	(0.013)	(0.024)	(0.019)
$\Delta \log \tau$	0.22	0.34	0.43	0.56
	(0.46)	(0.27)	(0.50)	(0.39)
$\Delta \log(S_1/Y)$	0.52	0.59		
	(0.17)	(0.10)		
$\Delta \log(S_2/Y)$			0.48	0.51
			(0.21)	(0.16)
$\log(Y/Y(-1))$		0.82		0.73
		(0.17)		(0.24)
Adj. R^2	0.38	0.78	0.22	0.53
D-W	2.76	2.37	1.85	1.48
No. obs.	16	16	16	16

Note: The dependent variable is the first difference of the log of the of total VAT revenues in Chile over the period 1982-1997, deflated by the GDP deflator. We report estimated coefficients from OLS regressions. τ denotes the average between beginning and end-of-year VAT rate, S_1 the IRS' total expenditures, S_2 the IRS' expenditures on salaries, Y: GDP and $Y(-1)$: lagged GDP. Standard errors are in parentheses.