E C O N O M I C S B U L L E T I N

With non−competitive firms, a turnover tax can dominate the VAT

Arindam Das−Gupta
Independent

Abstract

In an example with monopoly final and intermediate goods firms and substitutable primary and intermediate inputs, it is shown that there exist turnover taxes that yield more revenue than any feasible value−added tax. Second, simultaneously higher welfare, revenue and output are possible with the turnover tax.

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1. Overview and motivation

Conjectured efficiency and administrative advantages of the Value-Added Tax (VAT) have led to it being introduced or replacing other taxes on production and sales, often a general sales or turnover tax (TT), in over 120 developed, developing and transition economies over the past 50 years (Ebrill et. al., 2001). A major exception, the United States, has retail sales taxes (RST) in most states, which, like the VAT, does not tax intermediate goods.

An important theoretical argument favouring the consumption type VAT/RST over a TT stems from the Diamond and Mirrlees (1971) demonstration that a necessary condition for welfare maximizing second best taxes on competitive firms, given a fixed revenue requirement, is that there be no taxation of productive inputs. Dasgupta and Stiglitz (1972) extend this result to non-constant returns to scale. However, Stiglitz and Dasgupta (1971) show that the Diamond and Mirrlees result does not hold if the government's choice of fiscal instruments is constrained or if some producers are monopolists.[1] In this case, the difference between price and marginal cost should be subsidised, with the subsidy being financed by distortionary input taxes if a 100 percent profit tax is insufficient for budget balance. Stiglitz and Dasgupta (1971) do not examine if input taxation is optimal when, given constraints, there is a tax rather than a subsidy on monopoly producers, as obtains in most real world tax systems.

Direct analytical comparison of the VAT/RST with the TT and other taxes on production or sales have, however, affirmed the superiority of the VAT in terms of welfare, tax revenue, output or productive efficiency.[2] These comparisons of the VAT/RST with the TT have either assumed a production technology with fixed intermediate input requirements per unit of final output or competitive firms or both.

I construct an example here to illustrate the following straightforward intuition. A part of the tax base under a TT, the turnover of intermediate goods firms, is excluded from the base of the VAT. With competitive intermediate input and primary factor markets this does not actually result in any shrinking of the potential tax base since intermediate input firms must shift the tax burden forward or incur long run losses. However, with imperfect competition or monopoly, surplus accruing to intermediate firms escapes taxation under the VAT. If this causes enough VAT base narrowing, distortion from high output tax rates needed to raise a given amount of revenue may more than offset the production efficiency loss from input taxation under the TT and make it superior to the VAT in welfare, revenue and output terms. In fact I find in the example that at some tax rates the TT yields more revenue than any feasible VAT.

In the example, a monopoly final goods firm buys intermediate inputs from a monopoly intermediate goods firm. Primary and intermediate inputs are substitutes. The final goods firm chooses its output to maximize profits and the intermediate goods firm chooses the price of intermediate goods, with each firm taking the other firm's choice of strategic variable as given. I identify a set of numerical parameters for which the TT dominates the VAT/RST.

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[1] Other situations where input taxes can be optimal are where there is non-constant returns and limited profits taxation or where the government faces a budget constraint. For the case of non-taxable sectors, see also Newbery (1986).

[2] Das-Gupta and Gang (1996) compare welfare and output under revenue neutral VAT/RST and TT under fixed proportions and competitive intermediate good but not final good industries. Friedlaender (1967) and Bhatia (1992) examine price distortions.

2. The example

A profit maximizing monopoly, the C-firm, produces consumer goods (Q) using an intermediate input (M) and a primary factor (L). The inverse demand for the consumer good is $P = f - gQ$, where f and g are positive constants. The cost function for the consumer good firm is assumed to be derived from a linear homogeneous CES production function with elasticity of substitution equal to 2. That is, as in Varian (1984), write the production function as $Q(M,L) = [(aM)^{\rho}+(bL)^{\rho}]^{1/\rho}$, where a, b are positive constants and the constant $\rho < 1$ is related to the elasticity of substitution (ES) by $ES = \frac{1}{1-\rho}$. Then the associated cost function is

$$C(Q,r,w) = Q\left[\left(\frac{r}{a}\right)^{\theta}+\left(\frac{w}{b}\right)^{\theta}\right]^{\frac{1}{\theta}},\ \theta \equiv \frac{\rho}{\rho-1}.$$

In the expression, r and w are respectively the unit price of the intermediate input and primary factor. Setting $\rho = 0.5$, so that $\theta = -1$, implies that

$$C(Q,r,w) = Q\left[\frac{a}{r}+\frac{b}{w}\right]^{-1} = Q\frac{rw}{br+aw}.$$

Since factor prices other than r are held fixed in this example, extension to additional primary and intermediate factors is straightforward. From Shephard's Lemma, the derivative of C with respect to r gives the C-firm's derived demand for the intermediate input as

$$M = Q\frac{aw^2}{(br+aw)^2}.$$

Therefore the cost of the primary factor is

$$C\text{-}rM = C_P = Q\frac{wbr^2}{(br+aw)^2}.$$

A second profit maximizing monopoly, the I-firm, produces the intermediate input using a primary factor which is assumed to be available at a constant unit cost according to the function $C_I = cM$, $c > 0$. The cost function is compatible with any linear homogeneous production technology, given fixed factor prices. Choosing the primary factor as the numeraire, c is set to unity. Extension to many primary factors is trivial.

Proportional sales taxes at rate $u > 0$ and $s \geq 0$ are levied on the C-firm and I-firm respectively. So a VAT/RST is where $s = 0$, $u = v$. This is to be compared with a single rate TT levied at rate $s = u = t$.

In the example, value-added (VA) is PQ. Tax revenue (G), is $uPQ + sMr$. Welfare (W) is the sum of consumer surplus + producer surplus + G. This is equivalent, in the absence of fixed factors, to the area under the demand curve for consumer goods less the cost of primary inputs used in both consumer and intermediate goods production:

$$W = fQ - \tfrac{1}{2}gQ^2 - C_P - C_I$$

The profits of the two firms are given by

$$\pi_C = (fQ - gQ^2)(1\text{-}u) - \frac{rw}{br + aw}Q \tag{1}$$

and

$$\pi_I = \frac{raw^2}{(br + aw)^2}Q\,(1\text{-}s) - \frac{aw^2}{(br + aw)^2}Q\,. \tag{2}$$

It is easily verified that, if consumer goods and intermediate goods prices are constrained to equal marginal costs, as with competitive firms, then for any valid set of parameters and TT rate, a VAT rate can be found at which output, value added, tax revenue and welfare with the VAT are higher than with the TT.

From (1) and (2) the first order conditions for profit maximization of the two firms are (second order conditions can be shown to hold):

$$(f - 2gQ)(1\text{-}u) - \frac{rw}{br + aw} = 0 \tag{3}$$

and

$$\frac{(aw + br)(1 - s) - 2b[r(1 - s) - 1]}{(aw + br)^3}aw^2Q = 0\,. \tag{4}$$

Condition (3) and (4) each imply the usual property that optimal output is where demand is elastic. This implies, first, that VA is increasing in Q. Second, elastic demand immediately points to a technological restriction on the nature of strategic interaction: If the intermediate input to output ratio is fixed then no equilibrium is possible when the input firm takes output of the consumer good as given.

Solving the first order conditions simultaneously gives the equilibrium values Q* and r*:

$$r^* = \frac{aw(1\text{-}s) + 2b}{b(1\text{-}s)} \tag{5}$$

$$Q^* = \frac{f}{2g} - \frac{w}{4gb(1 - u)}\frac{[aw(1 - s) + 2b]}{[aw(1\text{-}s) + b]} \tag{6}$$

Equilibrium values of M, P, G, VA and W can be found from (5) and (6). Setting s = 0 and u = v, equilibrium values with a VAT can be found. Similarly, setting s = u = t, equilibrium values with a TT can be found.

The possibility of a TT dominating a given VAT and of there being no revenue neutral VAT for some rates of the TT can be illustrated with the parameters (a,b,f,g,w) = (0.4, 0.6, 2000, 3, 200). In Figure 1, welfare and revenue are compared at feasible TT and VAT rates yielding non-negative profits, output and costs, for v = 0.004n, n = 1,2,… and also at v = 0.000001. Some variables turn negative for v > 0.916. For each VAT rate, welfare, revenue and output are higher with a TT levied at t = 0.96v. Furthermore, revenue at any feasible VAT rate is below TT revenue to the left of both Laffer curve peaks for TT rates above 67.13%: There does not exist a

revenue neutral VAT at these TT rates. The Laffer curve peaks for the VAT and TT are respectively at v_L, $76.789\% < 100v_L\% < 76.790\%$ and at t_L, $75.849\% < 100t_L\% < 75.850\%$.[3]

On the other hand, the VAT dominates the TT if final goods firms or consumers capture a greater proportion of available surplus, for example with (a,b,f,g,w) = (0.984, 0.016, 10000, 1, 0.07)

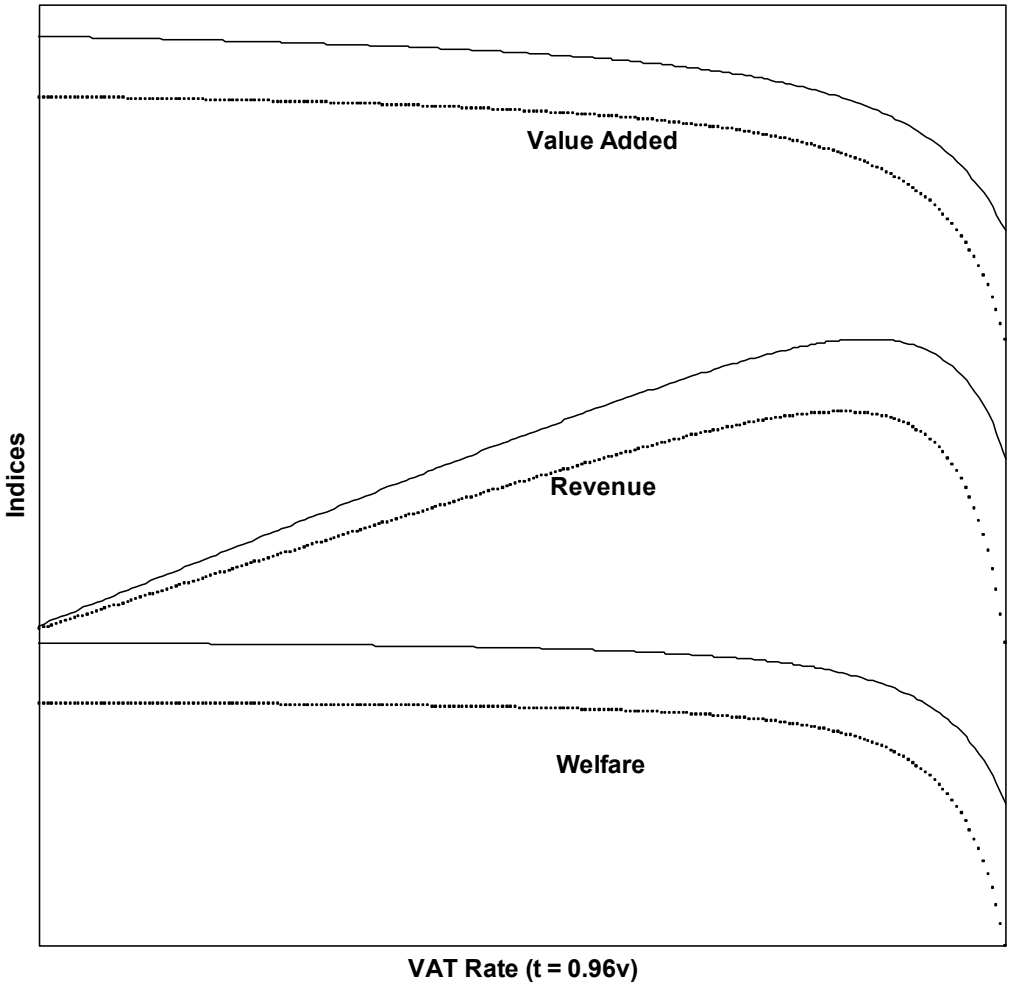

Figure 1: VAT Dominated by a Turnover Tax: Welfare, Revenue and Output Indices (VAT: Dotted lines)

[3] Data plotted in the graph are for indexes rather than actual data for clarity. Each variable (say x_V for the VAT and x_T for the TT), x_V is replaced by $x_W = (1 - 0.8D - 0.2D_{max})x_T$, where $D > 0$ is a fraction defined by $x_V = (1\text{-}D)x_T$. D_{max} is the maximum gap between x_T and x_V pairs in the graph. This leads to exaggeration of all but the maximum gap between VAT and TT indices. Data are then normalised using the transformation $x_i = J + \dfrac{x_i - \min(x_W, x_T)}{\max(x_W, x_T) - \min(x_W, x_T)}$ i = W,T. J = 0,1 or 2 respectively for welfare, revenue and output indices causing them to lie in the intervals [0,1], [1,2] and [2,3] respectively permitting plotting without overlap.

3. Concluding comment

The possibility of a TT dominating a VAT, along with earlier negative results relating to the optimality of input taxation in the presence of constraints, cast further doubt on whether a VAT really is superior to other production and sales taxes such as the turnover tax it has often replaced. Recent empirical evidence on the output or revenue impact of the VAT in comparison with production or sales taxes it has replaced, in a major cross-country study of the VAT by Ebrill et. al. (2001), also does not clearly establish the superiority of the VAT though the authors point to serious difficulties in drawing robust conclusions form cross-country data. The example given here suggests that a possible partial explanation for the VAT not being clearly dominant is market power of firms along with the possibility of input substitution.

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