Cascading, Revenue Neutrality and the VAT:
Some Theoretical Results

Hiranya Mukhopadhyay

No. 3   April 1997

Abstract

The conventional conclusion is that, ceteris paribus, a revenue-neutral VAT would have no impact on the aggregate price level, unless it elicits a supply response due to a lower degree of distortions. This paper shows that even if we ignore supply response, a revenue-neutral VAT can lead to higher output and lower price in a demand-constrained output regime. However, price will remain unchanged in a supply-constrained output regime.

JEL Code: H20, H22

Cascading, Revenue Neutrality and the VAT: Some Theoretical Results[1]

I.   Introduction:

One clear advantage of a value added tax(VAT) over a cascading type tax is that it removes cascading. Therefore, it is expected that the price of a commodity that is brought under VAT should fall. This is true even if we assume that the VAT is designed to be an equal revenue replacement of a cascading type tax, unless the mark-up rate is revised upward by the producers. The three components of cascading are duty on input duty, mark-up on input duty, and duty on mark-up on input duty (see the next section). The removal of a cascading type tax deprives the producers from the mark-up on input duty. Therefore, it is unrealistic to assume that the percentage mark-up will remain unchanged under the new system (NIPFP,1994). Sellers may not accept a reduction in their profit. The decision to revise the mark-up will of course depend upon the output regime that is prevailing in the economy. The sellers will not be able to revise their mark-ups in a demand-constrained output regime. Similarly they will be able to raise the mark-ups in a supply-constrained output regime, provided the tax switch creates an excess demand for the final good.

In the majority of cases, the VAT introduction was designed to be revenue-neutral (Tait,1988;p.194). Therefore, the duty rates are revised before the introduction of VAT to achieve this objective. Consequently, price reduction is limited to only the amount that is equivalent to'mark-up on input duty'.[2] It may also be noted that total revenue under the VAT regime depends on the new duty rate(s) and the base. Therefore, if the new regime expands the base through higher expenditure on the final goods, the rate revision may not be necessary to ensure revenue neutrality. Needless to say, the base could only be expanded in a demand-constrained output regime.

---

[1]I am extremely grateful to Drs. Parthasarathi Shome, Indira Rajaraman,Howell H.Zee, and seminar participants at the NIPFP for valuable comments. However, the usual disclaimer applies.

[2]It may be noted, this is not a part of total revenue. However, we do not deny the fact that the tax burden is now completely transparent and reflected in the statutory rate of duty.

Therefore, price may fall by more than the mark-up on input duty.

The conventional conclusion is that, ceteris paribus, a VAT that is introduced in a revenue-neutral manner would have no impact on the aggregate price level, since the aggregate demand in this case is unchanged (Zee,1995;p.91). However, this conclusion will not hold if the tax switch elicits a supply response due to a lower degree of distortion (Zee,1995;p.91). Furthermore, it can be shown that the tax switch may lead to a positive/negative excess demand for the good that is brought under VAT, and therefore, this result that the introduction of a revenue-neutral VAT wouldl not have any impact on the price level will not also hold.

The objective of this paper is to highlight the second possibility. We would like to illustrate some alternative implications of, first, how the replacement of a cascading type tax by a *revenue-neutral* VAT may lead to a positive excess demand, and how this excess demand is eliminated through a mark-up adjustment in a supply-constrained regime resulting in an unchanged price; and, second, how it is eliminated through higher output in a demand-constrained output regime, and therefore, lower price despite a revenue-neutral VAT. Furthermore, the reduction in price is more than the 'mark-up on input duty' due to the expansion of the base. Because, revenue requirement per unit of output is less due to the expansion of the base.

We present some preliminary results in section II. Section III deals with the effects of a revenue-neutral VAT on the mark-up rate, the *ad-valorem* duty rate ,and price in a supply-constrained output regime. In section IV, the effects of a revenue-neutral VAT on output, the ad-valorem duty rate, and price are examined in a demand-constrained output regime.

II.   Preliminary Results:

The price equation with fixed coefficients of production and the input price is assumed to be one is,

$$P = \{a(1 + \theta) + W\}(1 + r) = \{c + a\theta\}(1 + r) \tag{1}$$

where,

a	:	is the input-output coefficients
θ	:	is the *valorem* duty rate levied on input
W	:	wage cost inclusive of other manufacturing cost
r	:	is the mark-up rate
c	:	is the unit cost of production

In the above expression, total input duty is given by

$$T = a\theta \tag{2}$$

If the finished product is taxed at the *ad valorem* rate 't',the duty inclusive price P'is given by,

$$P' = P(1 + t) \tag{3}$$

Note that P' can also be written in the following way:

$$P' = [c(1 + r)] + [c(1 + r)t] + T + T\{t(1 + r) + r\} \tag{4}$$

In equation (4), the first term refers to total production cost, the second and third term refer to total excise revenue (net of duty on input duty (tT) plus duty on mark-up on input duty (trT))on output and input respectively and the last term to cascading effect. The last term is basically composed of three terms:

i.	tT	=	the cascading due to duty on input duty
ii.	rT	=	the cascading due to mark-up on input duty
iii.	t(rT)	=	the cascading due to duty on mark-up on input duty

Under the VAT scheme, when prices are set on a 'net cost'basis with set-off, the price equation is given by,

$$P^* = [a(1 + \theta) + W - T](1 + r) \tag{6}$$

which is simplified to

$$P^* = c(1+r) \qquad (7)$$

and the final price is determined by

$$P'' = P^*(1+t) \qquad (8)$$

It can be seen from comparing equation (8) with equation (4) that the 'cascading' term $T\{t(1+r)+r\}$ disappears from equation (8).

Revenue neutrality implies that pre VAT revenue is equal to post VAT revenue. That is,

$$[a(1+\theta) + W](1+r)t + T = c(1+r)t'$$

Therefore, statutory duty rate of the final good after VAT(t') is,

$$t' = t(1+T/c) + T/c(1+r) \qquad (9)$$

The new price level after substituting equation (9) into equation (8) is,

$$P'' = P^*(1+t') = c(1+r)(1+t') = c(1+r)\{1+t(1+T/c)+T/c(1+r)\}$$
$$P'' = c(1+r)(1+t) + T + tT + trT \qquad (10)$$

It may be recalled from equation(4) the pre VAT price level is,

$$P' = c(1+r)(1+t) + T + Tt + Ttr + Tr \qquad (11)$$

Where the term $T(t+tr)$ in equation (10) is a part of total cascading effect before VAT, which is $T(t+tr+r)$. Due to the VAT scheme, the term 'Tr' disappears from equation(10), but the revenue consideration forces the term $T + T(t+tr)$ to remain in equation (10). Without the revenue consideration that has been attempted to achieve by raising the average duty rate, the new price level could have been lowered further

by the amount $T + tT + rtT$ (total input duty per unit of output before the VAT plus duty on input duty and duty on mark-up on input duty). In other words, input duty(T) and the total cascading effect would have been absent from the final price (P''). It can be shown that if the post-VAT price level is derived on the basis of total cost with set-off, i.e, $P'' = [a(1 + \theta) + W](1 + r)(1 + t) - T$ (recall our equations 6 and 8), then revenue neutrality would not make any difference between the pre-VAT and the post-VAT price level (Sundaram, Pandit and Mukherji, 1995 and Mukhopadhyay, 1996). However, pricing on the basis of total cost is not based on sound principle under the VAT. Furthermore, competitive forces in a liberalized trade regime would not allow the producers to keep all of the windfall gain from the elimination of tax cascading. In other words, producers may not be able to keep the amount rT (mark-up on input tax) by deriving the price on the basis of 'total cost' principle after the introduction of a revenue neutral VAT (see also NIPFP, 1994; pp.82-83).[3] A survey conducted by the National Institute of Public Finance and Policy (NIPFP) in 1990 revealed that out of 128 responses received, a majority (56 per cent) of them reported pricing on a net cost basis (Narayana et.al., 1991). Therefore, we would like to build-up our models in the next two sections on the assumption of ' net cost pricing' rule with set-off.

III.   Supply Constrained Regime:

The economy produces one commodity (Z) with the help of labour and an imported input. The price of input is fixed and assumed to be one. The wage cost for unit production(w) is also fixed exogenously. The requirement of input to produce one unit of output is 'a'. Government spends σ proportion of its revenue on Z. Similarly workers and producers also spend σ proportion of wage income and profit on Z. Needless to say, this is a simplifying assumption. We could have assumed different propensities to consume.

Furthermore, output is fixed and is assumed to be equal to one in the supply-

---

[3]It may be noted that we are not assuming a reduction in the mark-up rate(r) at this juncture. rT will disappear after the introduction of a revenue neutral VAT if the pricing is done on the basis of ` net cost' rule with set off.

constrained regime. The mark-up rate is, therefore, an endogenous variable in this regime (Rakshit, 1989). Total income that is spent on Z is equal to total nominal supply of Z in the domestic market.

$$a(R+W)+I = \{c(1+t+r_0t)+T+Tr_0t+tT\} + cr_0(1-a) + r_0T(1-a) \qquad (12)$$

Where r_0 is the mark-up rate before VAT, I is exogenously given investment, and R is total revenue. The model can be closed for a given t, that is decided by the government.[4] The mark-up rate r_0 is,

$$r_0 = \frac{a(R+W)+I-(c(1+t)+T+tT)}{t(c+T)+(1-a)(c+T)} \qquad (13)$$

If we substitute for $I = P -a(R+W+cr_0+r_0T)$, then the numerator of (13) is positive. In the post-VAT regime, r_0T does not appear in the price equation. Therefore, producers's profit is also reduced by this amount. Expenditure is again equal to total nominal supply.

$$a(R+w)+I = \{c+c(1+r_1)t'\} + cr_1(1-a) \qquad (14)$$

Where r_1 is the mark-up rate in the post-VAT regime and t' is the new duty rate on the final product. Revenue neutrality implies,

$$c(1+r_1)t' = R = c(1+r_0)t+T+Tr_0t+tT$$

$$t' = \{t(1+r_0) + (T/c)(1+t+r_0t)\}/(1+r_1) \qquad (15)$$

Substituting t' in (14) we get,

$$r_1 = \frac{a(R+W)+I-(c(1+t)+T+tT)-r_0(ct+tT)}{c(1-a)} \qquad (16)$$

---

[4] The input duty rate θ is also given exogenously.

Using (13) we can write

$$r_1 = \frac{r_0(c+T)(1-\alpha)}{c(1-\alpha)} \qquad (17)$$

Therefore, $r_1 - r_0 = r_0 T/c > 0$, and $P_{postVAT} - P_{preVAT} = c(r_1 - r_0) - r_0 T = 0$

In other words, the mark-up rate is higher after the introduction of VAT and price is unchanged. It may be noted in a supply-constrained regime, after the imposition of VAT and due to the revenue neutrality the term $\alpha(R+W)+I$ does not change. However, producer's profit is reduced by the amount $r_0 T$. Since $1-\alpha > 0$, therefore, nominal value of total supply is reduced by $r_0 T(1-\alpha)$ (see equation 12). Producers are now in a position to raise their mark-up rate in a supply-constrained regime to recover the lost profit. Therefore, revenue neutrality objective and a higher mark-up together restore the price at the old level.

In fig.1, the equilibrium mark-up rate r_0 is derived from equation (13)(i.e., $r_0 = f(t)$) for a given t. However, after the introduction of VAT, the equilibrium configuration of r and t are derived from the intersection of $r_1 = g(t')$ (equation 14) and $t' = R/c(1+r_1)$.

Results:

1. In a supply-constrained regime, revenue-neutrality prevents the price to fall below its pre-VAT level.

2. Mark-up rate is higher in the post-VAT regime.

3. VAT is not superior to a cascading type tax when judged by its impact on price.

It can be shown that if the revenue-neutrality objective is not ensured, then (2) still holds but price is lower in the post-VAT regime.
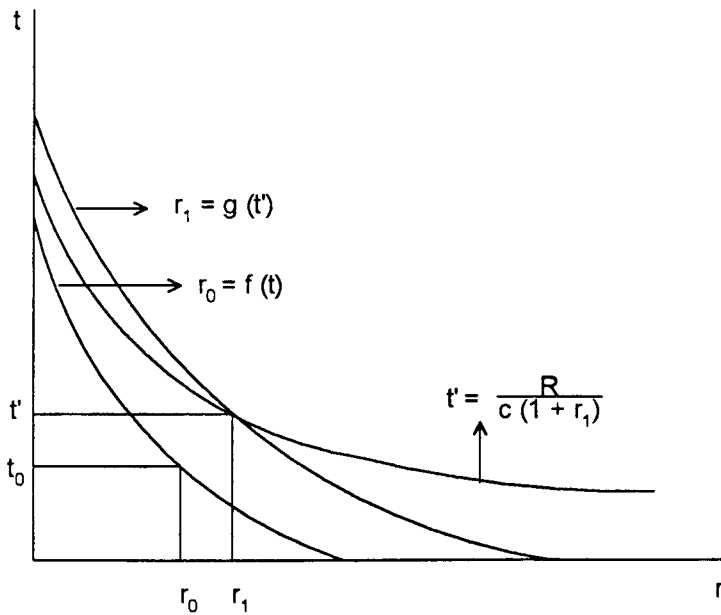
Figure 1. Determination of t and r

IV. Demand-Constrained Regime

The basic structure of the model is same, however, output is not fixed exogenously. Producers are unable to sell the desired amount(which equals capacity output under a fixed-coefficient production function). Therefore, total output Z is now an endogenous variable. The mark-up rate (r) is held constant.[5] Total revenue R can be expressed in the following way,

$$R = Z_0 [c(1+r)t + a\theta (1+t+rt)] = Z_0 A, \qquad (18)$$

where Z_0 in the pre-VAT output (total) and A is revenue per unit of output.

As usual the equality between total expenditure and total nominal supply can be expressed in the following way,

$$aZ_0 (A+w) + I = Z_0 [(A+c) + cr (1-a) + ra\theta (1-a)] \qquad (19)$$

Note that $a\theta = T = $ input tax revenue

$$\text{Therefore, } Z_0 = \frac{I}{(A+c) + cr(1-a) + rT(1-a) - a(A+w)} \qquad (20)$$

As we have already discussed after the introduction of VAT the term 'rT' drops out from the price equation. Similarly, total profit for unit of output is also declines by rT. We can now express the post-VAT output level (Z_1) in the following way,

$$aZ_1 [c(1+r)t' + w] + I = Z_1 [\{c + c(1+r)t'\} + cr(1-a)]$$

---

[5] We do not consider price sheding through a lower mark-up rate.

9

$$Z_1 = \cfrac{1}{\{c + c(1+r)t'\} + cr(1-a) - a[c(1+r)t' + w]} \tag{21}$$

Now revenue neutrality implies,

$$Z_1 c(1+r)t' = Z_o A$$

or,

$$t' = \frac{Z_o}{Z_1} \frac{A}{c(1+r)} \tag{22}$$

Substituting (22) into (21) we derive,

$$Z_1 = \frac{Z_o A\, a + 1}{c + cr(1-a) - aw} \tag{23}$$

Now substituting 1 from (20), we get,

$$Z_1 = \frac{Z_o \{aA + [(A+c) + cr(1-a) + rT(1-a) - a(A+w)]\}}{c + cr(1-a) - aw} \tag{24}$$

$$Z_1 - Z_o = Z_o [rT(1-a)/\{c + cr(1-a) - aw\}] > o \tag{25}$$

In other words, post-VAT output level is higher than the pre-VAT output level.

Now let us consider the impact on price. The difference between two price levels are,

$$P^{PostVAT} - P^{PreVAT} = c(1+r)(1+t') - [c(1+r) + A + rT] \tag{26}$$

It may be noted,

$$t' = \frac{Z_o A}{Z_1 c(1+r)} = \frac{R}{Z_1 c(1+r)} \text{ . Therefore, we get}$$

$$P^{PostVAT} - P^{PreVAT} = R \left[\frac{Z_o - Z_1}{Z_o Z_1} \right] - rT \tag{27}$$

Since $R/Z_1 = t'c(1+r)$, we get,

$$P^{PostVAT} - P^{PreVAT} = t'c(1+r) [1 - Z_1/Z_o] - rT \tag{28}$$

Since $Z_1 > Z_0$, implying the post VAT price level is lower than the pre VAT level. Without output expansion, the decline would have been rT for a given mark-up rate. However, additional revenue is earned due to higher output. This is represented by the term $t'c(1+r) [1- Z_1/Z_o]$.

However, it can be shown that the new rate (t') is still higher than the old rate (t).

$$t' = \frac{Z_o A}{Z_1 c(1+r)} = \frac{t[c+T] (1+r) Z_o + TZ_o}{Z_1 c(1+r)} = t \frac{(c+T)}{c} \frac{Z_o}{Z_1} + \frac{TZ_o}{Z_1 c(1+r)}$$

Now $t' < t$ if (necessary condition) $cZ_1 > (c+T) Z_o$ or $Z_1 > (1+T/c)Z_o$

Now $Z_1 > (1 + T/c) Z_o$ is equivalent to,

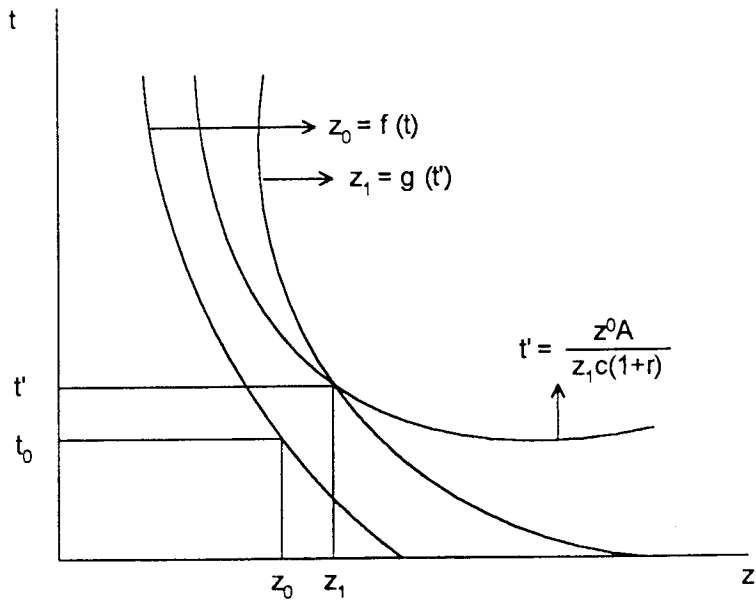$$(Z_1 - Z_o)/Z_0 > T/c$$

Figure 2. Determination of t and z

Using (25), we get,

$$\frac{rT(1-a)}{c + cr(1-a) - aw} > T/c$$

or,

$$cr(1-a) > c + cr(1-a) - aw$$

Since $c > w$, therefore this is not true. This implies that higher output does not generate enough revenue at the old tax rate (t) to compensate for the 'cascading revenue', namely $(T + Tt + Trt)$.

Figure 2, like figure 1, shows how output(Z_1) and the equilibrium tax rate (t') are determined after the introduction of a VAT.

Results:

1.   In a demand-constrained regime, the introduction of VAT lowers price and raises output.

2.   Higher tax rate is required to achieve revenue-neutrality.

3.   VAT is superior to CAT (cascading type tax) in a demand-constrained regime when judged by its impact on price and output.

V. Conclusion :

In this paper we attempted to demonstrate how the cascading element works even under the most restrictive assumption of a one commodity model with fixed coefficient production function, and a supply (or demand) constraint. In general, in a framework with more than one commodity and with factor substitutability and no demand/supply constraint, the positive supply effect of lower economic distortions(achieved through the replacement of cascading taxes by a VAT) is easy to show. However, even in a more restricted framework as discussed in this paper, the impact of introducing a VAT

13

may be clearly identified by breaking up the cascading in the pre-VAT state into its appropriate components, and analysing those that disappear with the introduction of the VAT.

The general conclusion of this paper is that a revenue-neutral VAT may lead to a reduction in price and higher output depending upon the prevailing output regime. A revenue-neutral VAT in a supply-constrained regime does not lead to a reduction in price because aggregate demand is restored to its initial level through a higher mark-up rate. Producers are capable of recover the loss in total profit (which is equivalent to mark-up on input duty, rT) in a *supply-constrained regime*, because replacement of a cascading type tax by a revenue-neutral VAT creates an excess demand for the good.

References

Rakshit, Mihir. (1989), Studies in the Macroeconomics of Developing Countries (edited). Oxford University Press, New Delhi.

Tait, Alan, A. (1988), Value Added Tax: International Practice and Problems. International Monetary Fund. Washington,D.C.

Mukhopadhyay, H. (1996), ' Restructuring the Tax System'. Economic and Political Weekly. December 28.

Narayana, A.V.L., A. Bagchi, and R.C. Gupta (1991), The Operation of MODVAT in India. National Institute of Public Finance and Policy(NIPFP). New Delhi.

National Institute of Public Finance and Policy (1994), Reforms of Domestic Trade Taxes in India: Issues and Options. New Delhi.

Sundaram, K,, V.Pandit, and B. Mukherji (1995), ' Restructuring the Tax System in India: A Reappraisal of Key Issues'. Economic and Political Weekly, July 1.

Zee, Howell, H. (1995), 'Value-Added Tax', in Parthasarathi Shome(edited), Tax Policy Handbook. International Monetary Fund. Washington,D.C.