CHAPTER FIFTEEN

COMMODITY TAXES—OUTPUT AND PRICE EFFECTS

In this chapter we shall study the *partial* effects of (*non-*general) commodity taxes (e.g., excise duty or sales tax) on the prices and production of the goods taxed and how the taxes are consequently shared by the purchasers and suppliers of the goods. In making the analysis we shall take the expenditure side of the budget as given and also ignore the effects of the tax-displaced resources on the other parts of the economy. The controversy on the *total* price-output effects of *general* commodity taxes will be discussed in Appendix V.

The goods on which taxes are imposed may be produced under different conditions of competition, namely, perfect competition, monopoly, oligopoly or monopolistic competition. The adjustments of price and output following levy of the tax will be different according to the nature of competition in the goods market.

I. *Adjustments under Perfect Competition*: Under conditions of perfect competition the incidence of a commodity tax depends upon the elasticity of demand and of supply of the product taxed. More specifically, we may get the following results of commodity taxes according to the elasticity of demand and elasticity of supply of products in question.

(*a*) If the demand curve of a commodity is perfectly inelastic, the price of the commodity rises by the full amount of the tax and the supply of the commodity remains unchanged. Under the circumstances, the whole of the tax is borne by the purchasers of the taxed commodity.

(*b*) If the demand curve of commodity is perfectly elastic, the price of the commodity taxed does not rise at all and the whole of the tax is paid by the producers/suppliers of the commodity. Under the circumstances, there is no shifting of the tax forward to the purchasers.

(c) Given the supply schedule of the taxed commodity, the greater the elasticity of demand for the commodity, the less will be the increase in price and the more will be the decrease in supply of the commodity, and the less the elasticity of demand of the taxed commodity, the more will be the increase in price and the less will be the decrease in supply of the commodity. This may be demonstrated in Figure 25 where *dd* and *ss* schedules are the demand and supply schedules of the commodity and *AB* is the price thereof. If a tax equal to *GD* is imposed on the sale of the commodity, the amount supplied will be reduced to *OC* from *OA*,

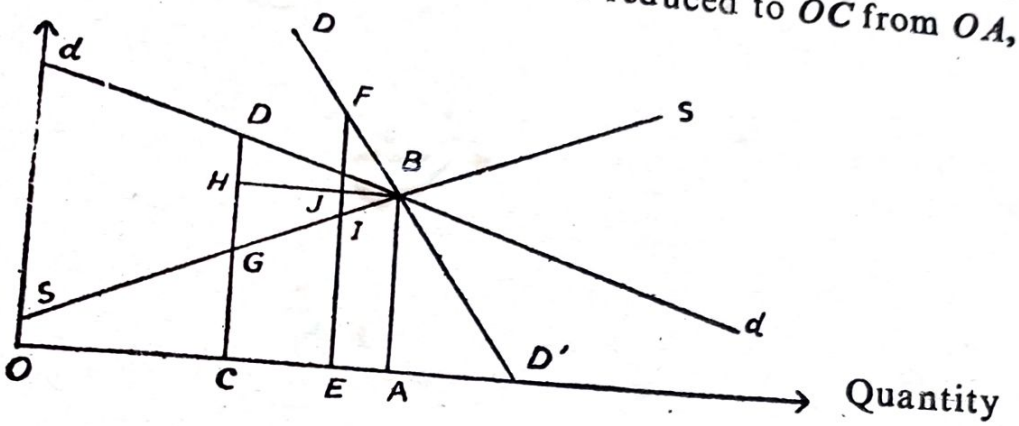

FIGURE 25

the *HD* portion of the tax will be paid by the purchasers of the goods in the form of increased price and *HG* portion of the tax will be paid by the suppliers in the form of decreased sales proceeds per unit of the output. If, however, the demand schedule is more inelatic, being *D'D'*, the fall in the output supplied following the levy of the same amount of tax per unit of output, namely, *IF* (=*GD*) will be to *OE*, but *OE*>*OC*. The increase in price in the latter case will be *JF*, but *JF*>*HD*. Hence we find that the more the demand for a commodity is inelastic, the greater will be the increase in price and the less will be the decrease in supply of the commodity taxed.

(d) If the supply of commodity is perfectly inelastic, there will be no increase in price or decrease in supply following the levy of the commodity tax and the whole of the tax will be absorbed by the suppliers.

(e) If the supply curve is perfectly elastic, the price of the taxed commodity will rise by the full amount of the tax ; in other words, under the circumstances, the whole of the tax will be shifted on to the purchasers of the goods in question.

(*f*) Given the demand schedule for a commodity, the greater the elasticity of supply, the greater will be the increase in price and the greater will be the decrease in the supply of the commodity taxed. This may be illustrated in Figure 26 where *dd* and *SS* are the demand and supply schedules of the commodity in question and, as a result, *OA* is the amount supplied of the commodity and *AB* is the price thereof. Now, if a tax equal to *GD* is imposed per unit of the commodity produced or sold, the amount

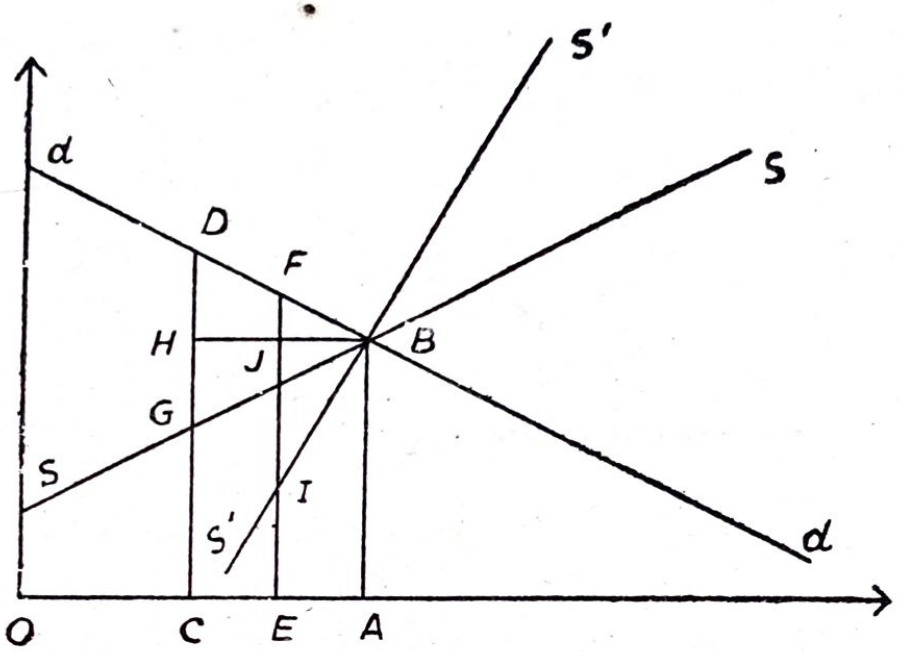

FIGURE 26

supplied will be reduced to *OC*, the *HD* portion of the tax will be paid by the purchasers of the products in the form of increased price and *HG* portion of the tax will be paid by the suppliers in the form of decreased sales proceeds per unit of output. If, however, the supply schedule is more inelastic, being *S'S'* instead of *SS*, the fall in the output supplied following the levy of the same amount of tax, namely, *IF*(=*GD*) will be to *OE*, but *OE*>*OC*. The increase in the price in the latter case will be by *JF*, but *JF*<*HD*. Hence we find that the more the supply of a commodity is inelastic, the smaller will be the increase in price and the less will be the decrease in supply of the commodity taxed.

(*g*) From the above it follows that the less the elasticity of demand and the greater the elasticity of supply of a commodity. the greater will be the increase in price following the levy of a commodity tax and the greater therefore will be the shifting of the tax to the consumers.

demand and supply may be different from the short-run elasticities. Thus in the short run the supply of an item may be relatively inelastic and as such the tax may be absorbed in full or in large part by the suppliers of the goods taxed. But in the long-run following the levy of the tax the sub-marginal firms making losses because of the tax may gradually leave the line and, as a result, in the long-run the supply of the commodity may become more elastic so that there is later an increase in price and the incidence of the tax on consumers may therefore be greater in the long-run than in the short-run:

II. *Adjustments under Monopoly*: If the demand schedule under monopoly is a straight line, the increase in the post-tax price under monopoly generally tends to be smaller than under perfect competition with identical demand and supply schedules. This can be demonstrated in the following manner: In Figure 27 *AB* is the pre-tax price of a commodity produced under monopoly. If a per unit tax equal to *DC* is imposed, the marginal cost sche-

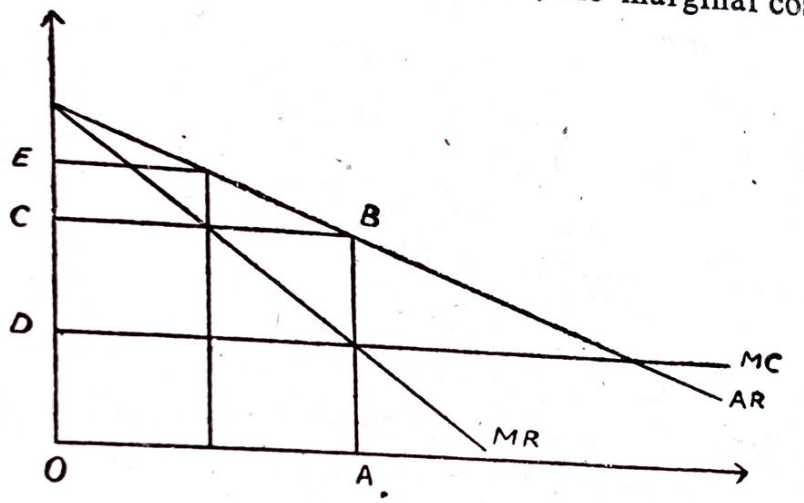

FIGURE 27

dule will rise to *CB* and the price will rise to *OE*, i.e., it will rise by *CE*. This the increase in price will be equal to half the increase in cost and, since the increase in cost in this case is equal to increase in tax, the increase in price will also be equal to half the increase in tax (since, geometrically, $CE = \frac{1}{2}DC$). Therefore, we may get the following results regarding the rise in monopoly price when the demand schedule is a straight line:

[In what follows $\triangle P$, $\triangle C$ and $\triangle T$ denote respectively increase in price, increase in cost and increase in tax.]

If the item taxed is produced under conditions of constant returns we shall have

$$\Delta P = \tfrac{1}{2}\Delta C$$
$$\Delta C = \Delta T$$
$$\therefore \quad \Delta P = \tfrac{1}{2}\Delta T$$
$$\therefore \quad \Delta P < \Delta T$$

If the item is produced under conditions of decreasing returns (i.e., if the marginal cost curve rises in the relevant range) we shall have

$$\Delta P = \tfrac{1}{2}\Delta C$$
$$\text{or, } 2\Delta P = \Delta C$$
$$\Delta C < \Delta T \text{ (because of the rising cost curve)}$$
$$\text{or, } 2\Delta P < \Delta T$$
$$\therefore \quad \Delta P < \tfrac{1}{2}\Delta T$$
$$\therefore \quad \Delta P < \Delta T$$

If the taxed item is produced under conditions of increasing returns (i.e., if the marginal cost curve is falling in the relevant range) we shall have

$$\Delta P = \tfrac{1}{2}\Delta C$$
$$\text{or, } 2\Delta P = \Delta C$$
$$\Delta C > \Delta T \text{ (because of the falling cost curve)}$$
$$\text{or, } 2\Delta P > \Delta T$$
$$\therefore \quad \Delta P > \tfrac{1}{2}\Delta T$$
$$\therefore \quad \Delta P \gtreqless \Delta T$$

Thus we find that under conditions of constant or decreasing returns the increase in price under monopoly will always be less than the tax, while under conditions of increasing returns the increase in post-tax price may be greater than, equal to or less than the increase in the tax depending upon the rate at which the cost line falls with the increase in output.

The general principle enunciated above that the increase in monopoly price will be half the increase in tax if the demand function is linear and the marginal cost is constant may be illustrated by an example. Suppose the demand function of a monopolist firm is $P = 100 - 0{\cdot}01Q$ and the total cost function is $C = 50Q + 30{,}000$, where P is price, Q is quantity and C is total cost all per unit of time. Let the government levy a sales tax of

Re. [illegible] by the monopolist. It can be shown that it does not pay the monopolist to pass on the full 10 p. tax to the consumer—rather it is most profitable for him to raise his price by only Re. 0·05 p.

In the pre-tax situation,

$$P = 100 - 0{\cdot}01Q$$

$TR = PQ = 100Q - 0{\cdot}01Q^2$, where TR is total revenue.

$MR = d(TR)/dQ = d(PQ)/dQ$

$= 100 - 0{\cdot}02Q$, where MR is marginal revenue.

$C = 50Q + 30{,}000$

$MC = dC/dQ = 50$ (since $d^2C/dQ^2 = O$, MC is constant), where MC is marginal cost.

π is maximised when $MR = MC$, i.e., when

$100 - 0{\cdot}02Q = 50$

i.e., $Q = 2{,}500$, where π is total profit.

$P = 100 - 0{\cdot}01\ (2{,}500)$

$= 75$ (in p.)

$\pi = TR - TC = PQ - 50Q - 30{,}000$

$= 75(2{,}500) - 50(2{,}500) - 30{,}000$

$=$ Rs. 325·00.

In the after-tax situation,

$C = 50Q + 10Q + 30{,}000$

$dC/dQ = 60$

π is maximised when

$100 - 0{\cdot}02Q = 60.$

Working out as before,

$Q = 2{,}000.$

$P = 80$p.

$\pi =$ Rs. 100·00.

Therefore the situations before and after the tax are follows :

	Before Tax	*After Tax*
Tax	0	10
Output	2,500	2,000
Price	·75	·80
Profit	325	100

Thus the increase in price = 1/2 tax. The reader may work out his own examples when the MC is not constant.

III. *Adjustments under Oligopoly* : (Under oligopoly, the demand curve of the product of an oligopolist has a kink at the ruling price, since the elasticity of the curve at any point to the right at which the price stands is sharply less than the elasticity of the curve at any point to the left thereof (signifying that if the particular oligopolist reduces his price, others will also reduce their prices and hence there will be no significant increase in sale ; but if the oligopolist increases his price, others will not increase their prices and hence, in this case, there will be a sharp fall in his sale). As a result of the existence of the kink in the demand curve at the point at which the oligopoly price stands, the marginal revenue curve of the oligopolist has a discontinuous range at the prevailing price. Hence if the marginal cost curve shifts upward following the levy of the tax but cuts the marginal revenue curve within the discontinuous range of the latter, there will be no increase in the price of the product nor will there be any fall in the output supplied.) This is illustrated in Figure 28 where *APB* is the average revenue curve of the oligopolist with a kink at *P* and *ADEF* is the marginal revenue curve with a discontinuous range of *DE* which is cut by the pre-tax marginal cost curve *CC* so that *OM* is the equilibrium output and *MP* is the price. The imposition of a tax increases the oligopolist's cost and raises the marginal cost schedule from *CC* to *C'C'*, but since *C'C'* cuts *ADEF* in the discontinuous range, namely, *DE* there will not be any change either in the price of the product charged or in the supply thereof. In

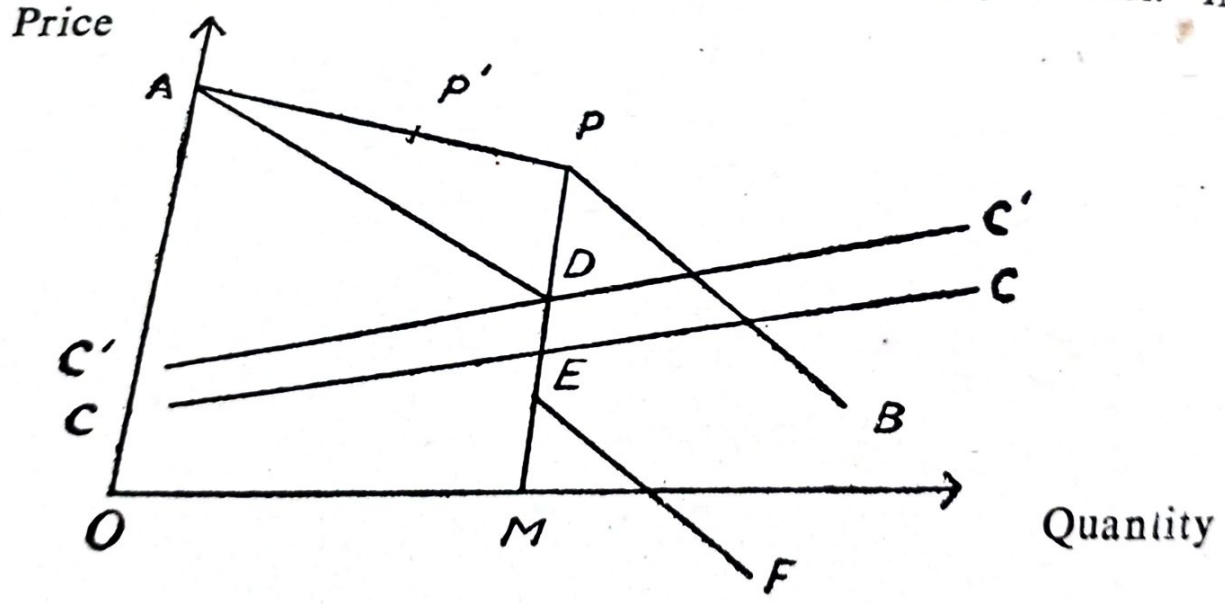

FIGURE 28

ther words, under the circumstances, the whole of the tax will be

The above conclusion of sticky price under oligopoly in the face of tax levy will have to be modified if we allow for the possibility of price leadership in an oligopolistic industry. If there are some price leaders in an oligopolistic industry, the leaders may take the opportunity of increasing the price following the imposition of the tax on the understanding that others would follow them. Thus, in Figure 28, the point of kink on the oligopolist's demand curve may shift from P leftward to, say, P' and price may accordingly be raised to the new point of kink. Since price leadership is very common in an oligopolistic industry, the tax tends to be shifted rather instantaneously to the consumers.

IV. *Adjustment under Monopolistic Competition* : Under conditions of monopolistic competition, in equilibrium, the average cost is equal to the average revenue (in the falling range of the latter) and as such when the average cost is raised following the levy of the tax, some firms just at the margin incur losses and are thereby compelled to gradually leave the line. Thus, in the longer run, with the exit of the sub-marginal firms the demand curve of the remaining firms is pushed up and the tax tends to be shifted to the consumers in the form of higher prices. If the demand curve becomes more inelastic in the process, the increase in price and hence the incidence of the tax on the consumers tend to be greater.

Certain other considerations, namely the following, have to be incorporated in the aforesaid analysis :

(*a*) The demand for and supply of the taxed items will be affected by the way the government spends the proceeds of the tax. This may alter the price of the items in question and thus the ultimate incidence of the tax.

(*b*) The government's taxation and expenditure programmes may increase or decrease the total demand for factors of production. If the demand for the factors of production is reduced, unemployment may ensue particularly in such lines where the workers are weak and the incidence of the tax may be shifted *backward* to the workers thus affected. A complete shifting of the tax on the workers is, however, not likely since the unions generally have escalator clauses in their wage agreements and any

Thus the ultimate incidence of a commodity tax depends on a number of factors. However, from empirical investigations it appears that in most cases the commodity taxes tend to be shifted on to the consumers. Nevertheless, in few cases there are exceptions as under :

(1) Whenever excess profits exist, there is always the possibility that some of the tax may be absorbed out of them ; this is especially so if the price has already reached full monopoly levels.

(2) In a few cases a portion of the tax may be absorbed through economies of production when output is concentrated in the hands of fewer firms.

(3) Where the net effect of the tax expenditure programme is to curtail output, some tax is likely to be borne by the owners of such factors of production (including labour) who have a comparatively weak bargaining power.

(4) The cases in which initial shifting is difficult, the burden will rest for a time on the owners of the businesses involved.

(5) When a reduction occurs in the real factor demand as a result of the tax expenditure programme, declines in factor prices will shift the tax burden from consumers to factor owners.

(6) When factor owners are able to obtain money income increases as a result of the higher cost of living due to the tax, a general redistribution of the burden occurs, with transfer of a portion of the tax burden to factor owners not able to obtain such increases.

In our above discussion on the shifting and partial incidence of commodity taxes we implicity assumed that all such taxes were specific, i.e., so much tax *per unit* of output produced or sold so that the levy of a tax led to a parallel upward shift of the supply schedule (or what comes to the same thing, a parallel downward shift of the demand schedule) of the taxed product in question. We should, however, allow for the possibility that the tax, e.g., the excise duty, may be *ad valorem*, i.e., so much duty on the production or sale of so much *value* of the output (so that with the increase in the sale there will be a fall in the amount of the tax per unit of output). While this possibility does not alter our conclusion on the general rules of shifting and incidence, we shall, however, see, in what follows, that under different circum-

stances we can make successful comparison between the relative desirability of the two types of taxes.

We can choose, theoretically, a large number of standards for the comparison. We shall here, however, use one particular standard, namely, given that after the imposition of an excise duty, specific or *ad valorem*, the same amount of goods should produced/supplied and the same price should be charged, whether the yield from one form of excise duty is larger than that from another form of the duty.

Suppose, first, that the item in question is produced under conditions of perfect competition. In Figure 29 *AB* is the pre-tax demand schedule and *EF* the marginal cost schedule. After the imposition of specific excise duty the demand schedule will shift down to *CD* parallel to *AB* (the parallel downward shifting of the demand schedule being equivalent to a parallel upward shift of the supply schedule) and in the post-tax situation *OL* will be the output, *LI* will be the price, *JI* will be the tax receipt per unit of output and *KJIH* will be the total tax collection.

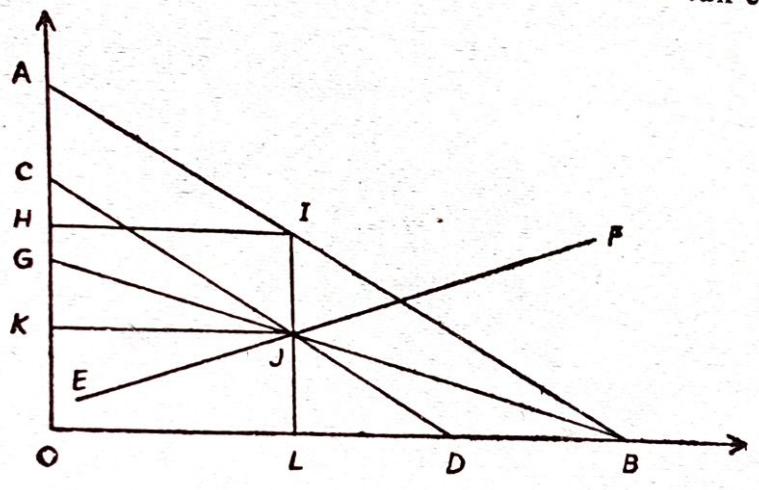

FIGURE 29

Suppose, next, that instead of a specific excise duty an *ad valorem* excise duty is levied as a result of which the demand schedule shifts to *BG* (indicating that with the increase in the production/supply of goods in question the tax per unit of output, shown by the vertical distance between *AB* and *GB*, will be reduced). Now, if the post-tax situation output equal to *OL* and price equal to *LI* are to be maintained (as in the case of the specific duty above) the *BG* must cut *EF* at *J*. But in this case the tax collection will also be equal to *KJIH*. In other words, under perfect competi-

tion with identical post-tax output and price equilibria, the tax yield from both the specific and the *ad valorem* excise duty will be identical. Hence under the circumstances we cannot say whether one form of tax is "better" than the other form.

On the other hand, under conditions of monopoly it can be shown that an *ad valorem* excise duty will a'ways yield a larger revenue than a specific excise duty with identical post-tax price-output situation. This is shown in Figure 30 where *AB* and *AC* are the pre-tax average revenue and marginal revenue schedules respectively and *GH* is the marginal cost schedule. The levy of a specific excise duty causes *AB* to shift down to *DE* (parallel to *AB*) and the post-tax marginal revenue schedule will be *DF* cutting *GH* at *I*. As a result, the output will now be *RJ*, price *JK*, tax proceeds per unit *KN* and total tax proceeds *MNKL*. Suppose, next, that the specific tax is replaced by an *ad valorem*

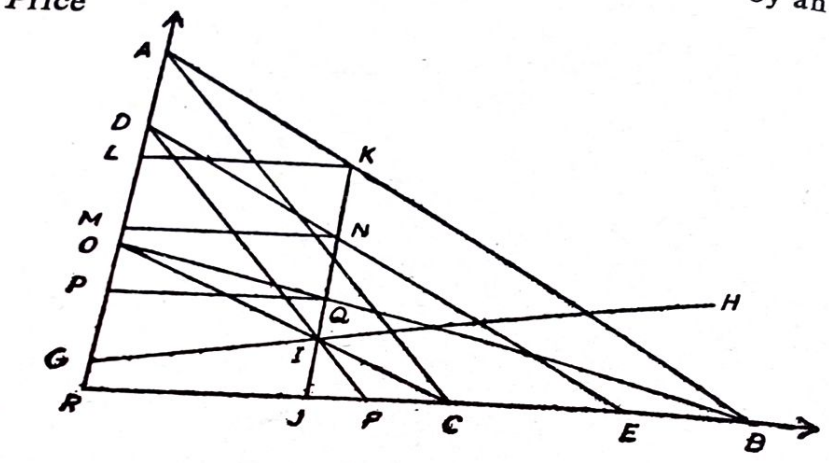

FIGURE 30

tax but the output and price in the post-tax situation should be same, namely *RJ* and *JK* respectively. If this condition is to be fulfilled, then the marginal revenue schedule in the post-*ad-valorem*-excise-duty situation would have to be *CO* cutting *GH* at *I*, as in the case of the specific excise duty above, so that the price-output equilibrium in the post-*ad-valorem*-duty situation is identical with that in the post-specific-duty situation. (Note that *CO* is drawn by joining *CI* and extending it onwards untill it cuts the vertical axis at *O*.) But, if *CO* is the marginal revenue schedule, *OB* would be the corresponding average revenue schedule. *OB* would, however, always cut *JK* below *N*—in the diagram at *Q*—giving a total

tax yield in this case equal to *PQKL*. But note that *PQKL*> *MNKL*. Hence the tax receipt in the case of *ad valorem* excise duty is greater than in case of equal-output-price specific duty under conditions of monopoly.

A Set of General Formulas For Studying the Partial Equilibrium Incidence of Unit and Ad Valorem Taxes : We can now derive a set of very useful general formulas for studying the partial-equilibrium incidence of unit and *ad valorem* commodity taxes under different conditions of competition. The taxes may, for instance, be either on sales or on production (excise duty). In order to keep the discussion within limit, we shall assume two types of competition, namely, (*a*) pure competition and (*b*) pure monopoly. Thus we will have four cases, namely, the following, in which the incidence of the commodity taxes (sales or excise) will be studied :

1. Unit tax under pure competition.
2. Unit tax under pure monopoly.
3. *Ad valorem* tax under pure competition.
4. *Ad valorem* tax under pure monopoly.

The demand function of the firm under study will be of the type of $p=a+bx$ where p is price, x is output per unit of time, $a(\geqslant o)$ is the intercept and $(b\gtrless o)$ is the slope of the function. Similarly, the supply (average cost) function of the firm will be of the type of $s=d+ex$ where s is average cost, x is as before, $d(\leqslant o)$ is the intercept and $e(\leqslant o)$ is the slope of the function. We can now derive the set of formulas as follows :

Case I. Unit Tax : Pure Competition

In pre-tax equilibrium,

$$a+bx=d+ex$$
$$x=(d-a)/(b-e).$$

Substituting the value of x in the demand function,

$$p=a+\{b(a-d)\}/\{e-b\}.$$

After tax @ t,

$$a+bx-t=d+ex$$
$$x=(d-a+t)/(b-e)$$
$$p=a+\{b(a-d-t)/\{e-b\}.$$