

Learning Note 20.1:

Economic analysis of transfer pricing

ADVANCED READING

It is difficult to discuss the economic analysis of transfer pricing in purely verbal terms without some loss of rigour. To overcome this difficulty, a number of theoretical transfer pricing models applicable to different situations are presented in diagrammatic form in this learning note.¹ These are based upon principles first suggested by Hirshleifer (1956) and Gould (1964). For simplicity, we shall assume that the company consists of only two divisions: a supplying division and a receiving division. The theoretically correct transfer price that will induce divisions to arrive at the optimum output for the company as a whole, when operating in their own best interests, is presented in the foregoing analysis.

Perfect external market for the intermediate product

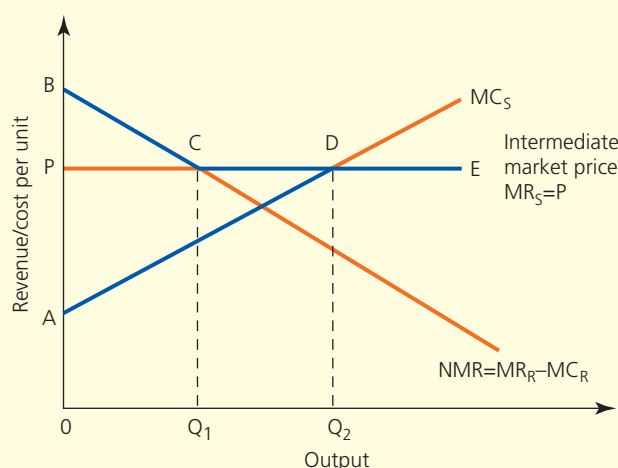
In our previous discussion in the main body of the chapter we established that where a perfect market for an intermediate product exists, the correct transfer price is the intermediate external market price. This situation is presented in Figure LN20.1.

The external market price for the intermediate product is OP , and, because the external market for the intermediate product is assumed to be perfect, the marginal revenue for the intermediate product (MR_S) is constant and is represented by the horizontal line PE . The NMR line refers to the net marginal revenue of the receiving division, and consists of the marginal revenue of the receiving division (MR_R) less the marginal conversion cost (MC_R) but excludes the transfer price paid to the supplying division.

The transfer price will be set equal to the market price of the intermediate product on the external perfect market at OP . At this transfer price the receiving division will require quantity OQ_1 (this is where NMR is equal to the transfer price) and will be indifferent as to whether it obtains this supply from the supplying division or the external market. The supplying division will also be indifferent as to whether it sells this quantity to the receiving division or the external market. However, the supplying division will wish to sell a total quantity of OQ_2 , and will sell an additional quantity Q_1Q_2 externally if it supplies OQ_1 internally. (Total quantity OQ_2 is where the marginal cost of the supplying division (MC_S) is equal to its marginal revenue (MR_S).) Note that the NMR schedule for the company as a whole is $BCDE$, and the most profitable output is where it intersects the company's marginal cost schedule ADE at point D . This requires an output of OQ_2 , which is identical with the amount produced by the supplying division.

A transfer price of OP , which is equal to the market price of the intermediate product, will mean that the divisions will achieve the total company's optimal output, and it will also allow them to deal with each other as they please.

FIGURE LN20.1 *Perfect external market for the intermediate product*



A perfect market for the intermediate product and the present of selling costs

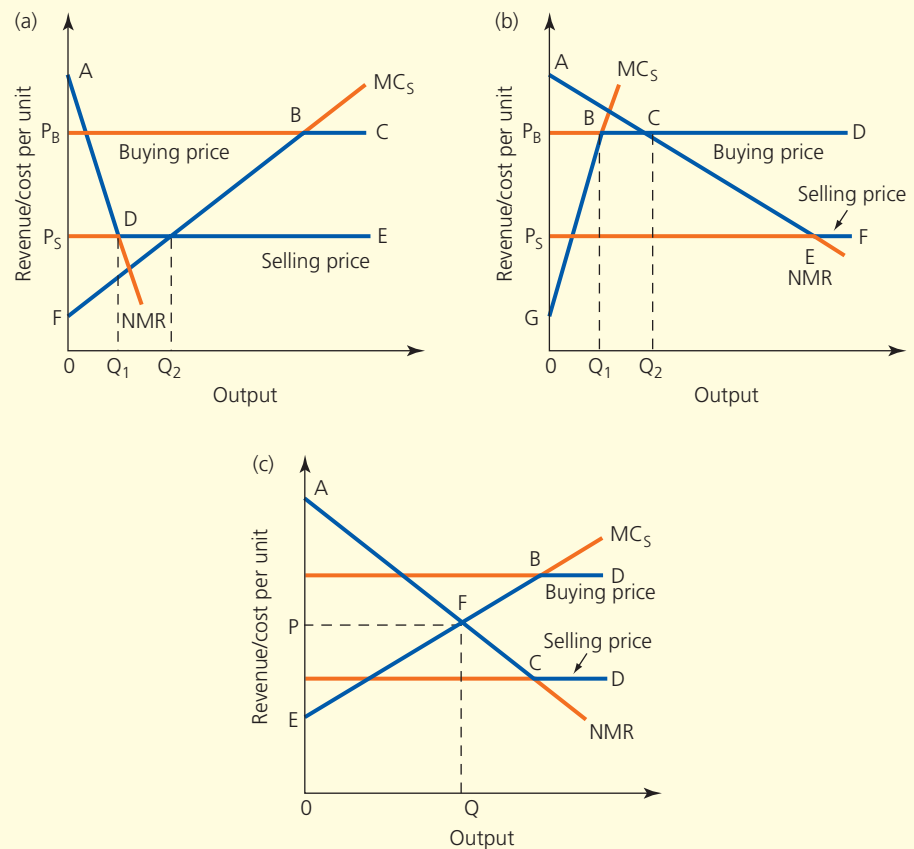
Gould (1964) considers the situation where a company incurs transportation and selling costs such that there might be a difference between the net price received for the sale of the intermediate product externally and the price at which the product is purchased on the external market. Also, if the intermediate product is transferred internally, some selling costs might be avoided. Under these circumstances an optimal production policy may not be achieved if the divisions are allowed to ignore each other's request for the transfer of intermediate products.

Figure LN20.2 contains information identical with that presented in Figure LN20.1, with the exception that the market price line is replaced by two lines – a buying price and a selling price. Figure LN20.2(a) represents the situation where the NMR and MCS lines intersect below the net selling price for the intermediate product. You will see that it is cheaper for the company to manufacture the intermediate product internally so long as the marginal cost of the supplying division (MC_S) is below the buying price of the intermediate product on the external market. Beyond B it is cheaper to purchase the intermediate product on the external market. The company as a whole therefore faces a marginal cost schedule equal to FBC.

So long as the company can obtain a larger marginal revenue by converting the intermediate product into the final product, it should do so. This situation applies so long as the NMR line lies above the net selling price for the intermediate product. This is represented by the segment AD of the NMR line, giving an output of OQ_1 of the *final* product for sale in the external final product market. Additional output of the intermediate product beyond OQ_1 can be sold profitably on the external markets; so in this case Q_1Q_2 of the intermediate product will be sold on the external market at a price of OP_s . The effect of this is that the company as a whole will face an NMR schedule of ADE, and since this intersects the intermediate product marginal cost function FBC directly above Q_2 , the optimal output for the company as a whole is OQ_2 .

At an optimal total output level of OQ_2 , OQ_1 will be passed from the supplying division to the receiving division for conversion and sale in the final product market. In addition, Q_1Q_2 of the intermediate product will be sold externally. An

FIGURE LN20.2 *Perfect external market for the intermediate product*



internal transfer price of OP_S (where the NMR line ADE intersects that MC line FBC) will induce optimal behaviour by the divisions, provided that the supplying division is instructed to provide the receiving division with all the output it requires at the transfer price of OP_S . The reason for this requirement is that the supplying division will correctly determine the optimum output level OQ_2 (where its marginal cost schedule cuts its marginal revenue schedule as represented by the transfer price P_SDE), but will be indifferent as to selling to the receiving division or the external market. The receiving division, however, wishes to purchase its total supply OQ_1 from the supplying division. This is in the best interest of the company, and the supplying division's profits will be unaffected if it supplies OQ_1 to the receiving division at a price of OP_S . Because the supplying division will be indifferent as to who it supplies with the intermediate product, a further rule requiring it to meet the receiving division's requirements is necessary to ensure total company optimality.

In Figure LN20.2(b) the NMR and MC_S lines intersect above the buying price for the intermediate product. The procedure for determining the optimum output level remains unchanged. The NMR schedule for the company as a whole is ACEF and the marginal cost of supplying the product is GBD. These two schedules intersect at point C, giving an optimum total company output of OQ_2 . The optimal transfer price is given at a point on the vertical axis where these two schedules intersect. The correct transfer price is therefore OP_B . At this price the receiving division will also wish to produce the optimal total company output of OQ_2 (this is where its NMR

schedule ACE cuts its marginal cost shown by the transfer price line $P_B CD$), but it will be indifferent as to whether it purchases its requirements from the supplying division or from the external market. The supplying division will want to produce OQ_1 to sell to the receiving division at the transfer price OP_B , and this will be in the best interest of the company, since the marginal cost of production is lower than the external purchase price. Because the receiving division is indifferent as to whether it purchases the intermediate product from the supplying division or from the external market, the receiving division must be instructed to purchase from the supplying division the quantity that it is prepared to supply at the transfer price OP_B . This will be quantity OQ_1 , and the receiving division will then obtain its additional supplies (i.e. $Q_1 Q_2$) on the external market.

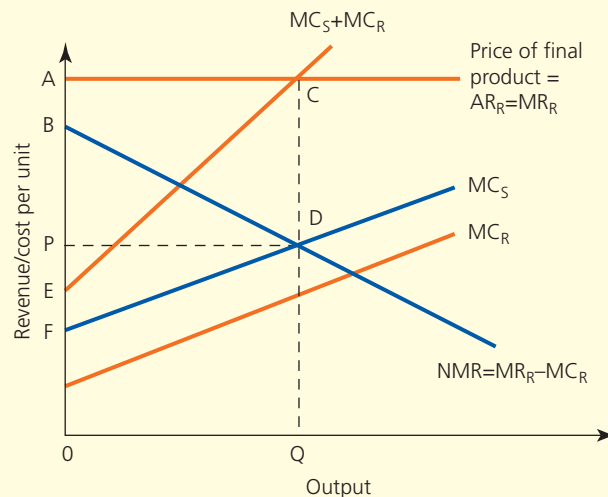
In Figure LN20.2(c) the NMR and MC_S lines intersect between the buying and selling price for the intermediate product. Here the NMR and the marginal cost of supplying intersect at point F, giving an optimal output for the total company of OQ. The transfer price is determined at the point on the vertical axis where these two points intersect. The correct transfer price is therefore OP. At this price there is no need for additional instructions to be given to the supplying or the receiving division about dealing with each other, since each division will prefer to deal internally, and no sales or purchases will be made in the external intermediate product market.

No external market for the intermediate product and a perfect market for the final product

This situation is illustrated in Figure LN20.3. The marginal costs of the supplying and receiving divisions are represented by MC_S and MC_R . The marginal cost schedule for the company as a whole is represented by $MC_S + MC_R$. The marginal revenue function for the final product is also shown, and is presented by MR_R . As it is assumed that the market for the final product is perfect, the marginal revenue line is horizontal and equal to the average revenue. The net marginal revenue for the receiving division is represented by NMR, and is ascertained by deducting the marginal cost of the receiving division (excluding the cost of purchasing from the supplying division) from the marginal revenue of the receiving division.

The optimum output level for the company as a whole is where the marginal revenue for the company, shown by the horizontal MR_R line, intersects the marginal cost line for the whole company, represented by $MC_S + MC_R$. This indicates an optimum output of OQ, and the maximum profit that results is the area ACE. The transfer price at which the supplying division wishes to sell OQ to the receiving division and also the price at which the receiving division wishes to purchase this amount is determined at the point on the vertical axis where the MC_S and the NMR lines intersect. The correct transfer price is therefore OP (i.e. the marginal cost of the supplying division at the optimum output level). The supplying division will view the horizontal transfer price line PD as its marginal revenue schedule, and will wish to produce OQ for transfer to the receiving division. The receiving division will want to purchase for conversion to the final product the quantity of output at which the transfer price will be equal to its net marginal revenue. This is also quantity OQ. So both divisions will want quantity OQ to be transferred between them, and the sum of their respective profits will be equal to the total company's maximum profit. The supplying division's profit is represented by the area FDP and the receiving division's profit by the area BDP, which together equal BDF; the area BDF is equal to the area ACE that represents total company profits.

FIGURE LN20.3 No external market for the intermediate product



Imperfect market for the intermediate product

In an imperfect market the quantity of the intermediate product that is sold externally will influence the market price, and the marginal revenue for the sale of the intermediate product (MR_S) will decline as output increases (Figure LN20.4). The marginal cost and marginal revenue schedules for the company as a whole are represented by the MC_S and $MR_S + NMR$ schedules. The latter represents the marginal revenue of the supplying division plus the net marginal revenue of the receiving division. The optimum output for the company as a whole will therefore occur where the MC_S and $MR_S + NMR$ schedules intersect; that is, at level OQ_3 .

The optimal transfer price that induces the supplying and receiving divisions to operate in this output level is shown by the point on the vertical axis where the MC_S and the $MR_S + NMR$ schedules intersect. The correct transfer price is therefore OP_T (i.e. the MC of the supplying division at the optimum output level). At this price the receiving division will view the horizontal line $P_T D$ as its marginal cost of supply and require output OQ_2 from the supplying division. At this point its NMR schedule intersects the horizontal line $P_T D$. The supplying division will face a marginal revenue schedule equal to BED (it will prefer to sell at a transfer price P_T beyond point E , since this is in excess of the marginal revenue line below E). This means that the supplying division will prefer to sell OQ_1 of the intermediate product on the external market at a price OP_E (the selling price at which its marginal revenue line is equal to or above E). In addition, the supplying division will wish to supply $Q_1 Q_3$ at the transfer price OP_T to the receiving division. This will give a total output by the supplying division of OQ_3 (i.e. the optimal output for the company as a whole), being the quantity of output at which its marginal cost MC_S is equal to its marginal revenue BED . This is consistent with the receiving division's demand for OQ_2 , because OQ_1 is equal to $Q_2 Q_3$. Therefore, OQ_2 equals $Q_1 Q_3$.

Notes

- 1 The models presented in this learning note are adapted from Tomkins, C., *Financial Planning in Divisionalised Companies*, Haymarket, 1973, Ch. 3.

FIGURE LN20.4 *Imperfect market for the intermediate product*

