October 24, 2006

Theorem of the Second Best and Principle of Targeting

The theoretical argument in favor of liberal trade is based on ideas concerning the efficiency of market outcomes, and on the Principle of Comparative Advantage. This Principle implies that under free trade and given that domestic markets are not distorted, a country exports commodities that it can produce relatively more cheaply than its partners. "More cheaply" is understood in terms of "opportunity costs" rather than in terms of dollars or labor hours. I review the meaning of opportunity cost using a two-commodity example. Then I discuss the Theory of the Second Best and the Principle of Targeting.

Suppose that food and steel are the only two commodities. In this setting, the opportunity cost of steel is simply the number of units of food that the economy must sacrifice in order to obtain one more unit of steel. The economy converts food into steel by reallocating factors of production from the food to the steel sector. Firms that use the factors of production, and workers and land-owners who supply these factors, maximize their profits, utility, or rent. In an undistorted competitive equilibrium, it is not possible to increase output of one commodity without decreasing output of the other commodity: the allocation of factors is efficient. The opportunity cost of steel equals the equilibrium relative price of steel, $\frac{p^s}{p^f}$ where p^s is the nominal price of steel and p^f is the nominal price of food.

If two economies have different equilibrium relative prices in autarky, then one economy necessarily has a lower equilibrium relative price of steel. That economy has a lower opportunity cost of steel – a comparative advantage in steel – and it exports steel in a free trade equilibrium. When the equilibrium trade price differs from the autarkic prices, trade increases total income in both of the countries. The income of owners of any particular factor of production might fall as a consequence of trade. In general, some agents gain and some lose when relative prices change. However, the income loss of one group is less than the gain of other groups, so total national income increases with trade. In this case, it is possible for the winners to compensate the losers, so that all are better off as a consequence of trade. (Of course, if the winners do not actually compensate the losers, the latter are worse off.)

The conclusion that trade increases national income depends on the assumption that the economies are "undistorted". Anything that causes the economy to be at an inefficient equilibrium can be viewed as a distortion, including imperfect competition, missing markets (e.g. absence of insurance markets) or government policies that restrict trade (e.g. tariffs).

The Theory of the Second Best states that if there are two or more market imperfections (distortions), correcting one of them may either increase or decrease welfare. For example, if there are two tariffs, eliminating one may not increase welfare. A pessimistic interpretation of this theory is that it implies that economic theory allows us to reach no conclusion about real world markets, since we know that these are subject to many imperfections/distortions. A more moderate interpretation is that we cannot uncritically use economic theory to conclude that a particular reform, such as trade liberalization, necessarily improves efficiency.

Here is a simple example of the theory of the second best. Imagine an economy in which there are only two market failures, both of which are present in a particular sector. The first failure is that production of the commodity damages the environment, but the producer does not pay for this damage (i.e. there is a negative environmental externality). The second failure is that the industry is oligopolistic rather than competitive. These two market imperfections cut in opposite directions. The first causes the market outcome to result in excessive production, from the standpoint of society. The second causes the market outcome to result in too little production, since oligopolists (typically) sell at a point where price is greater than marginal cost. At this level of generality, we do not know whether there is too little or too much production on balance. We cannot conclude that welfare would be higher if we remove one of the imperfections, e.g., by forcing the oligopolists to produce where price equals marginal cost in order to mimic the competitive outcome. The salient feature of this example is that each distortion affects the welfare cost of the other distortion.

Now we consider a different example. In this case (as above) production creates pollution, which causes damages that (in the absence of a policy intervention) firms do not internalize. (That is, firms do not bear the cost of the pollution unless a government policy forces them to bear this cost, e.g. by taxing them.) This externality is the first distortion, or market failure. The second distortion is "policy induced": we begin with a government policy that impedes free trade. In this case, the theorem of the second best tells us that trade liberalization might either increase or lower welfare, because

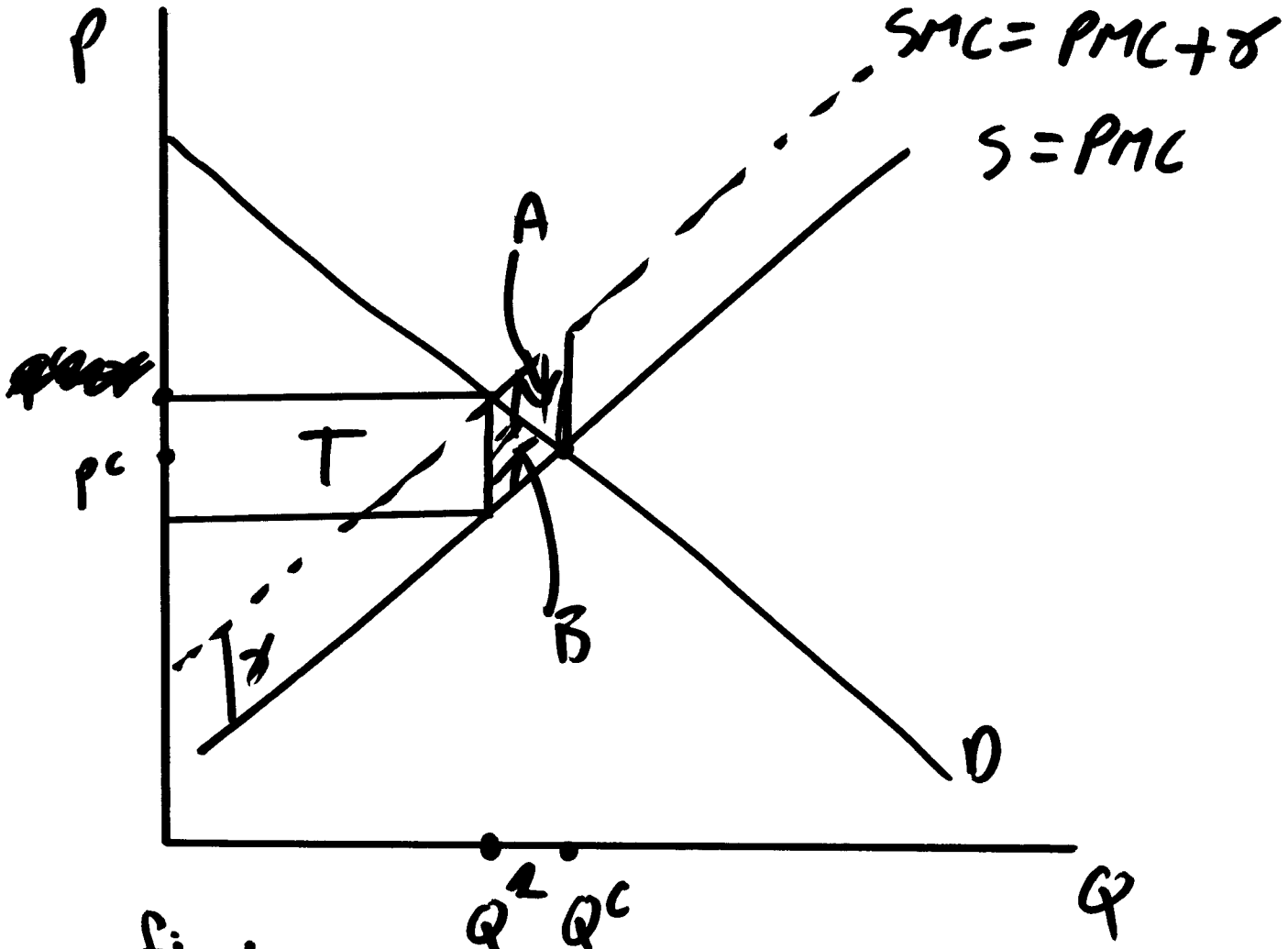

fig 1

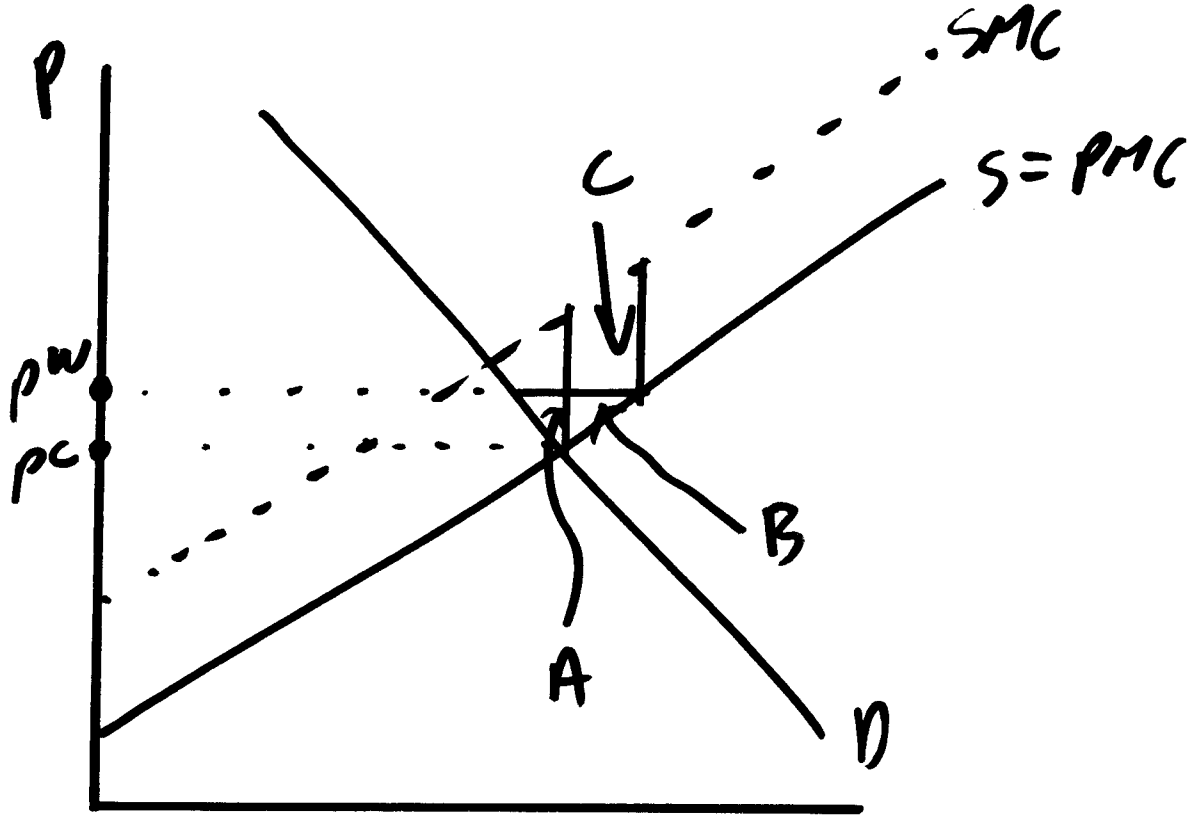

fig 2

the liberalization takes place in the presence of the other (environmental) distortion.

Figures 1 - 5 illustrate this example of the theory of the second best, using a partial equilibrium trade model. We first consider the effect of pollution in a closed economy; then we introduce trade. Suppose that each unit of production causes an amount of pollution that results in γ dollars worth of damage. (All costs and benefits are measured in dollars in this example.) The private marginal cost curve (PMC) is the supply curve in the absence of taxes. The social marginal cost curve (SMC) is equal to $PMC + \gamma$; this says that the cost to society of an additional unit of output is equal to the sum of private costs (e.g., the costs of capital and labor needed to produce an additional unit) and pollution costs. In the absence of environmental regulation, the competitive level of output is Q^c and the competitive price is p^c. The optimal tax is γ. In the closed economy, it does not matter if this tax were levied on producers or consumers. Either tax has exactly the same effect on the price that consumers pay and producers receive. The optimal level of output is Q^s, where the social marginal costs intersect the demand curve.

Suppose that no environmental tax is used. In this case, pollution creates a distortion: excessive production. Note that the "distortion" is not pollution. Pollution is simply an unfortunate consequence of production. The distortion is due to the failure of firms to internalize pollution. That is, the distortion is the fact that the pollution tax should be γ, but (by assumption) the tax is 0. The cost of the distortion is given by the deadweight loss, the area A in figure 1.

Here is how to see that area A really is the cost to society of not using the optimal tax. The loss in producer surplus plus the loss in consumer surplus of moving from the competitive price (in the absence of the tax) to the socially optimalimal price is the area B in figure 1. The change in price (from the competitive to the socially optimal level), and resulting decrease in quantity reduces the damage from pollution by the area A+B = change in quantity times γ. If society moves to the optimal price, it gains A+B because of the pollution reduction but loses B because of the loss of consumer and producer surplus, for a net gain of A. Therefore, if society does not use the tax, it sacrifices the benefit A, the deadweight loss of the distortion.

Imagine that the country is able to trade at world price p^w, but is prevented from doing so by the presence of a prohibitive export tax or an export quota. Now there are two distortions in the economy: the environmentally-

related distortion that leads to excessive production, and the trade distortion that restricts (eliminates) trade. The theory of the second best tells us that the removal (or more generally, the reduction) of one of those distortions does not necessarily improve welfare.

Figure 2 illustrates the possibility that allowing trade reduces welfare. In this example, the world price p^w is greater than the autarchic (no trade) price, so once the country is allowed to trade, it begins to export the commodity. When the economy opens up to trade, the private gains from trade are given by the area $A + B$, which equals the increase in producer surplus minus the decrease in consumer surplus. (See an earlier set of notes on the gains from trade.) However, greater output leads to higher environmental damages, equal to the area $B + C$. In this figure, $C > A$, so there is a net loss in welfare in moving from autarchy to free trade.

Figure 3 illustrates a case where trade increases welfare. Here, the competitive level of output under autarchy is Q^c and the socially optimal level under autarchy is $Q^s < Q^c$. As in the previous figure, there is excessive production (relative to the social optimum) in a the autarchic competitive equilibrium. Here, the private gains from trade equal the area $A + B + C$. The increased environmental damages equal the area $C + D$. In this figure $A + B > D$, so the private gains exceed the additional environmental damages. Trade increases welfare.

In both of these case, the world price is higher than the autarkic price, so when the country begins to trade, production increases. Since production was already too high (relative to the social optimum) in the autarkic competitive equilibrium, opening up to trade increases an existing distortion (excessive production of the commodity that damages the environment). Opening up to trade also provides the usual private benefits (the increase in the *sum* of producer and consumer surplus). In general, we do not know whether the benefits of trade exceed the costs.

What explains the difference between figures 2 and 3? In both cases the country increases production (and therefore increases pollution) when it opens up to trade, but in the first case its welfare falls and in the second case its welfare increases. The basic difference is that the relative magnitudes of the two distortions (the environmental distortion and the trade distortion) are different in the two figures. We can think of γ as a measure of the environmental distortion. It is the difference between the private and the social cost of one additional unit of production. We can think of $p^w - p^c$ as the trade distortion. It is the difference between the price of the commodity

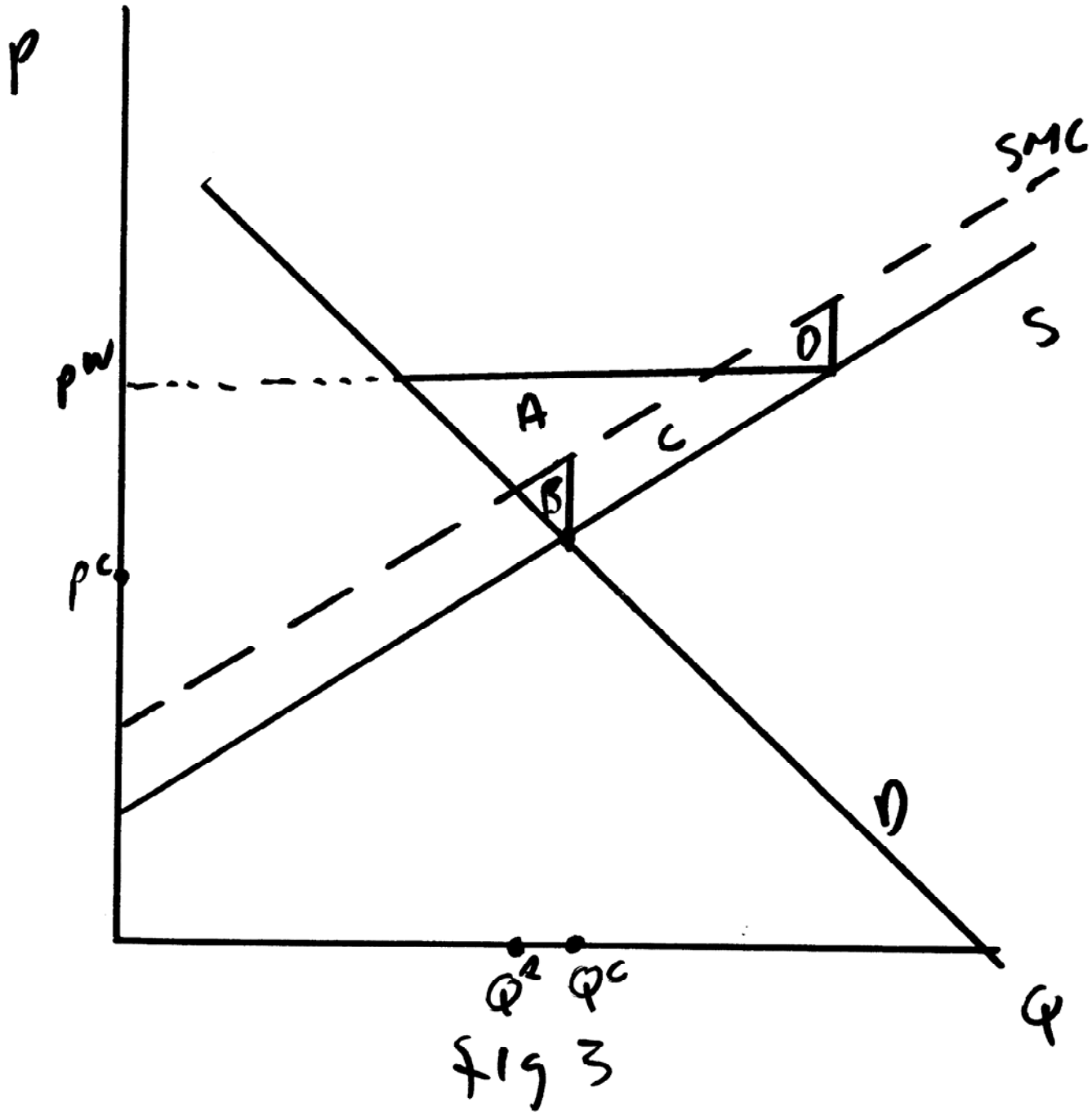

fig 3

on the world market and the price under autarchy. In the two figures, the magnitude of γ is approximately the same, but the magnitude of $p^w - p^c$ is quite small in the figure 2 and quite large in figure 3. Remember that the welfare cost of the trade distortion is proportional the the square of $p^w - p^c$, so when $p^w - p^c$ is small, the welfare cost of the trade distortion is very small. Thus, in figure 2 the welfare cost of the trade distortion is much smaller than in figure 3. In the situations described by the two figures, society incurs a cost (increased pollution) of opening up to trade. In figure 2 the offsetting benefit (increased sum of consumer and producer surplus) is small and in figure 3 the offsetting benefit is large. Thus, there is a net gain of opening to trade in figure 3 and a net loss in figure 2.

The Theory of the Second Best may appear to undercut economic arguments for liberal trade (or for other pro-market policies such as improving property rights to environmental goods). Policy decisions in the real world always involve many distortions that policy-makers reasonably regard as fixed. A set of theoretical results known as the Principle of Targeting explain why economists remain broadly united in favor of liberal trade and strong property rights. This Principle merely states that distortions, or market failures, should be "targeted" as directly as possible.

Since the distortion in the current example arises from production (not consumption), the optimal policy is a production tax of γ. Now suppose that the country uses the optimal pollution tax, γ. In this case, under autarchy, the equilibrium level of output is equal to the socially optimal level, Q^s (rather than the competitive level in the absence of a tax, Q^c. (Figure 4) Suppose, as before, that the country is able to trade at the world price p^w, but that a prohibitive export tax or quota prevents it from doing so. In this case, there is a single distortion – the trade restriction. The environmental problem is not a distortion, since the optimal tax is being used; this tax causes producers to internalize the environmental damage that production creates. Relaxing or removing the trade distortion, e.g. by permitting free trade, always increases welfare in this case. Figure 4 shows the gains from trade, the area A. This area equals the increased producer surplus minus the loss in consumer surplus, minus the higher level of environmental damages. Note that trade does increase the level of pollution damages (from Q^s to Q^t) – simply because it increases output. However, the use of the optimal production tax restrains the increase in production to an optimal level.

The Principal of Targeting assures us that the production tax is the correct instrument to use. If for some reason it is not possible to use a produc-

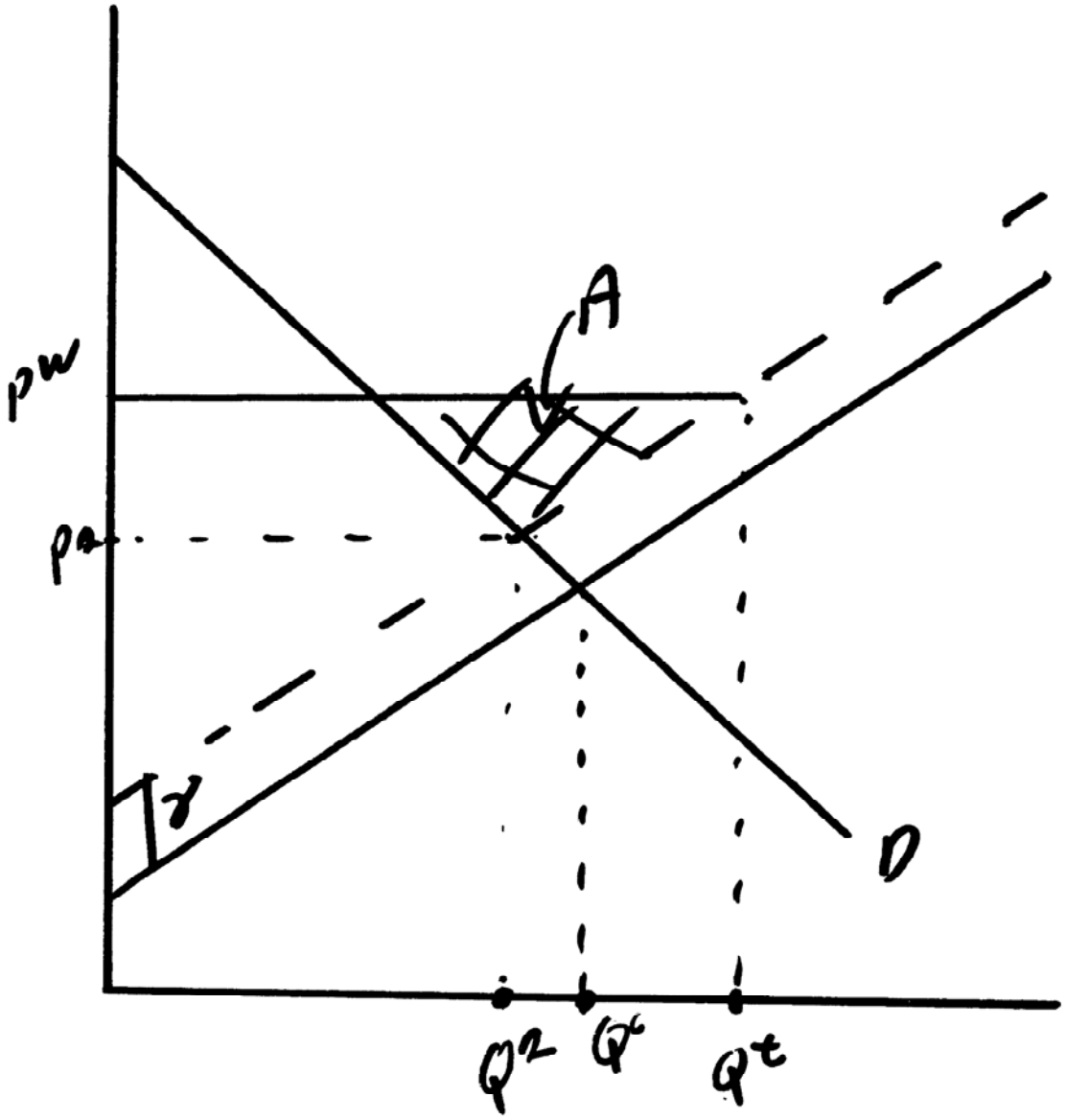

fig 4

tion tax, then a trade policy (e.g. an export tax) is a *second best* instrument. In the absence of a production tax, a trade restriction can result in higher welfare than free trade. In other words, (when production taxes cannot be used) free trade is not optimal. However, the second best trade policy cannot lead to as high a level of welfare as would be obtained under the first best production tax.

Figure 5 shows a circumstance where a small export tax increases welfare. (I have not shown the optimal export tax. The point of the figure is merely to show that an export tax can increase welfare.) Under a prohibitive export tax or quota (and no production tax) the autarchic price is p^c, as before. The world price is p^w. Figure 5 looks like Figure 3, in the sense that welfare under free trade is higher than under autarchy (even without the production tax). If the country allows trade but imposes a small export tax of t the domestic price is $p^w - t$. The tax revenue earned from this tax is shown by the area T. The loss in producer surplus, minus the gain in consumer surplus, is the area $A + T + B$. This loss, minus the gain in tax revenue is $A + B$. The tax reduces output from Q^w to $Q^{w\prime}$, thereby reducing pollution, leading to a reduction in pollution damages of $C + B$. Therefore the net gain to society from the tax is $C + B - (A + B) = C - A > 0$.

If the tax is increased, this net gain can become negative (a loss). Since we know that free trade is better than autarchy (in this example), we know that a prohibitive export tax (defined as the tax that eliminates exports) lowers welfare. There exists an export tax that improves welfare, relative to the free trade level. It is not true that an *arbitrary* export tax would improve welfare. Figure 6 graphs the gain in social welfare from using an export tax. The 0 export tax corresponds to free trade. A small export tax improves welfare (so the "welfare gain" curve is increasing in the neighborhood of 0). The point at which the curve reaches its maximum is the optimal export tax. If the tax is sufficiently high (at the prohibitive tax) trade is eliminated. Further increases in the tax have no effect on welfare.

This example illustrates a situation in which society is better off under free trade than under autarchy, despite the presence of the environmental distortion. By the Principle of Targeting, the optimal policy is to use a *production tax* (because the environmental distortion is caused by production). If for some reason a production tax cannot be used, then a sufficiently small *export tax* necessarily improves welfare. A small export tax causes a small trade distortion, but it partially corrects the non-negligible environmental distortion, so on balance welfare increases. It can be shown that

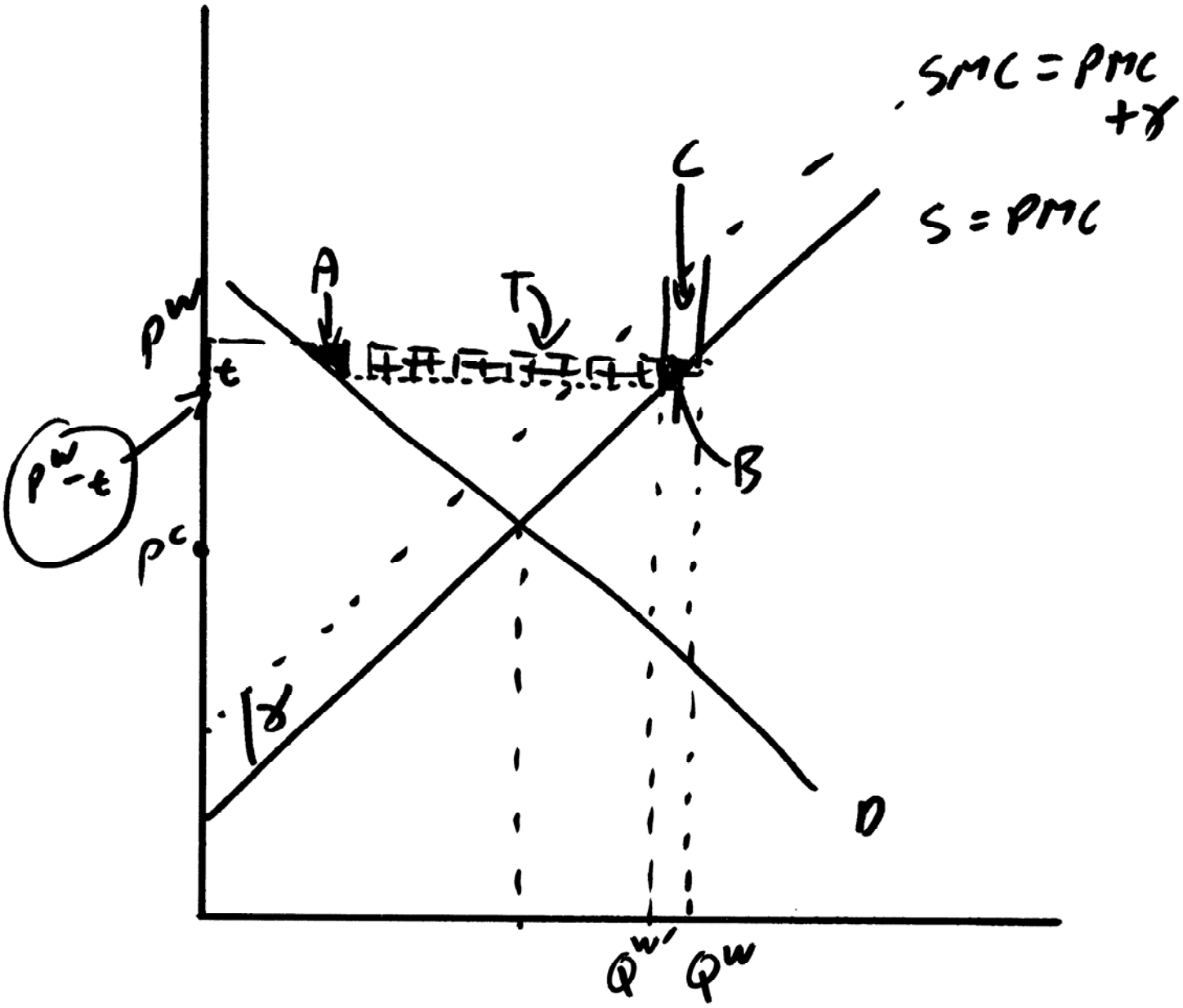

Fig 5

the optimal export tax is less than γ (which is the optimal production tax). When an export tax is used to correct the environmental distortion, that tax creates a *secondary distortion* because it distorts trade. The secondary distortion is that under the export tax, consumers no longer face world prices. Remember, the environmental problem in this example is associated with production, not consumption, so there is no reason to alter consumer prices.) This secondary distortion means that it is not optimal to cause producers to fully internalize the cost of pollution. In other words, the optimal export tax is less than the optimal production tax.

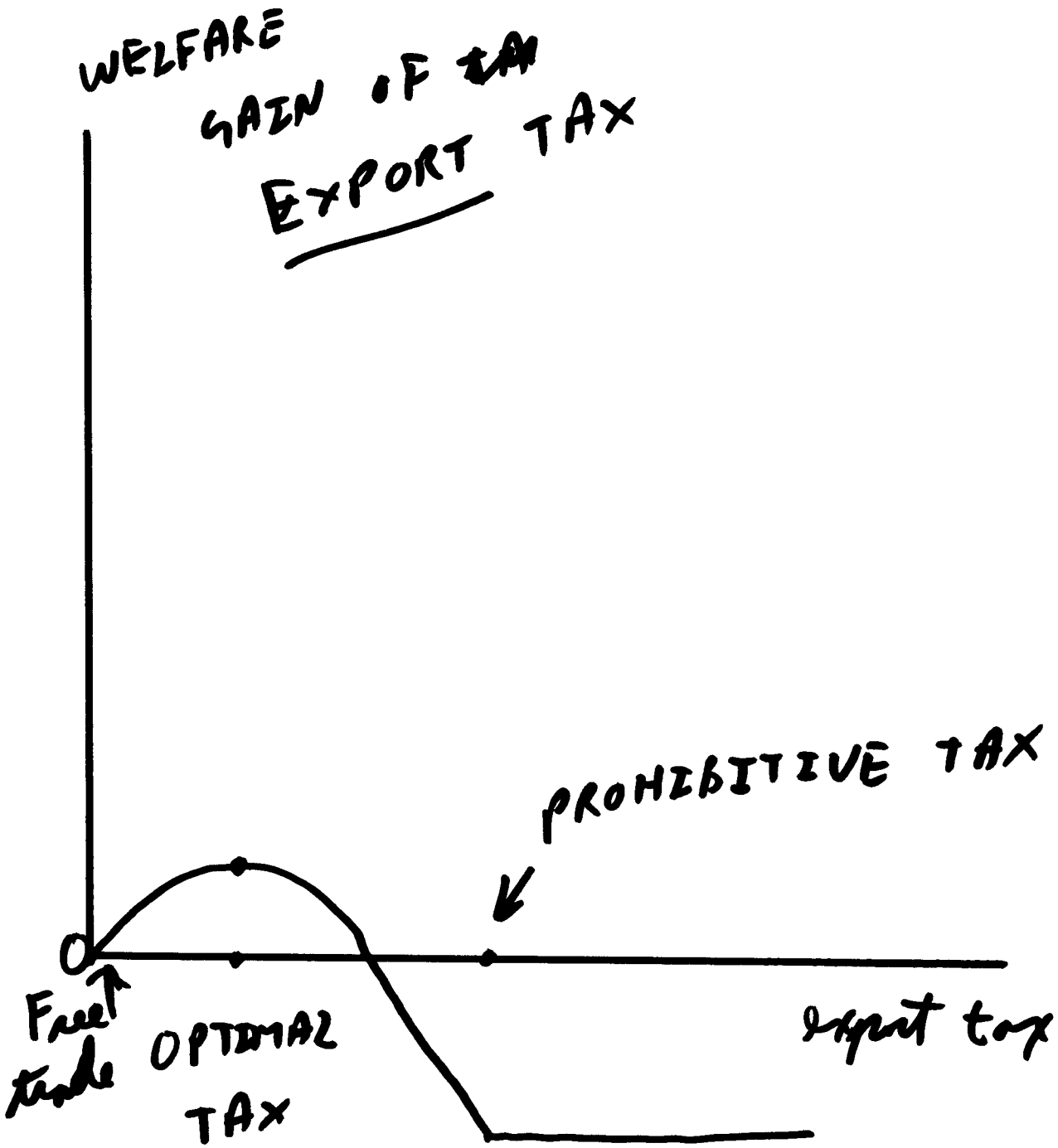
WELFARE
GAIN OF AN
EXPORT TAX
PROHIBITIVE TAX
Free trade
OPTIMAL TAX
Export tax

Fig 6