21.3 Policy in International Oligopoly

Now let us consider the more difficult but more common situation where firms from different countries are engaged in oligopolistic international competition, and one or both countries' governments use policies to secure more of the rent (profit) for their own country.

To keep matters as simple as possible, suppose there are just two firms, one owned entirely by the citizens of the home country, and the other by citizens of the foreign country. These compete as a duopoly in an international market. To simplify matters again, suppose that each government cares only about the profits of its national firm (and about its own budget, but not about its consumers' surplus). This assumption has some validity in reality because consumer interests are generally less organized and more muted in the political arena; more on this in the next section on political economy. (Alternatively, one could suppose that the market for the product is almost entirely located in third countries, so interests of the consumers in the two countries are not involved,)

The closest the world comes to this picture is the rivalry between Boeing and Airbus for the commercial jet aircraft market. That is the setting in which this theory is usually illustrated. Of course reality is more complex because of added considerations: (1) Each firm produces several types of aircraft, each of which has a niche in the market in terms of range, capacity etc. (2) There is dynamic learning by doing from one generation of aircraft to the next. (3) There are other existing producers like McDonnell-Douglas and possibility of entry by the Japanese. (4) Foreign investment and subcontracting of production spread the rents over many countries, etc. But the simple picture suffices to bring out the essential ideas.

Entry-Deterrence

We begin by supposing that the market is only big enough for one firm: either firm can make profit as a monopoly, but under duopoly both would make losses. Which firm will capture the lucrative monopoly, and how can it keep the other away? What can the governments do to promote their national champion?

Suppose it costs \$6 billion to design or develop the aircraft, and thereafter \$5 million to produce each plane. These figures are the same for both firms. If both firms carry out this development attempt to compete in the market, suppose each will sell 400 aircraft for \$15 million each. Thus each will make an operating profit of \$4 billion, and lose \$2 billion after subtracting the initial development cost. If only one firm designs the aircraft, it enjoys a monopoly. It will hold sales down to 600 (below the total of 800 in duopoly), driving the price up to \$20 million along the demand curve. The operating profit will be \$9 billion, leaving \$3 billion net of the development costs. (In Section 14 above we found the equilibrium of a simple Cournot or quantity-setting duopoly with a linear demand curve. The equilibrium quantities and operating profit figures above can be derived from that model by taking

Table 13: Strategic Entry-Deterrence

		Boeing	
		Develop	Not
Airbus	Develop	-2, -2	3, 0
	Not	0, 3	0, 0

$A = 35$, $C = 5$ and $Q_c = 1200$. The only new feature is the prior stage decision on development and its costs.)

Table 13 shows these outcomes in relation to the two firms' strategies, namely whether to proceed with the development. Airbus' two strategies are the rows, and Boeing's two strategies are the columns. In each cell, the first entry is Airbus' profit, and the second is Boeing's.

We can easily identify two possible equilibria or outcomes of this game of strategy. In one, Airbus develops and Boeing refrains; given that Airbus develops the aircraft, Boeing would only lose by coming in, and given that Boeing is out, Airbus profits from its development. In the other equilibrium, matters are the other way round. Of the two possibilities, each firm prefers the one where the other stays out. The question is how one firm can try to induce the other to make that choice.

In game-theoretic jargon, this is a game of Chicken. In the original scenario of this game, two 1950s American teenagers drive their cars toward each other. The first to swerve in order to avoid a collision is the Chicken, and the one who carries on driving straight wins. Of course the worst outcome for both arises if neither swerves. With Boeing and Aircraft, the similar question is who will fly and who will be the chicken.

The trick for Airbus, say, is to convince Boeing that it (Airbus) is already irrevocably committed to the project, so Boeing is sure to lose if it tries to enter. But this is not easy to do. The only sure way to convince the other is to make the irrevocable commitment of the development expenditure. And there is always the risk that the other does the same thing simultaneously, launching both on the collision-path.

Now suppose the European governments step in and pay Airbus' fixed cost of this product development. Then Airbus is protected from loss: if Boeing does not enter, it makes a monopoly profit of 9, and if Boeing does enter, it makes a duopoly profit of 4. Therefore Airbus is sure to enter. Boeing, on the other hand, is faced with this fait accompli. It knows that if it enters, it will engage in a duopoly and therefore make

a loss of 2. Knowing this, Boeing keeps out. Therefore Airbus enjoys the monopoly. (Exercise for those who know a little elementary game theory: Draw the game tree and show this outcome as the perfect equilibrium.)

What about the balance from the European governments' perspective? Their policy gets Airbus the monopoly profit of 9, but incurs the subsidy cost of 6. The net benefit to the European economy is 3. Without the policy, it was close to zero. Thus the policy is desirable for the EC.

What is the essence of this policy? It is the *strategic commitment* by the European government that altered Boeing's expectation and kept it out of the market. In this situation it is important to seize the first-mover advantage, and act in an irreversible way. If the European governments merely discuss the possibility of subsidizing Airbus, or offer a loan that might be forgiven in the future under some vague circumstances, then the effect may not be strong enough to ensure Airbus' entry or to deter Boeing.

If both governments pursue this policy, both firms will enter, and the economic outcome will be negative for both nations. The loss-making duopoly of the firms will merely become a loss-making duopoly of the governments.

Profit-Shifting

Even if the foreign firm cannot be kept out of the market altogether, it may be possible to gain some profit at its expense. To see how, we must examine duopoly equilibria somewhat more closely. In the text we offer a simple diagrammatic exposition; Appendix C provides a more detailed mathematical treatment.

We begin with the case where the two firms interact through quantity-setting (the Cournot assumption). The analysis of profit-shifting strategic trade policies in this situation is called the Brander-Spencer model after its inventors, although some textbooks also refer to the entry deterrence model above by this name.

Label the firms 1 and 2, and their outputs Q_1 and Q_2. Figure 43 shows the curves of constant profit (iso-profit contours) for Firm 1 in relation to the quantities of the two firms. The contours are upside-down parabolas; the successively vertically higher curves correspond to lower levels of profit. To see why they have this shape, note: [1] If Q_1 is kept fixed but Q_2 is increased, this lowers the price but keeps Firm 1's sales constant, so Firm 1's profit goes down. [2] If Q_2 is kept fixed and Q_1 is increased, Firm 1's profit goes up until its own profit-maximizing choice of Q_1 is reached, and decreases thereafter.

The peaks of the iso-profit contours are points where Q_1 maximizes Firm 1's profit for various alternative given levels of Q_2. They comprise a curve R_1 that is called Firm 1's *reaction function*; the idea is that it shows how Firm 1 can best respond or react to the quantity that Firm 2 might choose. It slopes downward because the higher is Q_2, the smaller is the portion of the demand left for Firm 1, and it is forced to produce less.

We can similarly find Firm 2's reaction function; the figure shows this as R_2.

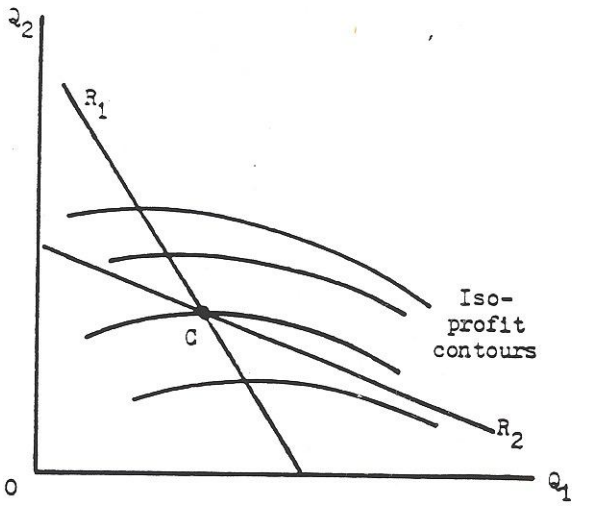

Figure 43: Iso-Profit Contours and Reaction Function

Where the two reaction functions meet, each firm's quantity is its best (profit-maximizing) response to the other firm's quantity. This is defined as the Cournot equilibrium C.

Observe a range along Firm 2's reaction function R_2, to the south-east of the Cournot equilibrium C, which is traversed by Firm 1's iso-profit contours corresponding to higher levels of profit than at C. In other words, Firm 1 would get a higher profit than at C if it could move the duopoly outcome to somewhere along this range. What it needs to do is to convince Firm 2 that it (Firm 1) is committed to producing somewhat more Q_1 than the Cournot equilibrium quantity, and thereby induce Firm 2 to back down along its reaction function. (Observe how this is a more general and flexible version of the commitment strategy of entry-deterrence in the previous subsection.) The question is how this can be made credible. Of course Firm 1 would like to increase its own profit, and will use all the devices it can summon up on its own to make its commitment credible. The interesting point in the policy context is that the home country government has an additional device that serves the same purpose.

This is the important new lesson of the model of export subsidies that was developed by Brander and Spencer. Suppose the home government offers Firm 1 a subsidy per unit of sales in every market where it competes with Firm 2. Then this firm's marginal cost falls, making it more profitable to expand its output. Therefore its

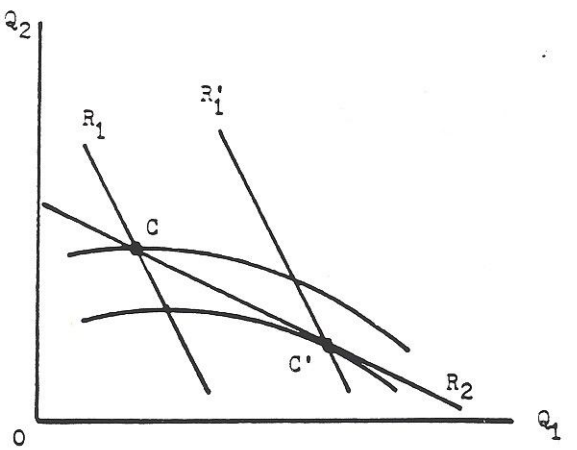

Figure 44: The Brander-Spencer Model

reaction function R_1 shifts to the right. Then the Cournot equilibrium slides to the right along the other firm's reaction function R_2, and into the range of higher profit for Firm 1. Figure 44 shows this.

The best choice of subsidy is that for which R_1 passes through the point of tangency between Firm 2's reaction function R_2 and an iso-profit contour of Firm 1: this is where the home country's profit is maximized given the response of the foreign firm.

In our earlier discussion of trade policy with perfectly competitive markets, we found that from the national perspective, export subsidies were utterly without merit. They worsened our terms of trade, and cost us revenue – they were simply gifts to foreigners. But in this model of international duopoly, export subsidies can be to our national advantage. The difference is their strategic role: they allow our firm to make a credible commitment to produce more, and thereby induce the foreign firm to produce less. The terms of trade worsening is still present, but is somewhat mitigated by the foreign firm's response. The effect falls disproportionately on the foreign firm. It sells less *and* receives a lower price. Our firm receives a *somewhat* lower price, but is able to sell a *much* larger volume, and thereby increase its profit.

Of course we should not expect the foreign government to remain passive in these circumstances. If they initiate a subsidy program of their own, the result is a subsidy war in which both countries are quite likely to lose. In other words, competitive

export subsidies can become a Prisoners' Dilemma for the governments. While the idea is intuitive, the detailed argument needs some algebra and is in Appendix C.

But the argument for strategic export subsidies is *not* that we must do this because everyone else does. The argument is that our government gives our firms a commitment advantage by making the first move in the subsidy game. It is in our national interest *whether or not* others follow the same policy. Thus subsidizing is our *dominant strategy*; each country pursuing its dominant strategy is what leads to the Prisoners' Dilemma between them.

Some further points to note about export subsidies:

• If there are several different markets (for example several importing countries) in which the two firms compete, and each firm has a falling marginal cost curve (internal economies of scale), then an advantage in one market leads to a cumulative advantage in other markets. This is Krugman's idea of "import protection *as* export promotion". Figure 45 shows how. The two firms sell in the home and the foreign market. In the home market (left hand panel) an import tariff has the immediate effect of shifting down the foreign firm's reaction function R_2. This raises Firm 1's sales, and lowers Firm 2's, in this market; the equilibrium shifts from C to C'. That lowers Firm 1's marginal cost and raises Firm 2's. That in turn shifts out Firm 1's reaction functions R_1 and R_1^* in both markets, and shifts down those of Firm 2's, R_2 and R_2^*. That in turn ... At each round of these shifts, the equilibrium in both markets is shifting in favor of Firm 1: from C' to $\overline{C}$ in the home market, and from C^* to $\overline{C}^*$ in the foreign. Thus protection in the home market promotes the home firm's exports.

Of course when we consider the economy as a whole (this industry and all others), the additional resources used by this home firm must come from some other use, so the policy has the effect of discouraging some other activities. The government should consider whether those activities had their own pure profit possibilities, or externalities, when it decides whether to promote the "virtuous circle" in one industry. This turns out to need too much subtle information, for example curvatures of reaction functions which in turn depend on third-order derivatives of demand functions, and such information is not reliably available from econometric work.

• If the industry is not a duopoly but an oligopoly, specifically if the subsidizing country has many firms, then the subsidy has the effect of intensifying their competition against each other as well. This weakens or even reverses the case for a subsidy. (With many home firms engaged in perfect competition, we have the standard case for an optimal export tax to exploit any national monopoly power.)

• If new firms can enter, the game and the policy changes. If the fixed costs are small so free entry eliminates profit, then the profit-shifting argument for subsidy is also eliminated. There can be an added social cost as each firm produces at a suboptimal scale, and exerts monopoly over domestic consumers. This is the common experience of many countries, especially small or medium-sized LDCs, which use trade restriction policies to promote industrialization.

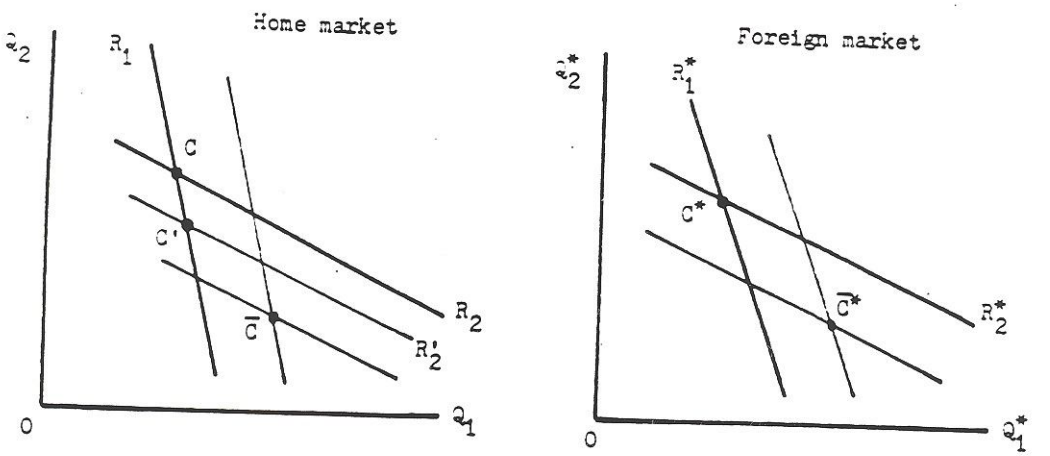

Figure 45: Import Protection As Export Promotion

• If the duopolists compete in prices rather than quantities (Bertrand rather than Cournot duopoly), then the reaction functions in prices slope up, and the optimum policy for each country is an export tax. Figure 46 demonstrates this. Many details are left for you to figure out by analogy with the Cournot case; see Appendix C.3.

Thus the government must know the exact oligopoly game that firms play if it is to follow the right strategic policy. Since no one knows which is the right model of oligopoly, this raises doubts as to the practicality of successful strategic trade policy.

With Bertrand duopoly each government prefers the other to take the lead in imposing the export tax. Thus the game between the government becomes one of waiting for the other to act.

• Empirical evidence: Dixit (US autos) and Smith and Venables (several European industries) find that moderately large tariffs or subsidies (10-15%) can be justified on profit-shifting grounds, but the magnitudes of the nation's economic gains are not large (well under $1 billion). When the various qualifications (including foreign retaliation) are considered, the economic case for strategic profit-shifting policies is not strong.

Krugman and Baldwin found that Japan's support of their DRAM microchip industry through market closure was instrumental in the growth of that industry. But entry eroded profit, and the harm to their own downstream industries (users of DRAMs) was substantial..

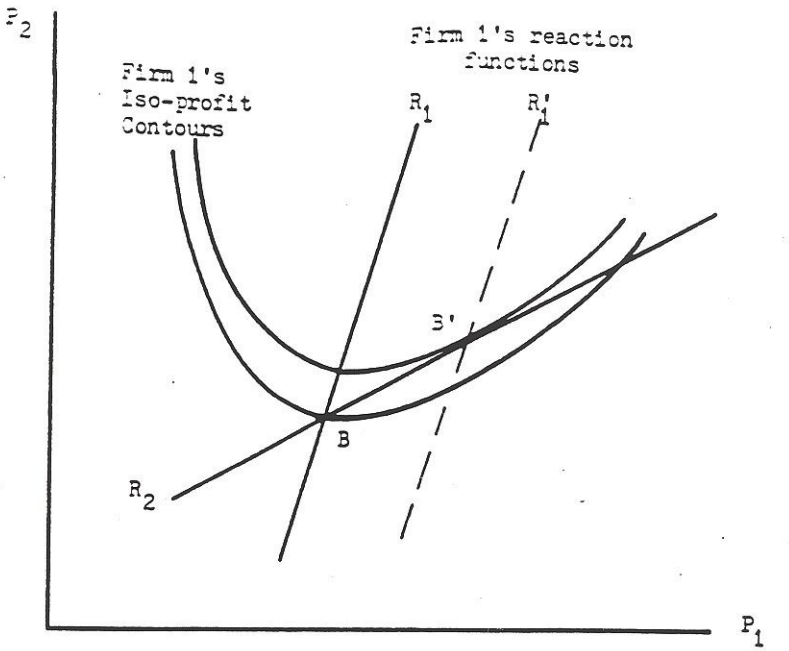

Figure 46: Bertrand Duopoly

• Finally, a reminder: in a world with international capital flows, higher profits of US-registered firms do not necessarily translate into higher incomes for US citizens. As these capital flows increase, there is less scope for the use of strategic profit-shifting policies in the national interest.

Strategic Protection and Countermeasures

Suppose one country is protecting its home market in an oligopolistic industry, presumably with the aim of nurturing the home firms to the point where they can exploit static or dynamic economies of scale and become competitive and profitable in world markets. Whether or not there is merit to this idea, such policies often hurt other countries. Such disputes are then discussed in bilateral or multilateral negotiations. This has been a regular feature of US-Japan economic relations.

Japan protests that it does not have any higher trade barriers than any other major industrial country, and this is true as regards the formal barriers like tariffs and quotas. But the US side claims that Japanese barriers are hidden. In this situation any agreement to reduce the formal barriers will avail nothing, and the US side has recently focussed on what they call "objective criteria" of market opening in Japan, most notably market shares of US firms there. The semiconductor agreement had a 20% "target," vague according to Japan and firm according to the US; failure to meet it led to further disputes.

Such *voluntary import expansion* (VIE) agreements have been advocated by Laura Tyson. She claims that, unlike protectionism, these agreements will actually bring benefit. The argument is that by increasing the number of firms in the market, the agreements will be pro-competitive. But in oligopolistic industries, fixing market shares changes firms' conduct, because it alters their perception of how other firms will respond to their own pricing or output decisions. In a duopoly, for example, a market share agreement will give each firm a sure share of total demand, and enable each to charge the monopoly price without fearing any loss of clientele to the competitor. Therefore others see such arrangements as being conducive to cartelization, and against consumers' interests everywhere.

21.4 Policy Toward High-Tech Industries

Some high-tech industries have substantial scale economies and oligopoly. Others have more modest scale economies and can accommodate several firms and fierce competition. But even these are important technological spillovers or externalities. As we have seen, such spillovers can create additional arguments for policy intervention. By promoting its national firm, a country as a whole can travel farther down a falling average cost curve or a dynamic learning curve and achieve higher productivity. But we also saw that two conditions are needed for success of such policies: [1] The spillovers should be kept confined within our national boundaries; else foreign firms will freely benefit from our government's efforts and expenditures. [2] The gains from higher productivity should take the form of higher incomes to factors in this industry rather than lower prices to consumers; otherwise our expenditures will mostly benefit consumers in foreign countries.

How likely are these conditions to be met in reality? A good case study is the semiconductor industry. The US lead in DRAM's has eroded since the late 1970s, although we are still leaders in the more advanced microprocessors. Proponents of US government policy to protect and promote this industry have argued that it has major external economies. They claim that Japan's industrial policy has allowed its firms to move down a much steeper learning curve, and thus dominate the industry. Critics of policy intervention respond that DRAMs are a homogeneous product with an intensely competitive market, so there is no pure profit to be had, and benefits of higher productivity go to consumers in the form of lower prices. Advocates of policy counter with the argument that a loss of DRAMs will be followed by a loss of the more important microprocessor portion of the industry because there are spillovers from the former to the latter. But all these arguments have been assertions backed by a few vague calculations, and hard evidence to support any of these claims has been lacking.

A recent study by Douglas Irwin and Peter Klenow of the University of Chicago adds significantly to our knowledge. Their findings are as follows: [1] Dynamic economies of scale are indeed substantial: a doubling of the cumulated volume of

chip production reduces the cost of the next unit by 20% on the average across generations of DRAMs and across countries. [2] A firm learns three times as much from its own cumulated production as it does from other firms'. [3] There is no significant national component to the external part of the scale economy; spillovers are worldwide. [4] Spillovers from one generation of DRAMs to the next are weak. [5] Japanese firms do not have significantly steeper learning curves than American ones.

These results come down squarely on the side of the critics of proposed policy intervention to help the US DRAM industry. If most of the scale economies are internal, then profit-motivated firms will have the incentives to achieve them. But free entry of such firms seems to have eliminated the pure profits in DRAMs, so there is no case for a policy to capture them. The spillovers are almost wholly international, so US subsidy to its own firms will merely provide some free knowledge to firms in Japan and Korea. And since intergenerational spillovers are very weak, there is little case for subsidizing DRAMs to protect microprocessors. And finally, the purported success of Japanese policies is called into question.

How do the gains from higher productivity accrue to different individuals in the economy? The evidence seems mixed. The most dramatic technical progress has taken place in the computer hardware and software industry. Many workers in these activities have amassed large fortunes. But prices of the products have fallen very dramatically: the relevant price is that of a standardized unit of computing service, which has fallen by factors of several thousand. Thus much of the gain has spilled over to consumers generally.

21.5 An Overview of Strategic Trade Policy

The new ideas about international trade based on scale economies have enriched our understanding of the realities of modern trade. Computer chips *are* different from potato chips. We can identify theoretical conditions under which free markets fail to achieve efficient outcomes when production has internal or external scale economies, national benefit can be served by strategic policies to promote such industries.

But we have also seen that successful practice of such policies is very difficult – it needs quite complex information about the economy, and quite subtle calculation of equilibria and games. When we recognize that the domestic producers have incentives to misrepresent this information in an effort to gain protection or subsidies, we should realize that a well-intentioned strategic trade policy is likely to be hijacked by special interests. There are numerous instances where industry representatives have made dubious claims about the spillovers they generate, and the national importance of their activities. Finally, the empirical evidence so far suggests that the potential gains from such policies are modest at best.

The position that free trade is always the best policy is no longer tenable, but great caution is warranted before a country embarks on policy activism of the kind that the theoretical models can in principle justify.