PROMOTING NEW INDUSTRIAL ACTIVITIES: A SURVEY OF RECENT ARGUMENTS AND EVIDENCE

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INTRODUCTION

Increasingly, politicians and the public alike gauge the economic performance of their nation by the success or failure of local firms engaged in global competition in certain glamorous, high-technology industries. The national desire to "win" these competitions often matches the public zeal for Olympic gold medals. This desire has given rise to calls for an industrial policy in North America, Europe and elsewhere. Proponents argue that the government should aid local firms in their efforts to become established in these new activities. They claim that economic vitality and vigorous growth hinge on performance in the dynamic sectors of the economy and that comparative advantage must be "created" in the current international competitive environment. Opponents deny the need for government intervention. They argue that resources will naturally find their way into the most profitable and socially desirable uses.

Much is at stake in this debate. Each new industrial opportunity – be it the search for commercial uses for superconductivity, the development of High Definition Television or the next generation of supercomputers, or research into the biomedical applications of interferons – involves an enormous commitment of resources. These huge investments are a prerequisite to future production capabilities. And once the technologies have been developed and production methods perfected it may be too late for new firms to enter the fray and gain competitiveness. *So* government policy today (or the lack thereof) may determine the global pattern of specialisation in production for many years to come.

Public discussion of the need for an industrial policy has been clouded by much rhetoric. Special interests shroud their case in the cloak of national pride. And frustration during a period of slow growth and high unemployment brings forth the urge to "do something". But the debate has also generated many attempts at careful, reasoned, economic analysis. Economists who were wont to dismiss all calls for government policy with casual reference to the wonders of the "invisible hand" have been forced to rethink their arguments in the context of modern industrial competition. While this rethinking has not led to wholesale abandonment of orthodox principles concerning the role of markets, it has led to refinement of these ideas, and also to the identification of many valid arguments for government intervention. These arguments are the subject of this article.

Not all of the issues discussed here are new ones. Many of them arose, for example, in the debates of the 1950s and 1960s about "infant industries" in less developed countries. What is new, perhaps, is the capacity of economic theory to inform the current policy discussions. Recent advances in the fields of game theory, industrial organisation, and international trade make possible a more rigorous analysis of the critical issues in the industrial policy debate than has previously been the case.

In what follows, I shall present analyses of the main features of modern industrial competition. I focus on the extent to which these provide arguments for government intervention in the market-place, especially where the entry of local firms into a new industrial activity is concerned. In each case I review the logic of arguments for government policy, discuss the robustness of the arguments to changes in assumptions about the underlying economic environment, and then consider the empirical evidence that bears on the particular arguments. Section II deals with fixed costs, economies of scale and learning-by-doing. In Section III, I discuss the externalities associated with R&D, with learning-by-doing, and with the creation of human capital. Section IV contains an analysis of capital markets, emphasising especially the implications of asymmetric information between potential borrowers and lenders. Finally, in Section V, I consider imperfect information on the part of consumers as a barrier to entry into new industrial activities. Before all this, I present a review of welfare economics as applied to industry analysis, and develop a general framework for the subsequent discussions.

I. THE WELFARE ECONOMICS OF INDUSTRY PROMOTION

Governments have various objectives in their promotion of specific industries. Subsidies may be used to foster development in certain regions of a country, to transfer income to certain disadvantaged groups within society, to augment national prestige, and *so* on. Economic analysis has little to say about the appropriate weights that should be placed on these objectives relative to that of maximising the size of the overall economic pie. Accordingly, economists tend to concentrate on efficiency arguments for policy interventions. I shall not deviate from this traditional course here.

A. A framework for analysis

In welfare economics, industry performance is often judged by comparing the benefits generated by an industry to those that would be created if the same resources were deployed elsewhere in the economy. In such "surplus" analysis,

market values are used to measure the opportunity cost of the resources that are consumed or released by the industry under consideration. Strictly speaking, the validity of this procedure requires that policy-induced resource reallocations not be so large as to alter the prices of primary inputs that are determined on economy-wide factor markets'.

Three components of industry surplus are distinguished, according to the identity of the potential beneficiaries. ***Producer surplus*** is the excess of the value of the output of an industry over the opportunity cost of the resources that are used up in production. This surplus may accrue to several different agents. Returns to capital in excess of the "normal" rate (i.e. the amount the capital could earn by being deployed elsewhere) constitute surplus for the owners of the capital. Wages paid to workers in excess of the "normal" rate (i.e. the amount the workers could receive in employment elsewhere) also constitute surplus. Owners of resources that have special value in a particular industry (e.g. the owner of land with characteristics especially suitable for growing grapes or the owner of a patent for an idea especially suitable for producing a particular product) derive surplus in the form of rents to their scarce but industry-specific inputs.

Consumer surplus is the excess of the "enjoyment" that consumers derive from purchasing a certain amount of some good over the cost of those purchases. The former concept is made operational by asking what is the maximal amount that the consumers would be willing to pay for each successive unit acquired. If the consumer is able to purchase the unit in the market-place for less than this maximal amount, the difference is imputed to total industry surplus.

The government derives surplus from any ***revenues*** it collects from an industry. In cases where subsidies are paid out by the government, this component of total surplus is negative. The government is included in the welfare calculus because, if an industry is to be supported, funds must ultimately be raised from domestic citizens through one form of taxation or another. The cost of a subsidy is at least as large as the payment that is made, and may be larger if the government must (as is typically the case) collect revenues by some method that imposes an efficiency burden on society. There remains the question of how these surplus components ought to be aggregated. The appropriate weights reflect societal concerns for equity. Lacking contextual information on who are the relevant actors and what is their claim to governmental attention, it is common for economists to weight all components equally. The resulting measure then reflects the contribution of the industry in question to the aggregate surplus generated in the economy. Sometimes government revenues are given a weight greater than one, in recognition of the fact that real-world taxes always distort economic decision making. For example, Ballard ***et al.*** (1985) place the marginal efficiency cost of a dollar of revenue in the U.S. tax system between $1.17 and $1.56. I shall not make any such explicit adjustments here, but only point out that any

case that emerges for government subsidies must be tempered to reflect the "excess burden" of raising the necessary funds.

The following formula expresses total industry surplus:

$$W = n[(p+z)x - S(x)] - n(f-v) + [U(c) - pc] - (p-p^*)e - znx - nv \qquad [1]$$

where :

- W is total surplus generated by an industry;
- n is the number of "representative" firms in the industry;
- x is the level of output of a typical domestic firm;
- P is the price paid by home consumers;
- z is the subsidy (if any) to producers per unit of output;
- $S(x)$ is the social opportunity cost of the resources used to produce x, net of any fixed costs of entering the industry;
- f is the social cost of the resources needed for entry (assumed to equal private cost of entry);
- v is the lump-sum subsidy (if any) to producers to induce entry;
- c is the level of domestic consumption;
- $U(c)$ is the (gross) consumer benefit from consuming an amount c;
- p^* is the international price of the .industry's output (in local currency); and
- $e = nx - c$ is net exports (net imports if negative).

The first two terms measure producer surplus. They incorporate total industry revenue (including government subsidies) minus the social cost of the resources used up in entry and in operation[2]. The third term is consumer surplus. The last three terms reflect the cost of export subsidies (or the revenue from import tariffs, if p exceeds p^* and e is negative)[3], of output subsidies, and of entry-inducing subsidies that help to cover fixed costs, respectively.

Government intervention typically alters many or all of the magnitudes on the right-hand side of equation [1]. The various channels through which policy might affect social welfare can be identified by asking how W varies with its determinants. This exercise proves useful for classifying the different arguments that have been made in favour of government support for specific industries.

Equation [1] implies the following expression for the total change in W, denoted AW (the symbol "A" will be used to mean "the change in"), that results from changes in the magnitudes of the various economically-determined variables:

$$\Delta W = W_x\Delta x + W_n\Delta n + W_p\Delta p + W_c\Delta c + W_e\Delta e + W_{p^*}\Delta p^* \qquad [2]$$

where W_x is the rate at which welfare changes with a change in output per firm x, W_n is the rate at which welfare changes with a change in the number of firms n, etc. The expressions for these rates of change can be derived from [1]. The term

$W_p\Delta p$ vanishes, because $W_p = nx - c - e = 0$. Intuitively, a change in the domestic price of an item, everything else constant, affects only the distribution of income between producers, consumers, and the government, but not the efficiency with which resources are allocated. The remaining terms in [2] can be expressed as the sum of seven distinct components. I shall list them here and describe them briefly. A more detailed discussion of each is reserved until later, when the particular arguments for intervention are reviewed. The components of ΔW are:

i) $n[p - m(x)]\Delta x$; where $m(x)$ is the private cost to a typical manufacturer of producing one more unit of output, or the "private marginal cost." This term has been referred to as the *profit-capture* effect. It arises in oligopolistic environments (where prices are above marginal cost) anytime policy induces firms to change their levels of output. The output changes alter firms' (net-of-subsidy) profits and thus total industry surplus (see Sections II.A and II.C).

ii) $n[m(x) - s(x)]\Delta x$; where $s(x)$ is the social cost of the resources used by a firm in producing one more unit of output, or the "social marginal cost." This is an externality effect, which arises when policy induces a change in resource use in situations where the amount that firms pay for their inputs deviates from their true opportunity cost to society. Such a divergence between private and social resource costs obtains when firms do not enjoy all the benefits or bear all the costs of their actions (see Sections III, IV.B and V).

iii) $[px - M(x) - f]\Delta n$; where $M(x)$ is the total private cost to a firm from producing x units of output net of any fixed cost of entry f. This term represents the *profits-from-entry effect,* reflecting the excess of the operating profits earned by new firms that are induced by policy to enter over the private cost of that entry (see Section II.C).

iv) $[M(x) - S(x)]\Delta n$. This is the *externality-from-entry.* When the number of firms in the industry changes, this term measures the extent to which the private costs of production borne by the new firms exceed the social costs. It is similar to the externality effect in *ii)*, except that it arises when policy induces entry by new firms rather than (or in addition to) expansion by existing firms.

v) $(p - p^*)\Delta e$. This is the *volume-of-trade* effect. Goods sold to or purchased from an external market have an opportunity cost p^*. In the presence of trade policies, the domestic price will differ from this opportunity cost. Then policies that alter the volume of trade have implications for efficiency, because domestic decisions are based on prices that differ from true international opportunity costs (see Section I.B).

vi) $e\Delta p^*$. This ***terms-of-trade effect*** reflects the welfare gain that accrues to a country when its exports command a higher price on world markets, or when it is able to purchase its imports more cheaply. Policies that induce an expansion of exports generally cause the world price of the export good to fall, and *so* contribute a negative component to industry surplus on this account. By analogy, policies that contract imports impart a positive effect if the country is large enough in relation to world markets to substantially affect the world price of its import good (see Section I.B, I.C).

vii) $[u(c) - p]\Delta c$; where $u(c)$ is the benefit consumers derive from consuming one more unit of a commodity after c units have already been consumed. This consumer-surplus ***effect*** measures the societal gain from any expansion in consumption of the good in question (see Section II.A, II.B, V).

Surplus analysis is used to check the logical consistency of various arguments for government intervention and to evaluate specific policy proposals. The advantage of this framework is that it catalogues all the different channels through which policy might affect the efficiency with which resources are allocated. A change in policy will, in general, invoke several component effects. Policy analysis then requires a comparison of their relative sizes. I shall proceed to describe a number of situations that frequently arise in the course of discussing modern, "high-technology" industries, and then use surplus analysis to elucidate the arguments for and against government intervention.

B. The orthodox argument against industry promotion

It is useful to begin by demonstrating how the current framework yields the conventional economists' wisdom against industry promotion when markets are "well functioning" and competitive. This exercise will illustrate why the various assumptions of the competitive paradigm are critical ,to the *laissez faire* policy conclusion.

The competitive paradigm assumes the absence of any barriers to entry and that individual domestic firms are *so* small relative to the size of the world industry that they neglect their individual influences on the ultimate market price of their output. In these circumstances, free entry drives "excess" profits (profits in excess of those needed to cover fixed entry costs) to zero. Producers receive $p+z$ for each unit of their output and collect revenues equal to $(p+z)x$. Then zero excess profits implies $(p+z)x = M(x) + f$. Also, each firm produces up to the point where marginal cost $m(x)$ equals the price $p+z$ that it receives. Then term *i)* reduces to $-nz\Delta x$ and *iii)* reduces to $-zx\Delta n$. The first of these is negative if an output subsidy $(z>0)$ is used to promote industry expansion by existing firms

($\Delta x > 0$). This is because the resources used to expand output have opportunity cost m, but create output in the targeted industry with value p. Since m exceeds p by the amount of the subsidy, the use of the resources in the targeted industry is inefficient. By similar reasoning, the second term is negative if an output subsidy is used to induce entry ($\Delta n > 0$). Then the value of the output created by the new firms does not justify the resources used by them.

Well-functioning markets are defined, in this context, by (inter alia) the absence of externalities. *So* terms *ii*) and *iv*) vanish in the orthodox analysis by assumption. Term *vii*) also is not present in this case, because each consumer selects an optimal level of purchases by setting the price of the last unit just equal to its marginal value (i.e. $u(c) = p$). All that remains are terms *v*) and *vi*). If a subsidy is used to stimulate exports ($\Delta e > 0$), domestic price p will exceed the world price p^* by the amount of the subsidy, and *so* term *v*) will be negative. Finally, there is the terms-of-trade effect. Both output subsidies and export subsidies serve to expand the amount that the home country sells on world markets, and thereby push the world price downward ($\Delta p^* < 0$). If the home country is a net exporter of the good in question ($e > 0$), this fall in world price is detrimental to the country's national welfare[4].

For exporting industries, output and trade subsidies generate only negative components in the surplus analysis. Thus, industry promotion by either measure can only reduce welfare in the orthodox economic setting. With perfect competition, small firms, and no externalities, market prices give producers the appropriate signals for efficient resource allocation. Government support causes resources to be used in an industry beyond the point where the marginal social benefit justifies the marginal opportunity cost. And, to the extent that the terms of trade deteriorate, the presence of international trade only strengthens the argument against the promotion of domestic industries.

C. An exception to the orthodox prescription

Itoh and Kiyono (1987) have recently provided an argument for subsidies to emerging export industries within the framework of the orthodox model. They show that subsidies to marginal industries that are almost, but not quite, competitive on world export markets without government support can improve a country's terms of trade. The subsidised industry is one with no (or few) prior exports, *so* any policy-induced change in the price of this product has a negligible effect on the nation's welfare. But, as resources are withdrawn from the economy at large into the targeted sector, outputs of some other locally produced goods will begin to fall. If the resources for the targeted industry come predominantly from other export sectors, as will be the case if a country's various export goods all draw on a common resource base, then the terms of trade for these other exports may improve.

Krugman (1987) argues further that, if production of new export goods involves learning-by-doing (see Section II.B below for the empirical evidence), then temporary support for an industry can be sufficient to achieve permanent competitiveness. Krugman refers to the Japanese "narrow-moving band" whereby the government allegedly targets a series of new industries in succession, leaving subsidies in place just long enough for long-run competitiveness to be assured. In this way, industries are "sliced off" one after another. Within limits, the Itoh-Kiyono argument provides a possible social welfare justification for this alleged policy approach.

The "marginal exports" argument relies on terms-of-trade improvement. As such, it amounts to nothing more than an indirect method of applying an "optimal tariff." But if this is the government's objective, it can always be achieved more directly by means of a tax on imports or on inframarginal exports. Such policies achieve the same benefits with fewer offsetting costs. Moreover, the welfare benefits from a program of subsidising "marginal exports" are not likely to be large, if the conditions of the orthodox setting prevail. They need not even be positive, if the intervention is not managed with great care. Unless the new export industries are quite large, the effect of their emergence on the world supply of other goods is likely to be small. *So* the price effects in other markets likewise will be small. But if the new industries are large, even modest subsidies may induce substantial terms-of-trade losses in the emerging industries themselves (i.e. exports of these new products will take place at prices less than the social cost of the inputs). These direct terms-of-trade losses can readily swamp the smaller, indirect benefits from the other export markets. Also, the new export industries may compete for resources with some import-competing sectors, in which case the resulting terms-of-trade effects in the import markets will be adverse. In short, when perfect competition prevails, there is no reason to be sanguine about the aggregate terms-of-trade implications of a program that promotes an expansion in the range of goods that a country exports.

D. Market distortions and the theory of the second best

For the most part, the new literature in support of government targeting has been cast in an economic environment where markets do not .function perfectly. This is not surprising, in the light of the attributes of the industries that are the focus of this literature. Nearly all of these characteristics imply some departure from the orthodox paradigm. I shall discuss in the sections that follow the principles that should guide government policy in markets where there are large fixed costs of entry, substantial economies of scale, steep learning curves with potential spillovers across firms, and imperfections in capital and product markets stemming from asymmetries of information.

The arguments that arise fall within the purview of "the general theory of the second best." This theory argues that, for every market distortion, there exists some targeted policy remedy that most directly corrects for the market failure. This policy tool is optimal in each case, because it does not create any additional by-product distortions[5]. However, if the designated policy remedy is not available to the government for political or other reasons, alternatives may exist that indirectly attain some of the same efficiency benefits. In many cases, industry-wide subsidies fall into this latter category. Since general support for an industry represents a blunt form of intervention, such support rarely redresses the market failure in a targeted way. Thus, in the case of each market imperfection it is necessary to ask not only whether export or output subsidies might enhance economic performance, but also whether and which other approaches might be available for achieving even greater efficiency in the ultimate allocation of resources.

II. ECONOMIES OF SCALE AND LEARNING-BY-DOING

A. Economies of scale

The most salient characteristic of many modern industrial activities is the large fixed cost of entry. This cost may take the form of a massive research and development program that is a prerequisite to production. Or it may result from the need to install highly specialised capital equipment. As an example, the initial set-up costs for Boeing and Airbus that made possible their entry into the market for medium range, wide-bodied jet aircraft are estimated to be $1.5 billion per firm (Schlie, 1986). Firms seeking to develop the technology for High Definition Television are spending in excess of $100 million per year on R&D. Fixed costs of this magnitude imply that few firms are able to enter these activities at profitable scales of production. Thus, perfect competition seems unlikely to emerge in these industries. Indeed, as Schumpeter argued long ago, the lure of monopoly profits is often a prerequisite for private research and development efforts.

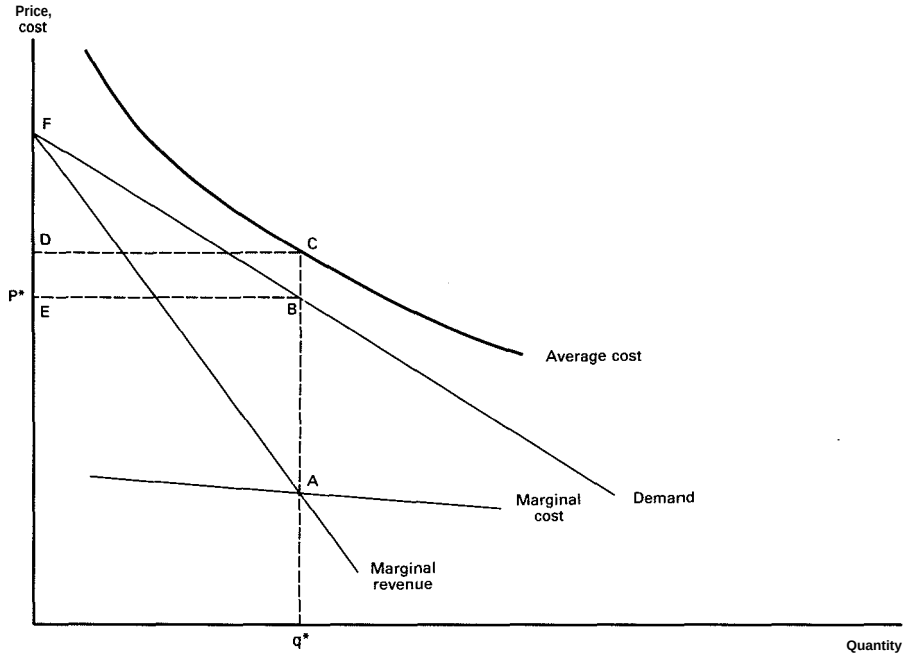
Most modern technologies exhibit economies of scale quite apart from any fixed costs of entry. There often exists a minimum efficient scale of operation, with average costs falling rapidly until that scale is attained. It is not possible, for example, for a plant to produce 50 000 automobiles per year at the same average cost as can be achieved for production runs of 150 000 or more. Scale economies limit the number of firms that can profitably be active in an industry, as output by each must exceed the minimum efficient scale in order for it to remain competitive.

What then are the welfare economics of industry equilibrium when fixed costs are large and scale economies prevalent? Let us consider first the simplest possible case, that of a single firm contemplating entry into a new activity. The firm knows that if it enters it will capture a monopoly position. It would then maximise profits by setting output where marginal revenue equals marginal cost, at a point such as A in Chart A. However, for the case shown in the figure, the profit maximising price p* falls short of the average cost of production at output level q*. So entry will not take place in the absence of any intervention by the government.

Is there any reason for the government to support entry in this case? The answer may be yes. If the government subsidises the firm's fixed cost, it can induce entry with a grant of amount BCDE that makes good the firm's operating losses[6]. Then consumers will enjoy surplus of BEF. Of course, if some of the consumers reside in export markets, then a purely nationalistic welfare calculus would exclude these buyers from the measurement of the total benefits. Nonetheless, the total domestic benefit can exceed the government's cost. In terms of the welfare framework developed in Section I, the positive consumer-surplus effect

CHART A

SUBSIDISED ENTRY WITH LARGE FIXED COSTS

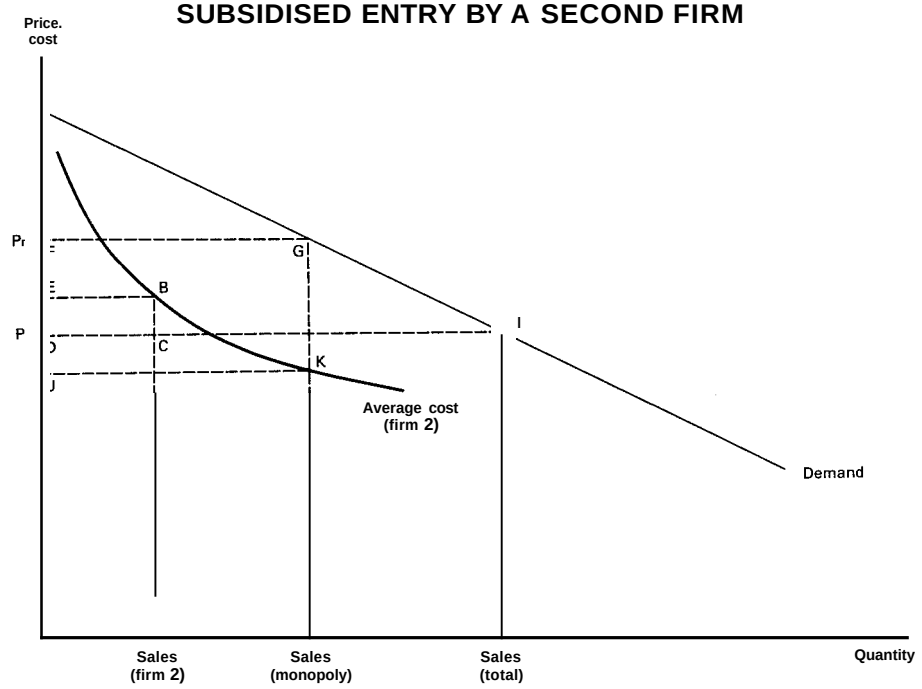


can outweigh the negative profits-from-entry effect. Market failure arises because under the given technology profitable production is not possible for private producers, and the private firm neglects any positive spillover to consumers in making its entry decision.

A new consideration arises when a subsidy is contemplated to promote entry by a second firm into a market where one firm could sell profitably without government support. I depict this case in Chart B. In the figure, p_m is the price that would prevail if only one firm were to be active, while p_2 is the lower price that would obtain in a more competitive, duopolistic market. Again, the subsidy has a direct cost BCDE, and again consumers benefit, this time by FGHD. But now the effect of the new entry on the profits of the firm already active in the industry must be considered. This effect is bound to be negative for three reasons. First, the incumbent firm makes fewer sales than before. Second, its sales take place at lower, more competitive prices. Finally, its average cost may rise as its scale of production falls. So the subsidised entry of a second firm creates a negative profit-capture effect, which must be added to the negative profits-from-entry effect before these two are weighed against the positive consumer-surplus

CHART B

SUBSIDISED ENTRY BY A SECOND FIRM



effect[7]. The net result will depend upon the specific cost and demand conditions in the industry in question. But, as Horstmann and Markusen **(1986)** point out, the more firms that are induced by policy to enter, the more likely it is that each firm will have an inefficiently small scale and thus an excessively high average cost of production[8].

B. Learning-by-doing

Another reputed feature of many modern industries is the existence of a steep learning curve. That is, production costs that are initially high may decline rapidly with cumulative experience in a new activity. Substantial empirical evidence confirms the significance of such learning effects. Zimmerman **(1982)** estimates, for example, that early on in the history of construction of nuclear power plants, the completion of a first plant lowered a firm's cost of building a second by **11.8** per cent. The second completion lowered per plant costs by an additional **4** per cent. Lieberman **(1984)** studied learning in the production of 37 chemical products. He found a learning curve with a "slope" of **0.20;** that is, production costs fell by approximately **20** per cent when cumulative output doubled. Baldwin and Krugman **(1987*a*)** report Office of Technology Assessment estimates of the slope of the learning curve for semiconductors of **0.28,** and estimates for the construction of aircraft are of similar magnitude (see, for example, Alchian, 1963).

The learning-by-doing referred to here is internal to the firm. That is, a firm must undertake the production itself in order to capture the indicated cost savings (spillover effects will be discussed in Section III.B below). In this case, learning effects simply represent "dynamic scale economies." Scale economies imply that average costs fall with increased output. Learning-by-doing similarly implies that per unit production costs fall as output accumulates over time. And like the fixed costs associated with research and development and many capital expenditures, learning costs are irreversible. As a result, the welfare analysis that emerges of activities with important learning effects is analogous to that for industries with large static scale economies (see, for example, Dasgupta and Stiglitz, **1988).**

Support for domestic firms during their learning phase might be justified by the consumer surplus gains that would ensue once this phase is complete. This requires dramatic scale economies (i.e. average costs that fall sharply with cumulative output, as in Chart A) or large price effects from increased competition (as in Chart B). But policy-induced entry by more than one firm can exact efficiency costs, inasmuch as production by each new firm cuts into the volume of sales for existing firms and so may reduce the speed with which they gain experience and the associated learning benefits. This is the same argument that applies in the case of static scale economies, where entry by new firms implies shorter production runs and higher average costs for extant producers. In short then, the

arguments for and against subsidies to firms with steep learning curves are analogous to those that apply in situations with static scale economies. The efficacy of policy here hinges on a comparison of consumer benefits and subsidy costs and not at all on the fact that learning benefits are "dynamic" (i.e. accrue over time) rather than "static" (i.e. accrue at a single moment in time).

C. Strategic entry promotion

Thus far, the arguments of this section have made no reference to international trade. But in the presence of scale economies, static or dynamic, governments concerned with national welfare may have reason to promote domestic firms in their competition with foreign rivals for the few positions in an emerging market. This strategic motive for policy has been studied by Ethier (1982) and Dixit and Kyle (1985).

The argument is a simple one. Suppose the world market is large enough to support only one firm in an activity, and that the potential entrant abroad has a small cost advantage over a potential domestic producer. Then in the absence of any government policy in either country, the foreign firm alone will enter the market and assume a monopoly position. Consider now an early commitment by the home government to support the entry of its domestic firm into the industry by whatever subsidy is necessary. If the foreign firm finds this policy announcement to be credible (for example, if the home government has a reputation for promoting its local firms, or if it can pass a law that provides an irreversible commitment of support), then that firm will refrain from bearing the costs of entry, recognising that the market is not large enough to support both firms at profitable scale. Consumer surplus is then nearly the same as it would have been without any government intervention (since the home entrant's costs are only slightly above those of its foreign rival) but the home firm earns monopoly profits where none would be forthcoming without the policy support. From a national perspective, policy provides an unambiguously positive profits-from-entry benefit that dominates the small consumer-surplus loss in this case.

There are several qualifications to the argument, however. First, the home government must be credible in its commitment to support its firm come what may. For suppose the foreign firm "calls the bluff" by resolving to enter the market despite the announced intentions of the home government. Then the home government will find itself with no incentive to carry out its policy promise since it knows that the market cannot profitably support the second firm once the first has entered. The policy can "work" only to the extent that it successfully deters entry by the foreign rival. Second, strategic entry promotion is essentially a "beggar-thy-neighbour" policy. The profits captured by the home firm in the example above come at the expense of the foreign firm. To the extent that policy induces the less efficient firm to enter the market, global efficiency must decline.

What comes to mind, of course, is the possibility that two might play the same game. But if both governments attempt to use subsidy policy to capture the profits from entry, then these profits will be dissipated in excessive entry and both countries will suffer in the end.

Third, excess profits may be dissipated if a government program induces multiple firms to spend resources to enter a new activity. If *so,* a negative profit-from-entry effect may be generated[9]. Fourth, the new activity might draw resources from other oligopolistic sectors, or from other activities within the same industry. If *so,* a negative profit-capture effect may be realised in these other industries (see Dixit and Grossman, 1986). For example, European promotion of entry by Airbus into some new market may entail loss of oligopoly profits from existing markets, as Airbus is induced to shift industry-specific inputs from old to new activities. Finally, the policy may fail to deter entry by foreign rivals if their mode of conduct is not as predicted by game-theoretic considerations. Then subsidised entry creates excessive world competition with high average costs and losses for all participants.

Many of these qualifications are similar to those that have been expressed in regard to arguments for strategic promotion of established, oligopolistic industries[10]. In that case the caveats to the basic argument have led many economists to urge caution in the use of aggressive output or export subsidies for shifting profits to domestic oligopolistic firms. The same counsel would seem to apply with equal force to the case of strategic entry promotion.

D. Empirical evidence

The arguments of this section for an active industrial policy require certain beneficial effects to outweigh adverse ones. Does a presumption exist in favour of such policies in industries with large economies of scale? Or, at least, can observable conditions be identified that will indicate when intervention is warranted? These questions beg empirical answers which, unfortunately, are only beginning to emerge slowly: In this section, I shall review some of the few case studies that have been completed.

Before proceeding, an important methodological issue should be raised. That is, ***ex*** post studies of specific (successful) industrial ventures are bound to overstate the average (or ***ex ante)*** rate of return to entry into new activities. This reflects sample selection bias. Researchers naturally focus on the known cases of success. Where attempted market entry has failed (e.g. efforts in regard to fusion power) the aborted projects have not generated the publicly available data needed for empirical economic analysis. As a result, it is difficult to form any conclusive judgements about the efficacy of policy on the basis of a select few industry studies. With this caveat in mind, I turn to the evidence.

Bresnahan (1986) examined the consumer surplus benefits that accrued to users of general purpose ("mainframe") computers as a result of innovations in the computer industry. Focusing specifically on financial service providers (i.e. banking, insurance, brokerage), he estimates that in 1972 this sector enjoyed benefits of between $225 and $417 million due to the fall in the quality-adjusted price of computer services between 1958 and 1972. These benefits are large compared to the total amount of $68 million that the sector paid for computing services in 1972. Although it would have been more appropriate to compare the gains to the amount paid by the computer producers for their technological improvements, presumably these R&D outlays could not have greatly exceeded the revenues taken in by the computer firms. It seems safe to conclude that the rate and extent of advance in the industry was far too low. In other words, the social returns to innovation in the computer industry exceeded greatly the private returns to producers of computers. Applying quite different measurement techniques, Trajtenberg (1989) draws much the same conclusion in a study of innovations in the technology for Computed Tomography (CAT) scanners. He notes that new scanners were introduced continually from the product's initial introduction in 1972 until the end of his data set in 1981. Each new variety provided faster scan times and higher image quality, and *so* the range of medical uses for the innovative product expanded tremendously. Trajtenberg estimates the benefit to U.S. consumers from these quality improvements and relates this measure to the aggregate of R&D expenditures by all firms producing scanners. He finds a capitalised benefits-to-cost ratio of 270 per cent, suggesting once again that far too little innovation took place. The estimated time profile of benefits and costs is also quite revealing. Societal gains from innovation were highly skewed toward the first half of the period, whereas R&D outlays were more evenly spread. Thus, the estimated benefit-to-cost ratio for the period from the industry's birth to 1977 was a staggering 80: 1, whereas the ratio was a much more modest 1.4: 1 for the period from 1978 to 1982. These results suggest that government promotion would have been tremendously productive early on, but less *so,* or even counter-productive, once the industry was well established.

Three studies have investigated the strategic argument for entry promotion in specific industries. These studies adopt quite a different methodology from those previously cited. Trajtenberg estimated an econometric model to quantify consumer benefits, while Bresnahan calculated an index of quality improvements from industry price and quantity data. These methods impose relatively little structure on the data. Research on strategic subsidies, by contrast, has adopted the techniques of computable simulation analysis. In simulation analysis, the researcher assumes the validity of some particular model of the industry. Then he or she "fits" the model to the data, by selecting values of the unobservable parameters of the model *so* that the equilibrium solution resembles the observed data on outputs, prices, market shares, etc. for one particular base year".

Baldwin and Krugman (1987*b*) model the competition between Boeing and Airbus in the emerging market for medium range wide-bodied aircraft (i.e. Boeing 767 versus Airbus A300). Their model highlights the huge fixed costs of product development and the steep learning curves that characterise production of new aircraft. Key assumptions in the analysis include:

i) the absence of any linkage between competition in this market and that for other aircraft produced by the same companies;
ii) the irrelevance of McDonnell-Douglas as a potential competitor in this market; and
iii) that market conduct can be modelled as Cournot competition between producers of a homogeneous product.

In calibrating the model to the data, Baldwin and Krugman assume that Airbus has received substantial subsidies from its parent European governments in order to enter this market. Their analysis is aimed at estimating the size and implications of these alleged subsidies. Since no direct evidence on the form or size of such subsidies exists, Baldwin and Krugman suppose that policy serves to lower the rate of return that Airbus is willing to accept on its capital investment. In particular, they assume that whereas Boeing used a five per cent discount rate in making its long-run investment decisions, Airbus used whatever discount rate it took to make entry profitable. Given the assumed parameters of the model, the authors find that Airbus would suffer losses on its initial investment even with profits discounted at a zero rate. The implicit interest rate subsidy to Airbus, if the model is correct, is on the order of $1.5 billion 1974 dollars.

What then are the welfare effects of this alleged subsidy? According to this study, the gain to European air carriers due to the presence of Airbus in the market about equalled the cost of the subsidy to the parent governments, while the loss of profits to Boeing far exceeded the gain to American carriers. So entry promotion seems to have come at considerable welfare cost to the United States, with little if any gain for Europe. The only clear national winners in the Baldwin-Krugman analysis are third countries, whose airlines and passengers enjoy lower prices due to increased competition. Baldwin and Flam (1989) have performed a similar simulation study of the market for 30-40 seat commuter aircraft. This market has three producers, one each from Brazil, Canada and Sweden. Their products are close substitutes, and again static and dynamic scale economies loom large in the competition. As in the Baldwin-Krugman study, assumptions must be made about the policy environment in order to calibrate the model to the observed data. Again, no explicit government policies are evident, although all participants complain that their rivals enjoy tacit government support. Baldwin and Flam assume that support for the Canadian firm takes the form of market access restrictions in Canada, since the Swedish and Brazilian firms have been unable to make inroads there. The Brazilian firm is assumed to enjoy an export

subsidy for sales to the United States that partially accounts for its competitive success in that market. Finally, the Swedish firm is taken to have received no government support, a somewhat questionable assumption in view of the nature of the financing that this firm has received from the Swedish government. Indeed, Baldwin and Flam themselves note that the firm might not have entered the market at all without its attractive financing arrangement.

Baldwin and Flam simulate the effects of removal of the alleged export subsidy in Brazil and the alleged market access restriction in Canada. They find that each of the strategic policies benefited the local producer at the expense of the other two. The net effect of the two policies together has been to harm the Swedish firm substantially, to exacerbate the losses of the Brazilian firm slightly, and to mitigate somewhat the losses suffered by the Canadian firm. Canadian air customers have enjoyed a modest gain in consumer surplus as well. The finding that both the Brazilian and Canadian firms would have suffered losses without government intervention, together with the authors' intimations that subsidised financing may have been a prerequisite for the entry of the Swedish participant, strongly suggest that this industry is one where competing governments have caused excessive entry to their mutual detriment.

The market for 16K random access memory chips has been analysed by Baldwin and Krugman (**1987*a***). The salient features of this market are the short product cycle (significant sales began in **1978** and had all but ceased by **1985**) and the steep learning curve. Learning in this industry takes the form of ever-greater yields of usable chips from a given batch of output. Baldwin and Krugman model the market as one with free entry by American and Japanese firms. The high market shares of Japanese firms in their home market are taken as evidence of implicit infant-industry protection there, and the model is calibrated with the rate of "protection" as an unobserved parameter. Given their assumptions about the modes of market conduct, which certainly are open to some question[12], the authors estimate that a Japanese tariff of 26 per cent would have been needed to generate the observed market outcome. Baldwin and Krugman then perform the experiment of removing the alleged Japanese import barrier. They find that without home market protection none of the Japanese firms would have entered the world market, while entry promoting policy in Japan reduced by one the number of producers in the United States. The Japanese "industrial policy" served to reduce welfare in both the United States and Japan by raising average costs and prices in both markets.

In summary, the few case studies that exist suggest that consumer benefits from major new innovations have been quite large in comparison to the research costs borne by the innovators. As noted above, this may reflect selection bias. But to the extent that the findings can be extended to include a broader range of (randomly selected) R&D projects, or to the extent that it would be possible to

identify ahead of time which potential technological developments are most promising, some government support for major new innovations may be indicated. Since the social benefits in these cases stem from R&D and not from output per se, a targeted policy response would dictate subsidies to research and development. The government might be able to promote a faster pace of innovation by encouraging entry by more firms, but again the most directed way to accomplish this would be for the government to bear a portion of the cost for R&D. Only to the extent that productivity improvements result from experience in production would output subsidies be justified. Unfortunately, the available evidence does not speak to the issue of whether the pace of learning-by-doing has been appropriate or too slow.

The argument for promoting entry by domestic firms on strategic grounds finds little support in the data. When governments vie on behalf of their local firms for a limited number of places in some global activity, the outcome often seems to be one of excessive entry, with average costs of production that are higher than need be, and with all firms suffering losses in the resultant equilibrium. Thus, for example, competing government efforts in Europe, Japan, and the United States to promote local firm participation in the emerging market for High Definition Television might well prove costly to all involved.

III. EXTERNALITIES

Externalities arise when the actions of one party affect the well-being of others (positively or negatively) in ways that are not mediated by the marketplace. Without government intervention, the party that confers the external influences generally does not have adequate incentive to take the interests of the affected parties into account. Many arguments for an active industrial policy rest on the allegation that significant externalities are generated in the process of entry into or expansion of new industrial activities. This section describes the various externalities that have been mentioned in the popular and professional literature, assesses their likely empirical magnitudes in the OECD countries, and discusses potential policy remedies.

A. Research and development

I have argued above that entry into many modern industrial activities requires substantial research outlays. The goal of any research, industrial or otherwise, is

the creation of knowledge. Knowledge has several unique attributes as a commodity that render its private provision in a market setting sub-optimal. First, knowledge is not exhaustive *in* use; that is, unlike most other goods and services, the use of information by one party does not preclude its simultaneous use by another. Second, *complementarities* in the uses of different pieces of knowledge abound. A particular discovery may not be of much value unless it is combined with bits of information generated by others. Third, knowledge may be imperfectly excludable; individuals or firms that have devoted resources to generating new knowledge may be unable to prevent others from making use of it. In other words, it may be difficult for the originator of some technological advance to protect his or her property rights, even though patent and copyright laws have been devised exactly for this purpose. These public good characteristics of knowledge make it both efficient and perhaps inevitable for the fruits of any research effort to be spread widely through society. But private agents will only bear the cost of research efforts to the extent that they can capture private rewards. As a result, R&D will be under-provided by a market system to the extent that spillovers take place, while dissemination will be sub-optimal when spillovers are prevented (see Arrow, **1962).**

Spillovers from R&D need not be only national in scope. With the remarkable advances that have taken place in recent decades in communication technology, information now travels rapidly and almost costlessly around the globe (see Pasinetti, **198**1). International dissemination of new ideas and technologies takes place through professional journals and conferences, by international licensing arrangements, and via the transnational operations of multinational corporations. With different factor prices and different consumer preferences existing in different parts of the world, knowledge created by a firm located in some country is likely to yield potential benefits elsewhere that the originator does not recognise or is unable to exploit. Recognising the importance of complementarities in the creation and use of new knowledge, it becomes apparent that any limitations that exist on the international diffusion of technology and information must be quite costly to countries that are active in its creation.

The inefficiency of the market provision of new technology has been established in many theoretical contexts; see, for example, Griliches **(1979)** and Spence **(1984).** More recently, Romer **(1988)** and Grossman and Helpman **(1989*a*, 1989*b*)** have modelled the process of ongoing technological advance and the entry by entrepreneurs into new industrial activities. They have established that, when spillovers from R&D are present, changes in the incentive structure provided by the policy environment will affect not only the static level of economic well-being, but also the rate of economic growth[13].

Several recent empirical studies confirm the widespread importance of externalities in the R&D process. Jaffee **(1984)** examines the research performance of

432 U.S. firms that account for **80** per cent of all privately funded R&D, testing the hypothesis that a firm's R&D success is positively related to the amount of R&D undertaken by other firms in closely related areas of research. Using several alternative measures of research output, and controlling for the possibility that disparate industrial areas may afford different opportunities for technological success, Jaffee finds considerable support for the externalities hypothesis. He estimates that if all firms performing similar research were to increase their outlays by 10 per cent, total patents among them would rise by 20 per cent, with more than half of this marginal product due to spillovers. For the same increase of **10** per cent in the R&D spending of relevant parties, a firm with an average level of R&D would see its accounting profits increase by **3** per cent, with one-third of this increase attributable to external effects.

Bernstein **(1988)** measures spillovers from R&D in Canada. He estimates cost functions for each of seven Canadian industries, using four years of annual observations on a cross-section of corporations. The specification of a firm's production costs includes an own R&D variable, plus variables measuring R&D outlays by other firms in the same industry and by other firms in different industries. In most cases statistically significant intra-industry and inter-industry spillovers are found together with substantial evidence that firms reduce their own R&D expenditures when the opportunity to free ride on others increases. Bernstein estimates social rates of return to R&D of between **19.3** and **26.4** per cent for the seven industries examined, compared with the (estimated) private return of 11.6 per cent. Of this difference, inter-industry spillovers contribute about two percentage points, while intra-industry spillovers account for the rest[14].

Turning to the policy implications of R&D spillovers, several potential remedies present themselves. First, governments may subsidise the private costs of R&D, thereby encouraging firms to expand their research efforts. In terms of the framework of Section IA, such a policy would generate only a positive externality effect without offsetting negative implications. Of course, if the social cost of raising tax revenue for purposes of paying the subsidy exceeds the amount of the subsidy, as is likely to be the case in any real world application, the spillover benefits must be sufficiently great to cover the inefficiencies introduced by the taxes. In any event, most industrialised countries already subsidise R&D in the forms of direct government grants to universities and think-tanks for basic research, grants to firms for certain types of applied research (especially those with military applications), and accelerated tax write-offs for all product development costs. In fact, Griliches (**1986**) and Lichtenberg and Siegel **(1989)** find that federally funded research by a sample of U.S. corporations has been substantially less productive than projects financed by the firms themselves, and that in some cases the private return from such research has not been significantly positive. However, their studies measure only private R&D returns captured by the firms themselves and ignore potential spillover benefits that might have motivated the

subsidies in the first place. Moreover, these authors are forced to assume that the industries that have been receiving the federal funds are no different in their characteristics than those which have not, an assumption that precludes any systematic basis for the government's selections. For these reasons, it remains an open question whether or not the currently provided levels of government support for private **R&D** are adequate, insufficient, or perhaps even excessive. Second, governments may spur firms to internalise the externalities associated with creating new technologies by forming joint research ventures. Governments can encourage such ventures with direct financial support, as in Japan, or by granting favourable antitrust treatment to these industry-wide research efforts, as in the United States. In many cases, it will be appropriate for the participants in such arrangements to emanate from several different countries. Then international as well as national spillovers can be realised and enjoyed by the co-operating parties. One potential danger posed by the joint venture as a response to the appropriability problem in **R&D** is that it may foster collusion on the part of firms in an industry to slow the rate of technological progress (see Katz, **1986,** and Grossman and Shapiro, **1985).** This risk is mitigated, however, when several distinct entities are formed or when a strictly national venture faces stiff competitive pressures from abroad.

A third approach to the problem of **R&D** spillovers involves increased overseas protection of intellectual property rights. Firms and governments in North America and Europe claim weaker incentives for **R&D** due to inadequate enforcement of patent and copyright laws in parts of the developing world. These complaints have spawned international negotiations within GATT and elsewhere, but the willingness of the less developed countries to accede to demands for stricter enforcement of intellectual property rights, when such may not be in their own interest, remains to be seen (see Chin and Grossman, **1989).**

Finally, the use of output or export subsidies, or temporary home-market protection, as alternative means to overcome the **R&D** externality problem may be considered. However, as Baldwin **(1969)** has pointed out in the context of the debate on infant industries, these policies may be totally ineffectual in dealing with the market failure at hand. By acting on the price of final output, they provide equal inducement to firms that free-ride on the **R&D** of others as they do to firms that engage in **R&D.** As such, they do nothing to overcome the problem of appropriability. The level of inventive activity among existing firms may or may not expand when protection or output-based subsidies are provided. Only if the subsidies or trade policies serve to encourage entry by firms that otherwise would be inactive, in situations where entry necessarily entails the undertaking of **R&D,** will a positive externality-from-entry effect necessarily be generated. Even *so,* these policies induce a negative profit-capture effect and (in the case of subsidies to export industries) a negative terms-of-trade effect. More direct policies that augment incentives for **R&D** without encouraging the excess employment of other

factors of production in the targeted industry are to be preferred on efficiency grounds.

B. Learning-by-doing

In principle, knowledge spillovers may arise not only when technology is created via the devotion of resources to R&D, but also when it derives from experience at production. That is, the productivity gains that stem from learning-by-doing may accrue partly to firms other than the one that actually undertakes the manufacturing. The alleged existence of such knowledge spillovers lies behind the most familiar variant of the classic infant-industry argument. When private marginal costs of production exceed social marginal costs, because other firms benefit from a given firm's output, then an output subsidy is the policy instrument of choice. In this context, such subsidies generate a pure externality benefit without any offsetting welfare negatives[15]. Trade policies are next best, as they promote learning but also introduce a negative volume-of-trade effect.

Empirical evidence of external benefits from learning-by-doing is scant, but not wholly non-existent. Zimmerman (1982) estimated, for example, that roughly one half of the internal cost savings generated by experience in constructing a nuclear power plant during the early history of this industry could be'enjoyed by firms other than the one that undertook the construction. Lieberman (1982) found extensive diffusion of the knowledge generated by learning-by-doingacross firms in the chemical processing industry. But Bell, Ross-Larson and Westphal (1984), in their extensive review of research on the performance of infant firms and industries in less developed countries, find little support for the claim that firms entering a new activity can learn costlessly from the experience of others. They read the evidence as implying that firms must consciously invest in learning in order to become competitive in a new line of business. Successful entrants were those that devoted resources to monitoring production performance and to analysing the success or failure of different production and marketing strategies.

C. On-the-job training and investment in human capital

Another argument that has been advanced in favour of government support for new industrial activities alludes to externalities in the process of investment in human capital. Firms will be reluctant to invest resources in training workers if, once skilled, the workers are free to move to other firms in the industry or elsewhere in the economy to capture the rents from the training. As a consequence, it is claimed, firms will endow workers with less than the efficient amount of general (as opposed to firm-specific) skills, and new, skill-intensive activities may be slow to emerge.

The first point to note about this argument is that there must exist some imperfection in capital markets for any such externality to arise. Otherwise, workers could finance their own training by accepting lower wages during an initial period of apprenticeship. Only if a worker has few assets and limited ability to borrow against his or her future earning potential will he or she be unwilling to bear the cost of acquiring skills. While such capital market failures undoubtedly exist (see Section IV below), there is also substantial evidence that workers accept low wages during their early, less productive years[16].

Second, as for the case of R&D spillovers, there is no guarantee that output subsidies or trade policies will solve the appropriability problem (Baldwin, 1969). If firms must pay workers more than their marginal product during a training period, and if they stand to lose the skilled workers to other firms when they try to recoup their investment, then no amount of output subsidy will induce the firms to provide the needed training. Even if the appropriability problem, though present, is not *so* severe, a policy targeted to the externality-generating activity (i.e. one that directly supports investment in human capital) is bound to be more efficient than one that promotes activity in the industry more generally.

A search of the vast empirical literature on labour markets turned up no research that compares the social and private returns to investment in human capital. Horowitz and Sherman (1980) and Maranto and Rogers (1984) provide evidence that training, both explicit and on-the-job, generates productivity gains. Barron, Black and Lowenstein (1987) and Simpson (1984) found that large firms provide their workers with more training than small firms. This result suggests the existence of a spillover effect that large firms are better able to internalise (although other explanations are possible). Also suggestive is the finding by Simpson that firms with high turnover rates provide less job-specific training than do firms with low turnover rates. But, surprisingly, Simpson finds that the level of general training (which is more likely than job-specific training to generate external benefits) rises with the turnover rate. Taken together, the available studies do not explicitly reveal the existence of any inefficiency in the provision of on-the-job training, nor do they indicate that firms in new industrial activities suffer any special difficulties in appropriating the benefits from training their work force. But the question of whether significant externalities exist in the process of human capital formation remains an open one.

D. Vertical linkages and co-ordination failures

A final externality-based argument for promoting entry into new industrial activities refers to the linkages that may exist between different nascent sectors. If scale economies are significant and if export opportunities are limited by transport costs or trade barriers abroad, then profitable entry by a producer of an

input may be precluded by the non-existence of a domestic downstream buyer for its product. Similarly, a potential downstream producer may be unable to enter profitably without access to a low-cost source of supply for a critical component. Then the market outcome may involve a co-ordination failure in which neither the upstream nor the downstream producer bears the large fixed costs of entry, though both could profit if they did *so* together. This argument, originally due to Scitovsky (1954), has been re-introduced and extended by Pack and Westphal (1986) in their brief for industrial targeting in newly industrialising countries".

An argument based on vertical linkages has been made by proponents of a High Definition Television industry in the United States. Local production of this new product, it is claimed, would provide a market for U.S. semiconductor producers, who could thereby realise dynamic scale economies and *so* remain active in their industry. What is missing from this argument is an explanation of why scale economies in the U.S. semiconductor industry could not otherwise be achieved through international trade, and why the High Definition Television industry could not establish itself in the absence of a local semiconductor industry, if foreign producers of semiconductors are indeed the most competitive world suppliers.

Evidence of actual co-ordination failures of the sort described in the preceding paragraphs are entirely anecdotal, even for the less developed countries, where the arguments would seem to have more pertinence. With opportunities for international trade readily available to most producers of high-technology products, and with costs of transportation of these products generally low in comparison to value added, it would seem that the size of the domestic market should not limit the possibilities for entry of viable, potentially profitable producers. Thus, there are grounds for skepticism about the relevance of the co-ordination failure argument to the industrial policy debate in the OECD economies.

IV. CAPITAL MARKET IMPERFECTIONS

New ventures in modern industries often require substantial amounts of capital. Firms must finance the often enormous costs of product development, as well as the losses that they may incur during initial learning phases in production and marketing. Moreover, all such ventures are fraught with risk, as the pioneers in a new activity initially will know neither the feasible production costs nor the size of the potential market for the new product[18]. Since many firms will not be able to generate internally the capital necessary to finance significant new ventures, capital markets take on a critical role in the process of entry into new

industrial activities. This process can only be efficient if corporations are able to borrow funds at rates that truly reflect social cost plus a reasonable premium related to the inherent riskiness of the new ventures. However, under plausible credit market conditions, allocation of credit to new ventures will not be efficient. The analysis that follows seeks to clarify the nature of imperfections in capital markets. It also highlights the difficulties that will inevitably arise if governments attempt to devise policies to improve upon the market outcome.

A. Divergence of social and private cost of funds

The simplest scenario to consider is one where some exogenous divergence exists between the social opportunity cost of funds and the rate at which the market makes these funds available to borrowers. Often such divergences are ascribed to the shortsightedness of lenders, their "irrational" aversion to risk, or their systematic over-estimation of the riskiness of new activities (see, for example, Kafka, 1962). In such circumstances, the policy prescriptions are clear. If private discount rates are too high, governments must subsidise credit (reduce borrowing costs to entrepreneurs or augment returns to lenders) in order to bring private and social costs of capital into line. If aversion to risk is too great, the government ought to alleviate some of the private exposure by providing subsidised insurance or generous tax offsets for corporate losses. Such subsidies and tax benefits ought to be available to all investors in all sectors of the economy, unless it is known that the market systematically discriminates against certain types of ventures.

Although simple, this scenario is hardly compelling. Policies that aim to deny the legitimacy of societal preferences regarding time-discounting or risk-taking smack of paternalism. And there is little reason to believe that governmental assessments of the uncertainties involved in new business enterprises will be superior, on average, to those of analysts in the private sector. It is difficult, then, to build a convincing case for the existence of a divergence between private and social discount rates without making reference to the nature of the market interactions that might give rise to such a divergence.

B. Asymmetries of information

More recent efforts to understand the nature of imperfections in the capital market begin with the supposition that the transactors in these markets, like those in other markets (and perhaps even more *so),* behave sensibly and with foresight to serve their own best interests. Nonetheless, capital markets do differ in important ways from many textbook commodity markets. First, informational asymmetries are likely to be rampant in this market. Borrowers are bound to

know more about the nature of the venture that is being contemplated, including its riskiness and the likely returns under alternative scenarios, than are lenders. Also, borrowers should be able to make a good assessment of their own abilities to undertake the proposed ventures, whereas the lenders can only guess whether they are dealing with an individual or firm with the skills needed for success.

These asymmetries of information would make little difference to lenders if debt contracts could require repayment of principle and interest under all contingencies. For then the lenders would need no information about the likely success of the venture. It would be enough for them to quote an interest rate equal to the opportunity cost of funds and then accept all loan applicants at that rate. The second important feature of modern credit markets, then, is the protection afforded by the state under limited liability statutes. These provisions of the law make bankruptcy an option for the unsuccessful firm, and *so* expose the lenders to risk even when their contracts with the borrowers call for repayment on fixed terms.

To understand the consequences of limited liability in situations of asymmetric information, consider a firm that seeks to finance its entry into some new activity. Following Stiglitz and Weiss **(1981),** suppose to begin with that the firm has better information about the riskiness of the project, but that both the firm and the lender (call it a "bank") can assess and agree upon the mean return that the project would yield. The bank knows that it must charge an interest rate that yields on average a competitive rate of return after allowance is made for any risk of default. It should recognise, moreover, that an offer of a loan at a relatively high interest rate will elicit acceptance only by those who know the project to be especially risky. The reason for this is as follows. A project with greater risk is one with a higher probability of an especially good outcome, but also a higher probability of a particularly unfavourable outcome. The more favourable outcome adds to the return of the borrower, who keeps everything after principle and interest are paid. But the especially bad outcome does not cost the borrower anything extra compared to the outcome which is sufficiently unfavourable to induce bankruptcy. The most that the borrower stands to lose in any event is the value of his collateral. *So,* the bankruptcy option implies that, for given average gross return to a venture, the average net return that accrues to the borrower increases when the risk associated with a project becomes greater. As a result, firms that know the project to be of low risk may decline a loan at some relatively high interest rate, when firms that know it to be of high risk would be willing to accept the terms.

This adverse selection problem leads the bank to raise the cost of funds beyond the rate appropriate to its initial assessment of the risk, since it recognises that the debt contract will self-select those potential borrowers who know the project to be especially risky. Flam and Staiger **(1989)** have shown that, in this case, the private cost of funds must exceed their social value. Intuitively, an

interest rate subsidy would induce acceptance of the loan by all borrowers who would have paid the higher rate, plus a few more. Compared to the firms who would have borrowed at the higher rate, the new borrowers are those with private information that the project actually is not so risky. Since the marginal project that goes forward due to the subsidy is, in this sense, better than the average from before, the subsidy (financed by lump-sum taxes) augments social surplus when there are asymmetries of information of this sort.

It is important to note that this argument for intervention does not rest on the ability of the government to identify the less risky ventures, since the government indeed is quite unlikely to have access to information that is better than that available to credit analysts in the investment banks. If the Flam-Staiger argument applied without regard to the exact nature of the risks and distribution of returns among potential market participants, then it might be concluded that realistic aspects of credit markets together with the especially large financing requirements of new industrial activities conspire to bias the market allocation against these dynamic sectors.

However, the issue is not *so* straightforward. In related research, DeMeza and Webb **(1987)** and Sen **(1989)** have studied credit markets with asymmetries of information of a slightly different sort. In their formulations, projects either succeed or fail. Successes yield some return that is common knowledge to the borrower and the bank, while failures result in default and losses for the bank. Borrowers are assumed to have private information about their own probability of success that is more accurate than the information available to the bank.

As before, the bank must take into account its informational deficiency. It charges an interest rate *so* that, among those whom it expects to accept the loan, the expected interest payments are sufficient to compensate for the likely number of defaults. But now, since the size of the gains under success and of the loss under failure are the same for any pair of borrowers, the expected net returns are higher for the borrowers who are more likely to succeed. Thus, it is the potential entrants with more favourable information who are the first to accept any given interest rate offer. An interest rate subsidy, then, attracts marginal borrowers who are less attractive from society's point of view than the average, and *so* reduces total surplus. In fact, an interest rate tax would enhance efficiency in these circumstances.

Where does all this lead us in our quest for practical policy advice? Asymmetries of information in credit markets justify selective interest rate subsidies only in cases where it is felt that the market mechanism systematically selects those entrepreneurs or potential entrants who, from society's point of view, are the least attractive. To the extent that different potential entrants into some new activity are distinguished mostly by the riskiness of their potential returns and not in the expected value of that return, then the existence of bankruptcy laws and the possibility of default give reason to suspect adverse selection. But when firms

differ in their management talents or in venture-specific skills in some unobservable ways, then not only variance, but also mean rates of return, are likely to vary across potential entrants. It may be difficult if not impossible for the government to know ex ante whether to encourage or discourage investments in some new activity to compensate for the biases stemming from imperfections in private capital markets. As with the case of strategic entry promotion discussed in Section I.C above, a cautious policy response to alleged capital market imperfections seems advisable.

V. REPUTATION FOR QUALITY AS A BARRIER TO ENTRY

A further barrier to entry into new industrial activities arises in markets where consumers are imperfectly informed about product attributes. Consumers may not be able to judge perfectly the quality of a sophisticated, modern product merely by inspecting it on the shelf or by reading the available technical literature. Then newcomers in the market may be hampered in their efforts to compete with incumbents, because they lack the reputation for quality merchandise that the incumbents have developed already.

This type of barrier to entry need not be complete, in the sense of precluding all entry by latecomers, though in some cases it will be. More often, producers with highly competitive products will be able to establish themselves after a period of investment in their reputation, for example by initially offering their products at low prices. But imperfect information on the part of consumers will mean that competitive products emerge only slowly, with market shares exhibiting more inertia than price and quality comparisons between the new and established products would seem to justify. And some firms that are only marginally competitive, who would be able to enter the market and make a small profit if consumers were fully informed, may be kept out entirely.

I analyse the incentives that firms have to enter new markets and invest in their reputations. Suppose that consumers initially do not know what quality product a potential entrant into some new activity would provide. However, suppose that the firm does have a familiar brand name and trademark, or that it has the potential to establish these via advertising. Brand name recognition together with trademark protection make feasible a strategy of investing in a reputation[19]. A firm can gain a reputation as a purveyor of high-quality goods if it supplies such products to the market for a while. However, investment in reputation is costly to the firm, since high-quality products often cost more to produce than lower quality wares, and consumers will initially be unwilling to pay a premium for the (unknown) quality.

To keep matters simple, I assume initially that consumers expect the quality offered by a new producer to be either "high" or "low." These expectations accurately reflect the proportion of producers in the country that could supply goods of each type. For a firm that knows the true calibre of its merchandise to be "high," two strategies are available in order to establish its reputation. The firm might charge a price commensurate with the average level of quality as perceived by consumers, and so induce them to bear the risk of trying an unknown product. But the requisite price for entry by this route may be quite low, if the quality of the shoddy products is very low or if there are a large number of potential fly-by-nights. In this case, the high-quality firm might not be able to recoup its investment in its reputation. Alternatively, the firm might charge an introductory price low enough to convince consumers that only a firm that plans to remain active in the market could possibly make such an offer. But to be convincing this offer must fall below the cost of production of the fly-by-nights, and again this price might be too low to allow recoupment of the firm's investment. Thus, the mere potential for entry by poor-quality producers confers a negative externality on firms that would wish to enter and develop their reputations.

What then might the local government do to overcome this externality? Bagwell and Staiger (1988) have studied the case of attempted entry by domestic firms into an export market and show that an output subsidy might improve welfare as follows. The subsidy will induce both the high-quality producers and the fly-by-nights to enter the market. Foreign consumers will pay a price commensurate with average quality, and so will enjoy the same surplus as before. The prescribed subsidy will be just sufficient to induce entry by the high-quality producers, and so these firms will earn positive profits, and these can exceed the subsidy cost. If so, the home country enjoys an improvement in its welfare due to a profit-from-entry-effect.

However, Grossman and Horn (1988) show the fragility of this policy advice. They consider a situation where firms' products are not of high or low quality as a fact of nature, but product attributes are the consequence of explicit choices. Some firms may have lower cost in providing higher quality products and so will have greater incentive to do so. But every firm may elect to degrade the quality of its product if it can thereby augment its profits. Suppose that consumers initially form an expectation about the likely quality of a domestically produced good based on their assessment of the number of potential producers of each type and of the incentives that they perceive each to face. Thereafter, each domestic firm can establish a reputation by selling products of a given quality for a while. Then in an equilibrium without government policy some firms will enter and invest in their reputations, while others will free ride by selling shoddy products during the phase where consumers are uninformed. An informational externality is once again present and serves to retard industry expansion relative to the counterfactual with perfect information.

But the policy implications of the Grossman-Horn analysis are strikingly different from those of Bagwell and Staiger. A subsidy to output during the industry's infancy does not change the ***relative*** incentive that any firm has to produce a high-quality product rather than a low-quality product. This is *so* because the subsidy is collected no matter which type of good is produced[20]. The subsidy does encourage entry. However, the marginal entrants are those with the highest production costs among those that enter the market, and *so* are the ones with the greatest incentive to produce low-quality goods. The output subsidy thus serves to reduce average quality. Grossman and Horn show that, for the case of infant domestic producers competing with established imports in the domestic market, a subsidy generally reduces domestic welfare. Home consumers suffer a loss in surplus due to the downgrading of quality induced by the subsidy. In fact, a tax on domestic output would alleviate the informational externality and *so* improve welfare. If the infant home producers are instead exporters to a new foreign market, the surplus of foreign consumers is of no consequence for domestic well-being. In this case, neither a tax nor a subsidy to output or trade can be used to raise total surplus.

I conclude that output subsidies or trade policies, which affect only the price that a firm receives for its product, are not well suited for solving informational externalities when firms have the ability to establish reputations. Informational externalities arise in these situations only because the firms that wish to invest in their reputations find an increased cost of doing *so* in the presence of potential free riders. Price-based policies do not help the firm distinguish itself from the free riders during the infancy phase, and *so* may fail to solve the market failure. What is needed are policies that provide a ***differential*** incentive for firms to produce goods of high rather than low quality. Examples of such policies might include minimum quality standards for some products, and perhaps greater government involvement in the enforcement of warranties.

VI. CONCLUSIONS

Popular support is rising in Europe and North America for an industrial policy that would encourage the entry of national firms into new industrial activities. The activities that proponents have in mind are primarily technology-based and skilled-labour intensive. They are the industries that seem most likely to experience rapid growth in the coming decades.

Some of the arguments stem from the misguided belief that principles of comparative advantage do not apply in a dynamic world. More sophisticated analysts recognise that the markets provide agents with incentives to invest in the

future, and *so* the mere likelihood of future growth is no reason in itself for governments to intervene in the process of resource allocation. These analysts have sought instead to identify potential failings in the market mechanism for allocating resources to new activities, and to prescribe remedies for these failures. I have reviewed a number of such economically-based arguments in the preceding sections. The arguments rely on the alleged importance to modern industrial competition of economies of scale, of learning-by-doing, of externalities stemming from R&D, production experience, on-the-job training and demand linkages, and of imperfections in capital and product markets due to asymmetries of information. In each instance, the aim was to evaluate the logical merits and empirical relevance of the case for government action and to identify an appropriate policy response where a need for intervention was indicated.

Several common themes emerge from the analysis. First, arguments in favour of government subsidies to particular new activities rest on detailed qualitative descriptions of the marketplace and often on specific parameters that describe conditions there. These arguments do not apply across the board, nor is there any presumption that the prerequisites for intervention to be beneficial will be satisfied for a majority of high-technology ventures. The nature of the problem makes case-by-case analysis unavoidable.

Second, output subsidies and trade policies often are not the proper instruments for correcting the most common market imperfections. These policy tools are simply too blunt for effecting the needed market corrections, inasmuch as they fail to differentiate among the types of firms that they support and fail to attract to the industry especially those resources that are underprovided by the market. When market activity is too low relative to an efficient outcome, it is because the active and potentially-active firms fail to appropriate all the benefits from some aspect of their operation. Corrective government policy should be targeted to the particular activity that generates positive spillovers, and should not merely encourage firms to produce more output. Only if the externalities are a by-product of production per se will output subsidies be the policy instrument of choice. In all other cases such intervention will at best provide benefits that are less than might otherwise be attained, and at worst will fail to promote the desirable objective at all.

Third, policies that require government revenue should only be invoked when the potential efficiency gains outweigh the costs of raising the necessary funds. When lump-sum taxes are available to the government, a dollar of revenue can be raised at a dollar of social cost, and then targeted subsidies ought to be invoked whenever their direct impact on the allocation of resources is positive. But real world taxes are far from lump sum in nature. Empirical research has established the existence of a non-negligible excess burden in raising government revenue. Such research suggests that governments ought to pursue a conservative bias in their use of subsidies.

Fourth, few of the valid arguments for intervention rely explicitly on the existence of international competition. Where growth of some new activity is too slow, it often is so for the world as a whole. Rarely does the national identity of the new firms matter for the argument. The exceptions to this rule are arguments in favour of strategic promotion of domestic interests in their competition with foreign rivals. These arguments have been shown to be especially sensitive to the details of market structure and conduct and to rely on information that the government is not likely to have at its disposal. Moreover, strategic interventions seek gain at the expense of trade partners, and so invite retaliation. When countries head down this road, mutually harmful subsidies or protection can easily be the outcome. Countries may need on occasion to invoke strategic trade policies to safeguard their interests, but the ultimate goal in all cases ought to be a co-operative outcome in which all parties desist from pursuit of strategic gains.

Finally, from the limited empirical evidence available to date, it appears that the strongest case for government intervention may arise in the early stages of development of a new, technologically-innovative product. When the introduction and improvement of a new product involve substantial research outlays and costly learning-by-doing, private firms often are unable to capture more than a fraction of the benefits they create for consumers and for other firms in the industry. As a result, innovations in the markets for computers, for CAT scanners, for nuclear power plants, and probably for many other innovative products have taken place at an inefficiently slow pace. A strong case can be made for government support for research and development, and for favourable tax treatment of operating losses, during initial stages of a new product's history. It will, of course, be difficult for the policy analyst to identify the deserving innovations and to delimit the period of government support to the time when substantial externalities are being generated. But the magnitude of the foregone gains that have been estimated for several industries suggest the existence of a margin for error.

One last caveat is in order. In any public policy program the parties that stand to benefit from government support have more than ample incentive to plead the merits of their own cases. The success of an industrial policy program hinges as much on the protection that it builds into the process to prevent it from being co-opted by interested parties as it does on the ability of economists and policy makers to identify market failures and to propose appropriate remedies under idealised analytical conditions. The potential societal gains from an activist policy can easily be sacrificed if opportunities for wasteful rent seeking are created or if the criteria for selection becomes the political clout of the applicant rather than the economic merits of the case.

NOTES

1. Surplus analysis takes a partial equilibrium perspective. The analyst ignores feedbacks from the targeted sector to others in the economy via induced changes in factor prices. When a policy instrument directly affects a number of sectors (e.g. an economy-wide minimum wage, a capital levy, or an across-the-board import duty), or when an industrial policy targets a critical sector in the economy, a proper welfare analysis requires a general equilibrium approach. Such an approach takes explicit account of, for example, the factor-market linkages between sectors.
2. The social cost of resources may differ from the private cost to firms if the resources are engaged in activities that generate spillover benefits or costs to other producers. This possibility is discussed further below.
3. If non-tariff barriers are used to drive a wedge between domestic and international prices, then the penultimate term represents the rents created by trade policy. This term still comprises part of total industry surplus, provided that the rents accrue to domestic agents.
4. Of course, if the country is an importer of the good in question, then a subsidy to output or a barrier to imports could, to the extent that it reduces the world price, improve the home country's welfare. This is the well known "optimal tariff argument." In the case described in the text, the argument indicates the optimality of an export tax.
5. If the "optimal" targeted intervention requires government outlays, then taxes for this purpose must be raised by non-distorting lump-sum levies. If such levies are not feasible, as is likely to be the case, the benefits from correcting the market distortion must be weighed against the welfare cost of raising the requisite funds.
6. A per unit subsidy to output provides even greater efficiency gains in this case, because it both induces entry and entices the firm to expand output beyond the restricted, monopoly level.
7. In the figure, for example, if Firm 1 produced under cost conditions similar to those of Firm 2, then its monopoly profits would be FGKJ. In a duopoly this firm suffers losses equal to EBCD. Therefore, the negative profit-capture effect is the sum of the areas EBCD and FGKJ.
8. Horstmann and Markusen point to some evidence for Canada that suggests that too many firms are active in many protected industries. Thus, industry "rationalisation" is considered to be one of the major benefits that can emerge from the removal of protectionist barriers and elimination of other policies that promote local production.
9. See Horstmann and Markusen (1986) and Dixit (1986), who discuss the problem of rent dissipation in the context of a critique of strategic subsidies to established, oligopolistic competitors.
10. The argument for a strategic industrial policy in support of local firms engaged in global oligopolistic competition is made in Brander and Spencer (1985). Eaton and Grossman

(1986) were the first to point out some of the caveats. More far ranging critiques are provided in Grossman (1986) and Helpman and Krugman (1989).

11. For a discussion of the pros and cons of counterfactual simulation models, see Richardson (1989).

12. They adopt a model of "conjectural variations" in which firms somehow anticipate instantaneous responses from rivals to their own unobservable actions. Such models have been criticised in the theoretical literature on industrial organisation for their attempt to capture what is, of necessity, a dynamic concept (the notion of "reaction") in an inappropriate, static framework. In any event, the parameters reflecting the size of the anticipated response cannot be observed or measured by the authors, so they assign values to three of the four parameters in their calibration process. The fourth cannot be disentangled from the policy parameter which they wish to estimate, so they set its value arbitrarily.

13. In Grossman and Helpman (1989*a*), the international dissemination of new knowledge plays a central role in the determination of the long-run growth rate of trading partners.

14. Bernstein and Nadiri (1988, 1989) have conducted similar studies of R&D externalities in the United States. They find evidence of both intra-industry and inter-industry spillovers in the five industries they have examined, with social rates of return exceeding private rates by amounts ranging from 20 to 900 per cent. In all cases, larger spillovers, *ceteris paribus,* reduce the rate of R&D investment by individual firms.

15. Again, this statement presumes that the government has access to lump-sum taxes to raise the needed revenue. Otherwise, the externality benefit must be weighed against the social cost of the subsidy funds.

16. See, for example, Abraham and Medoff (1980).

17. Related work by Murphy, Schleifer and Vishny (1988) studies a different co-ordination problem. These authors formalise the Rosenstein-Rodan (1941) argument for a "big push" in industrialisation. When industry is characterised by scale economies in production and demand spillovers exist because monopoly profits feed aggregate demand, it may not pay for any one firm to enter a small LDC market. However, if many firms enter at approximately the same time, aggregate demand will be high enough to justify their co-ordinated action.

18. Zimmerman (1984) notes that experience in constructing nuclear power plants provided not only the learning-by-doing benefits described above, but also considerable information about what construction costs could be achieved.

19. Some authors writing about infant industries in less developed countries have assumed, on the contrary, that firms cannot distinguish themselves from compatriot producers of similar products. Then consumers in foreign markets form an overall impression about the quality of the new products emanating from the country. If that impression is unrealistically pessimistic, each export sale conveys positive information that benefits them all. Mayer (1984) has shown that an export subsidy raises welfare in this context. Chiang and Masson (1988) consider the incentives that firms have to improve the quality of their output when their reputation is shared, and show that the informational externality leads each to supply a quality that is too low. They suggest several policy remedies including minimum export quality requirements and government encouragement of industry consolidation.

20. I assume that the government cannot distinguish in its subsidy policy among producers of high- and low-quality goods, for otherwise it could solve the informational externality simply by taxing sales of low-quality goods.

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