The case for industrial policy: a critical survey*

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Abstract: What are the underlying rationales for industrial policy? Does empirical evidence support the use of industrial policy for correcting market failures that plague the process of industrialization? To address these questions, we provide a critical survey of the analytical literature on industrial policy. We also review some recent industry successes and argue that only a limited role was played by public interventions. Moreover, the recent ascendance of international industrial networks that dominate the sectors in which LDCs have in the past had considerable success, implies a further limitation on the potential role of industrial policies as traditionally understood. Overall, there appears to be little empirical support for an activist government policy even though market failures exist that can, in principle, justify the use of industrial policy.

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1. Introduction

Many nations in recent years have encountered great disappointment with the results of pursuing conventional economic policies that Williamson crystallized and named the Washington Consensus. Although few countries ever followed the pristine form of this consensus, some countries in East Asia adhered to many (but hardly all) of its components and experienced extraordinarily rapid growth for a period of three decades or more. Though there was a brief and sharp recession in some of these countries during the crisis of 1997 to 1999, most have rebounded with the exception of Indonesia. Yet other nations that have gotten their macroeconomic and trade regimes much closer to the idealized consensus than the Asian countries did have failed to experience comparable growth. In many Latin American nations and in some African ones as well, there is an understandable search for the magic bullet and many policy makers have expressed interest in some form or other of industrial policy.

Few phrases elicit such strong reactions from economists and policy-makers as *industrial policy*. As Evenett (2003) notes, industrial policy means different things to different people. According to us, industrial policy is basically any type of selective intervention or government policy that attempts to alter the structure of production toward sectors that are expected to offer better prospects for economic growth than would occur in the absence of such intervention, i.e., in the market equilibrium. Given this definition, it is not surprising that those who believe strongly in the efficient working of markets view any argument in favor of industrial policy as fiction or, worse, an invitation for all types of rent seeking activities. On the other side, people who believe market failures are pervasive think that any path to economic development requires a liberal dose of industrial policy.

In this paper, we address arguments for and against industrial policy and then ask whether empirical evidence helps settle the debate in favor of one group or another. While there certainly exist cases where government intervention co-exists with successes, in many instances industrial policy has failed to yield any gains. The most difficult issue is that the relevant counterfactuals are not available. Consider the argument that Japan's

industrial policy was crucial for its success. Since we do not know how Japan would have fared under laissez-faire, it is difficult to attribute its success to its industrial policy. Maybe it would have done still better in the absence of industrial policy or maybe it would have done much worse. Given this basic difficulty, we can only hope to obtain indirect clues regarding the efficacy of industrial policy. Direct evidence that can `hold constant' all of the required variables (as would be done in a well specified econometric exercise) simply does not exist and it is unlikely that it will ever exist – perhaps that is why the debate over industrial policy has remained unsettled and may remain so in the future.

The paper is organized as follows. In section 2 we critically analyze the major conceptual arguments in favor of industrial policy. Since the infant industry argument for trade protection anticipates most of the rationales for industrial policy, we begin with an extensive discussion of this argument. Then, in section 3, we examine how the case of India's successful software industry fits into the arguments for industrial policy. In section 4, we ask how the expansion of international production networks has altered the case for industrial policy. In section 5, we provide some concluding remarks where we also comment on the issue of 'policy space.'

2. Why industrial policy?

At a general level, there is room for government intervention either when markets are characterized by some distortions (such as externalities or market power) or because they are incomplete (for example futures markets for many goods simply do not exist). As is known from one of the basic theorems of welfare economics, under such *market failures*, a competitive market system does not yield the socially efficient outcome. In the end, any argument for industrial policy is a special case of this general argument.

Three specific arguments in favor of industrial policy have received the most attention. The first is derived from the presence of knowledge spillovers and dynamic scale economies; the second from the presence of coordination failures; and the third from informational externalities. Before discussing these arguments in detail, it is useful to begin with the rather well known infant industry argument for trade protection since in many ways it is a precursor of modern arguments for industrial policy.

A. The infant industry argument: a precursor of modern industrial policy

The infant industry argument is one of the oldest arguments for trade protection and is perhaps the only such argument that is not dismissed out of hand by trade economists. The most popular (and the simplest) version of the argument runs as follows. Production costs for newly established domestic industries in a country may be initially higher than those of well-established foreign competitors due to their greater experience. However, over time, domestic producers can experience cost reductions due to learning by doing (i.e. they enjoy dynamic scale economies) and can end up attaining the production efficiency of their foreign rivals. However, if the fledgling domestic industry is not initially protected from foreign competition, it may never take off. Furthermore, if dynamic scale economies are strong enough, temporary protection of the domestic industry can be in the national interest.

A stronger version of the argument states that the domestic industry might even be capable of attaining production costs below its foreign rivals if it is given sufficient protection. In this version of the argument, true comparative advantage lies with the domestic industry and temporary protection can actually be in the global interest since consumers in the rest of the world also benefit from the eventual lower production cost of the domestic industry. In an influential paper, Baldwin (1969) provided an incisive criticism of the infant industry argument. He argued that "if after the learning period, unit costs in an industry are sufficiently lower than those during its early production stages to yield a discounted surplus of revenues over costs (and therefore indicate a comparative advantage for the country in the particular line), it would be possible for firms in the industry to raise sufficient funds in the capital market to cover their initial excess of outlays over receipts."

As Baldwin (1969) points out, if future returns indeed outweigh initial losses, capital markets would finance the necessary investment needed by the domestic industry. It is obvious, but worth stressing, that if future returns fall short of initial losses, the industry should not be established in the first place. A frequently cited counter to Baldwin (and one that he acknowledged) is that capital market imperfections might prevent the infant industry from being able to obtain the required financing. For example, a proponent might appeal to the presence of informational asymmetries: unlike producers, investors

may not know that the industry is profitable in the long run and therefore fail to provide the capital needed to cover the initial costs. However, such an argument defies credibility since it requires one to believe that firms that have not even begun to produce the good in question know more about their prospects than those whose main objective is to find profitable uses for their excess capital and have previously analyzed and financed similar projects. Even if one grants the presence of asymmetric information, why cannot potential producers convey such information to likely investors?

While the infant industry argument assumes that it is known with certainty that the industry in question will eventually be profitable, it seems more likely that the prospects for most new industries are uncertain and *no one* really knows whether or not a particular infant industry will in fact be profitable in the future. Under such circumstances, capital markets would require compensation for the risks involved and the interest rates required might make the investment unprofitable. But efficiency requires that those bearing risks should be compensated and there is no market failure if the underlying problem is that investors do not provide the necessary capital because they perceive the rewards to be not commensurate with the risks they are asked to bear.

Nevertheless, the assumption of omniscient financial intermediaries should be viewed with some degree of skepticism. From early bubbles such as the tulip mania to the internet bubble of the late 1990s it is clear that financial actors are often deficient. In the case of Asian countries that suppressed the financial sector and directed loans to specific industries and firms as a part of industrial policy, the banking sector was itself in need of significant improvement in operating procedures much as industrial firms were. Thus, the argument that if there were opportunities they would be exploited by investors might be a weak link in Baldwin's argument. On the other hand, it also implies that any selective economic policies would have to simultaneously address the weakness of the financial sector along with that of manufacturing or other services. Indeed there might be an argument for initially strengthening the banking sector, perhaps by allowing foreign financial intermediaries into the country, before pursuing targeted sectoral policies. In any case, as Baldwin notes, if there indeed is a problem with capital markets, policy ought to target that specific problem as opposed to resorting to trade protection. In today's world of global capital markets, the simple version of the infant industry

argument runs into another difficulty: investors ought to be able to determine the prospects for the domestic infant industry from the experience of foreign producers. If domestic investors lack such information, surely foreign investors ought to have it. Why cannot the borrowing be international rather than local? A potential answer to this question is that investors may believe that just because an industry has succeeded abroad does not necessarily imply that it will also succeed at home. But this explanation can be consistent with the very hypotheses underlying the infant industry argument only if investors are not fully rational.

What light has formal analysis shed on the infant industry argument? A seminal paper by Bardhan (1971) noted that the infant industry argument is dynamic in nature and that "any elaboration of this idea involves explicitly dynamic analysis, and it has hardly been integrated into the main corpus of trade theory which is mostly comparative-static in nature." Bardhan (1971) provides the first dynamic model of learning by doing (LBD) in an open economy and derived the optimum *extent* and *time path* of protection to the learning industry. In his model, there are two goods *c* and *m* and two factors of production capital and labor with constant returns to scale in production of both goods. The learning effect is assumed to depend upon the cumulated volume of industry output in good *m* and it shifts out the production function for the good in a Hicks neutral fashion.[1] Bardhan models LBD as a classic Marshallean externality: the higher the cumulative output of the industry, the more productive the technology of each individual firm. When learning is unbounded, Bardhan shows that it is socially optimal to subsidize the infant industry and that the time profile of the optimal subsidy depends upon initial conditions, However, his framework does not capture the idea that international spillovers may partially *substitute* for domestic learning since the learning effect function contains the stock of domestic and foreign outputs as separate arguments and the relationship between the two is not really considered.[2]

Succar (1987) extends Bardhan's (1971) analysis to allow the learning in one

[1] Bardhan's model is in the spirit of the original learning-by-doing model of Arrow which posited learning that occurred in the machine producing sector. Some of the endogenous growth literature also posits such effects. However, much of the literature on technological innovation summarized in Evenson and Westphal (1995) and Ruttan (2002) shows that learning can occur in all sectors, a fact that makes would enormously complicate the results of much of the literature.

sector to generate spillovers for both sectors thereby providing an *inter-industry* spillover rationale for the infant industry argument. However, the presence of such economies is not sufficient to justify intervention. As Succar notes, the discounted stream of productivity gains generated by LBD in the infant industry should outweigh the discounted stream of subsidies or else intervention is socially undesirable.[3] The intuitive idea underlying Succar's model is that the production of capital goods can enhance growth by acting as an "informal learning center where technical skills are required" thereby contributing to a country's technical infrastructure.[4] Such improvements in the skill base of workers complement investments in human capital and can help further the industrialization process in developing countries.

The distinction between firm and industry level LBD becomes quite important when one considers the fact that firms are heterogeneous in nature. Suppose some firms are more efficient at learning than others. Under such a scenario, optimal subsidies would necessarily have to be non-uniform and the government is unlikely to possess the information needed to implement an optimal subsidy program. Given the information problem, it might make sense for the government to adopt a uniform policy even though it may not be first best. While in theory one can design mechanisms that result in firms revealing their learning capabilities but the practical relevance of such mechanisms is far from clear.

As one might expect, there is more to the infant industry argument than the 'simple version' formalized by Bardhan and Succar. As Baldwin notes, notes that there are four versions of the infant industry argument that are a bit more nuanced: (a) acquisition of knowledge involves costs but yet knowledge may not be appropriable by an individual firm - this is the standard argument for subsidizing R&D; (b) firms may provide costly on-the-job training but may be unable to prevent the diffusion of such knowledge via movement of workers (i.e. there might be a free-rider problem in worker training) - while firm specific training involves no potential externality, general training

[2] Pack and Saggi (2001) explore the implications of the provision of free technology by the purchasers of a firm's exports, a further complication.

[3] It is *not* likely that this criterion has been satisfied by the European Airbus effort, widely considered a major example of a successful industrial policy. Furthermore, one also needs to account for the cost of distortions that are generated by the taxes needed to finance the subsidies paid.

can lead to externalities that would justify subsidies; (c) static positive externalities in the production of a good may justify trade protection and (d) determining profitability of a new industry might require a costly investment the results of which may become freely available to potential competitors – in other words, investment into new industries might result in *informational externalities* that make it difficult for investors to earn a rate of return that is high enough for the initial investment to be justified. This is precisely the argument that has been formalized by Hausmann and Rodrik (2003) although they call it the process of 'self-discovery' – i.e. the process of determining what you can produce profitably at world prices.

The infant industry argument does not really specify how learning occurs – i.e. it just assumes that dynamic scale economies will be somehow realized by the infant industry. Of course, learning is rarely exogenous and it usually requires considerable effort and investment on the part of firms (Pack and Westphal, 1986). If such investments are to be made, firms need to be able to appropriate the benefits of the knowledge gained. As is well known, knowledge is a non-rival good and, once created, any number of agents can use it simultaneously. If firms cannot prevent the leakage of knowledge that is costly to create, then they will have little incentive to create such knowledge in the first place. In other words, property rights over knowledge may not be enforceable and this can create a rationale for government intervention (this is one reason why we have intellectual property rights protection).

As Baldwin (1969) notes, many types of knowledge acquisition are not subject to the externality described above since entrepreneurs can often prevent the leakage of their knowledge to potential competitors. Similarly, if there are only a few firms in the industry, inter-firm negotiations should help offset the externality problem (see Coase, 1960). But what if many rivals firms benefit from the investment undertaken by a knowledge acquiring firm and nothing can be done to prevent such diffusion? Is government intervention justified then? As is clear, trade protection is certainly not called for – a tariff does nothing to solve the basic externality problem. In fact, trade protection may very well worsen the problem. A production subsidy to the entire sector will also fail

[4] Succar's emphasis on the capital goods sector is similar in spirit to Arrow's learning by doing model and endogenous growth models such as Romer's (1986) model that employed it as a building block.

to remedy the externality. Instead, what is needed are subsidies to initial entrants into the industry that help create new knowledge and discover better production technologies. As in the case of R&D subsides, governments should target the marginal rather than inframarginal research. In the case of new firms, it takes time to discover whether a new idea or technology is socially valuable and the adoption of a novel technology by others is in fact the strongest proof of its social value. Thus, such a policy of rewarding early entrants requires an accurate forecast of the social value of their inventions and discoveries – a process that can be fraught with failure. Not only that, given the uncertainty associated with new technologies, a delayed pattern of adoption might even be socially optimal.

A. Knowledge spillovers, dynamic scale economies, and industrial targeting

Ever since David Ricardo, it has been well known that under free trade a country can increase its national income (and welfare) by moving resources into sectors in which its opportunity cost of production is lower than its trading partners. But is this prescription sufficient to generate economic growth? Perhaps not. Allocating resources according to comparative advantage can only ensure static efficiency and in no way guarantees dynamic efficiency. Succar (1987) argues "…the comparative advantage theory is a static construct that ignores forward linkages exist between present choices and future production possibilities. Therefore it cannot guide the pattern of international specialization when there are asymmetric learning opportunities associated with the production of different goods and/or use of certain techniques. Promotion of industries which generate substantial learning by doing economies should be an integral part of a strategy of human capital formation in LDCs." In other words, Succar argues for some sort of *industrial targeting* although her model does not explicitly deal with this issue.

Even if one accepts the premise that certain industries are more likely to generate spillovers (based on knowledge diffusion or other factors), can policy be designed to encourage the 'right' industries? The ideal but rarely attained goal of industrial policy is the development of a general-purpose technology. DARPA, a small unit within the U.S. Department of Defense that generated and financed a portfolio of projects, is widely credited with having been the key contributor to the development of the internet, the demand for this innovation being derived from the need to maintain communications

during an assault on the U.S. This breakthrough was clearly fundamental and has social benefits many-fold the cost of the DARPA effort. This instance of success addressed a market failure, namely, the social benefits of research were much larger than the anticipated private benefits. Moreover, DARPA foresaw a potential need that may have escaped the purview of private firms. While the internet was a major technological breakthrough and suggests the potential gains from such an activity, it is useful to remember that, by their very nature, the discovery of such "general purpose technologies" is a rare event and less likely in low innovation intensity developing nations than in research rich developed countries.

The informational constraints facing policy-makers pursuing industrial policy are severe and any realistic model of industrial targeting needs to account for them. In a recent paper, Klimenko (2004) models industrial targeting as an optimal experimentation strategy of a government that lacks information about the set of industries in which the economy has comparative advantage with respect to rest of the world. He examines the set of industries in which a country will specialize as a result of such policy. In his model, for any set of targeted industries, it is possible to know whether or not a country will specialize in this set with positive or zero probability. He shows that an optimally designed industrial policy can actually lead a country to specialize in sectors in which it does *not* have comparative advantage. Depending on the beliefs of the policymaker, a country can end up abandoning the industries in which it has "true" comparative advantage.

Furthermore, Klimenko argues that the policy-maker may stop looking for better targets when the favored industries perform well enough. He interprets this outcome as a *failure* of industrial targeting policy even though it may not appear as such. In fact, he goes on to show that, despite the existence of market failures, the outcome of the learning process through private experimentation (without any assistance from the government) can even yield outcomes that are closer to the full information social optimum. Klimenko's rigorous analysis of this issue underscores our intuitive argument that the relevant counterfactuals are unavailable and what may appear to be a successful industrial policy may not be the first best outcome from a country's perspective – merely doing something well need not imply one cannot be better at something else.

B. Coordination failures as a rationale for industrial policy

The basic idea behind the coordination failure argument for industrial policy is that many projects require simultaneous investments in order to be viable and if these investments are made by independent agents there is little guarantee that, acting in their own self interest, each agent would choose to invest.[5] As Scitovsky (1954) noted, *reciprocal pecuniary externalities* in the presence of increasing returns can lead to market failure because the coordination of investment decisions requires a signaling device to transmit information about present plans and future conditions and the pricing system is not capable of playing this role.

Pack and Westphal (1986) argue that such pecuniary externalities related to investments in technology are pervasive in industrialization. They provide an example of two infant industries (say A and B) where industry A produces an intermediate that is required in industry B and neither industry is profitable if it is established alone. However, if both industries are established together, then both are profitable implying that it is socially optimal to indeed establish both. Of course, the problem is that without explicit coordination between investment decisions this outcome would not be obtained.

Okuno-Fujiwara (1988) presents a formal model of such interdependence between industries and the coordination failure that can result from such interdependence. He considers an economy with three goods: x, y, and z where good z serves as a numeraire and is produced under perfect competition with constant returns to scale. Good x is produced by a competitive industry and it requires good y as an intermediate. The technology for good y exhibits large economies of scale and the industry is assumed to be oligopolistic where the number of firms is endogenously determined to ensure zero profits in equilibrium. A coordination problem arises in the industry because the derived demand for the intermediate good y depends upon its price, which in turn determines incentives for entry into the intermediate sector. If y-producers anticipate low demand for their good, given the fixed costs of entry, few of them would want to enter implying a higher price for the intermediate which may then make industry x unsustainable – the key assumption here is that the intermediate good y must be locally supplied. On the other hand, if y producers are assured of a high demand for their product, more of them would

[5] Rodriguez-Clare (1996b) has shown that coordination failures can lead to 'development traps'.

enter and such entry would lower its price which would then allow the high demand for the intermediate to be sustained.[6] Okuno-Fujiwara (1988) shows that there is no unique equilibrium in a small open economy with the above production structure. In the *bad* equilibrium, the economy ends up specializing in good *z* where in the *good* equilibrium it produces both goods *x* and *y* and exports good *x* to the rest of the world (where the latter equilibrium Pareto dominates the former).

Turning to policy analysis, Okuno-Fujiwara suggests that three types of traditional government intervention can help ensure that the good equilibrium is realized: (a) the government can provide a production subsidy to either *x* or *y* industry (or both) thereby causing the two sectors to expand or (b) provide an export subsidy to the *x* sector; or (c) shut off international trade. However, he notes that trade protection can be effective only if the autarkic equilibrium production of good *x* is sufficiently large – something that is less likely to be true of small developing countries. In addition to traditional industrial policies (a) and (b), Okuno-Fujiwara (1988) also suggests that the government can play a coordinating role between *x* and *y* producers by facilitating information exchange between them.[7] However, he argues that only *repeated information exchanges* can resolve the coordination failure. It is difficult to believe that policy-makers can effectively execute such information exchange between disjoint industries about whose day-to-day business they may know very little. Furthermore, the above policy prescription suggests a massive role for government intervention in the process of industrialization. It is noteworthy that Okuno-Fujiwara himself is skeptical whether the mechanisms captured by his model and the policy prescriptions that emerge from his analysis had any practical analog in the Japanese experience.

In a paper along the lines of Okuno-Fujiwara (1988), Rodrik (1996) argues that for coordination failures between upstream and downstream industries to exist, it is necessary that there be some type of scale economies in production and that imperfect tradability holds across national borders of some of the goods, services, or technologies

[6] As will be discussed below, good *x* could be produced by multinationals that establish local production, thus obviating the coordination problem.

[7] Much of the effort of MITI and the Ministry of Finance in Japan can be described as the interchange of information among firms and the interaction with the government to reduce any obstacles to the realization of consistent plans. The same is true of French indicative planning of the 1950s and 1960s. As noted

associated with manufacturing. In his model the intermediate good sector is characterized by monopolistic competition rather than oligopoly. Second, he suggests that the nontradable intermediate goods sector should be viewed as representing different categories of specialized skill labor. The idea is that a worker's decision to acquire any skill depends upon demand for that skill and it is indeed quite costly or simply infeasible to import labor services should certain skills be in short supply locally. Like Okuno-Fujiwara (1988), Rodrik (1996) is quite hesitant to offer strong policy recommendations based on his analysis and he concludes that government intervention designed to resolve such coordination failures "must be judged a risky strategy". Thus the World Bank's (1993) well-known report on the East Asian miracle argues that East Asian efforts to coordinate investment decisions led to a number of inefficient industries.

While the theoretical rationale for redressing coordination failure appears to be sound, the argument rests on certain key assumptions, particularly that the organization of production activity is exogenously given. Why would industries whose profitability is so intimately intertwined not find ways to help coordinate decisions as is the case of the many international supply networks (Gereffi and Memedovic, 2003, Sturgeon and Lester, 2002, 2003). For example, vertical integration between intermediate and final goods producers can help resolve some coordination problems although there are clearly limits to the extent to which organizations can adjust their scale and scope in order to solve coordination problems. At some point, all firms have to interact with others via the market. But long-term contracts between firms have been used to solve problems of relation specific investments in many industries. It is not clear why contracts cannot play the same role in the context of coordination failures.

Perhaps the biggest problem with the coordination failure argument is that it relies heavily on the assumption of non-tradable intermediate inputs, partly reflecting the fact that much of the early literature was based on the example of steel and autos circa 1960 rather than the products in which transportation costs for the intermediate are likely to be low. Virtually all of the models make this assumption despite the fact that the majority of international trade is in intermediate goods. Thus, the coordination failure argument runs

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earlier, it is difficult to assess whether such sector specific targeting was successful. For an extensive review of the empirical evidence on Japan, see Noland and Pack (2003).

up against the central fact around which much of the 'new' trade theory has been built (see, for example, Ethier, 1982). This is no small contradiction and if the coordination failure story has to be rescued it needs to appeal to nontradable services as in Rodriguez-Clare (1996a). But the problem then is that the case for industrial policy on the basis of coordination failures is quite thin if inward foreign direct investment (FDI) is feasible and/or permitted. If local firms do not produce sufficient number of intermediates due to coordination failures, why can't they be produced by foreign multinationals that are surely not dependent upon the production structure of any one economy? In small developing countries, a large-scale investment by a multinational can create sufficient demand for intermediates and easily resolve the coordination problem. In fact, this is partly what the literature on backward linkage effects of FDI argues (see Markusen and Venables, 1999 and Rodriguez-Clare, 1996a). It is quite unlikely that multinational firms would be hostage to the type of coordination problems that confront small producers in developing countries. Indeed, the huge growth in the importance of international supply chains established by MNCs has become one of the most visible features of industrial growth in the last decade (Sturgeon and Lester, 2002). In section 2E we further discuss the role multinational firms can play in determining the overall case for industrial policy.

C. Informational externalities

In a recent paper, Rodrik (2004) argues that the traditional view of industrial policy (based on technological and pecuniary externalities) is out-dated and does not capture the complexities that characterize the process of industrialization. His view is that industrial policy is more about eliciting information from the private sector than it is about addressing distortions by first-best instruments. He envisions industrial policy as a strategic collaboration between the private and public sectors the primary goal of which is to determine areas in which a country has comparative advantage. The fundamental departure of this viewpoint from classical trade theory is that entrepreneurs may lack information about where the comparative advantage of a country lies. Or more to the point, at the micro level, entrepreneurs may simply not know what is profitable and what is not.

In the presence of informational externalities, a *free rider problem* arises between initial investors and subsequent ones. Suppose no one knows whether activity x is

profitable or not and the uncertainty can only be resolved by making a sunk investment that cannot be recovered in case the outcome turns out to be unfavorable. If there is free entry *ex post*, no entrepreneur may be willing to make the investment required to discover the profitability of activity *x*: if someone does make the investment and the activity turns out to be profitable, other entrepreneurs will be attracted to the same activity thereby eliminating all rents. It is worth noting that Baldwin's (1969) classic paper anticipates Rodrik's argument almost exactly. He wrote "…suppose, for example, that a potential entrant into a new industry, if he could provide potential investors with a detailed market analysis of the industry, could borrow funds from investors at a rate that would make the project socially profitable. However, should this information become freely available to other investors and potential competitors, the initial firm might not be able to recoup the cost of making the market study….under these circumstances the firm will not finance the cost of the study, and a socially beneficial industry will not be established." Similarly, in the context of adoption of high yielding varieties of crops by farmers in developing countries, Besley and Case (1993) note that late adopters may learn from early adopters when "a technology is of uncertain profitability, some potential adopters may wait until they observe whether others have fared well by using it" and that such "externalities are potentially important in agricultural technology adoption."

Given the importance of this argument for the debate on industrial policy, it is useful to consider the framework presented in Hausmann and Rodrik (2003) in some detail. They consider a small open economy comprised of two sectors: traditional and modern. The production technology in the traditional sector is constant returns to scale and the presence of a fixed factor generates diminishing returns. In the modern sector (that consists of many goods), there are constant returns to scale in production but the cost of production of a good depends upon an unobserved productivity parameter (θ_i) that becomes known only when the production of a good is attempted (something that requires a time period in which resources must be utilized but no production takes place – this is what Baldwin called a 'market study'). Entrepreneurs lack information about the profitability of production of various goods in the modern sector and this information can be obtained only by undertaking a sunk investment.

After uncertainty regarding θ_i is resolved, entrepreneurs compare their production

costs with world prices and produce those goods for which they make monopoly profits (which accrue for length of time *T* -- call this the monopolization period). Of course, once information becomes public (which it does in period three when the monopolization period has elapsed) there is further entry (into goods that yield positive profits) until all profits are competed away to zero.

Hausmann and Rodrik (2003) analyze the laissez-faire equilibrium of the above model and compare it to the social planner's problem in order to derive the market failures that result from the presence of informational externalities. They argue that the market equilibrium is deficient in two respects. First, the level of investment and entrepreneurship delivered by the market does not coincide with the social optimum because the entrepreneurs care only about profits and not about economy-wide benefits of their investment. If the monopolization period is very long, the market economy can actually deliver *too much* investment in the modern sector as opposed to too little. This suggests that in economies where firms face substantial entry barriers, the underinvestment problem noted by Hausmann and Rodrik (2003) is not likely to be serious. For example, the industrial licensing regime pursued by India during the first forty or so years after independence made it quite difficult for firms to enter new markets. And the recent literature on the business climate that emphasizes other factors that discourage investment such as the time it takes to obtain business permits, telephone lines, and other utility hookups further discourages excessive investment in the modern sector (World Bank, 2006).[8] Such barriers should have helped protect rents for those that did manage to enter profitable markets.

The second market failure identified by Hausmann and Rodrik (2003) is that the market equilibrium yields too little specialization – all activities that turn out to be profitable are sustained whereas optimality requires that *only* the one with the highest return be pursued. In other words, in their model, while it is optimal for the small open economy to only produce the good for which the profit margin is the highest, the market solution allows all those that make positive profits to stay in business during the period of monopolization.

[8] If there is concern about excessive investment, some aspects of the adverse business environment may unwittingly be a second best policy.

This result reflects the general equilibrium nature of their model and the fact that they consider a small open economy. To see this, first note that the modern sector draws resources out of the traditional sector and optimality requires that these resources be utilized where they generate the largest profits (which happens in the modern good for which the productivity parameter (θ_i is the highest). Second, since the country's output of a good does not affect world price, one can never have a situation where the mark-ups across different goods are equalized. Clearly, if world prices changed with a country's exports/output, complete concentration in the modern sector need not obtain. A more likely scenario would be that a country should produce higher quantities of modern goods for which it has a more favorable productivity draw and lower quantities of other goods.

Hoff (1997) argues that if initial producers benefit subsequent producers, the case for subsidizing initial producers hinges very much on the assumption that the externalities operate in a deterministic fashion (i.e. do not involve any uncertainty). She constructs a model where initial entrants provide information that is socially valuable by reducing uncertainty for potential followers regarding production conditions. In her model, factors that increase the informational barrier to entry can actually imply a lower optimal subsidy for the infant industry. By contrast, in most existing models, the externalities are assumed to remove all uncertainty as opposed to reducing it. Since Hoff's model is clearly more realistic, it is notable that her results weaken the case for subsidizing an infant industry.

D. The international dimension: role of exports and FDI

For small developing countries, the case for industrial policy is rarely a purely domestic one. International considerations are fundamental in many respects but the role of exports (on the part of domestic firms) and inward foreign direct investment (FDI) has received considerable attention. A potential rationale for industrial policy in the context of exports arises when product quality is unknown to foreign consumers. The informational asymmetry can lead to market failure that can then potentially justify some form of intervention. Adding an explicit process of reputation acquisition may be an objective of policy (Mayer, 1984, Grossman and Horn, 1988). The results differ as the latter focus on reputation acquisition at the firm level whereas Mayer focuses at the country level. In the Grossman/Horn view, Toyota can affect only its own reputation in foreign markets whereas in Mayer's model, the experience with Toyota also determines

how foreign consumers view other Japanese companies such as Honda. The difference matters because returns to reputation acquisition are *appropriable* in the Grossman and Horn model whereas they are not in the Mayer model.[9]

Now we discuss how an argument for industrial policy might arise in the context of FDI. Policy intervention with respect to FDI has a long history and the rationale for such intervention has frequently been the effects of FDI on productivity of local firms via technology transfer as well as linkage effects. The literature on FDI, technology transfer, and linkages has been surveyed extensively in Saggi (2002) and here we confine ourselves to those aspects of FDI that relate intimately to local industrial development and its linkage effects since these correspond quite well to the coordination failure rationale for industrial policy.

There exists a voluminous informal as well as empirical literature on backward linkages. For example, the 1996 issue of the *World Investment Report* was devoted entirely to the effects of FDI on backward linkages in host countries. However, analytical models that explore the relationship between multinationals and backward linkages in the host country are hard to come by. Two prominent examples of such models are Markusen and Venables (1999) and Rodriguez-Clare (1996a). Both models emphasize the demand-creating effects of FDI on the host economy: multinationals generate derived demand for intermediate goods, thereby promoting industrial development of the intermediate goods sector in the host country.[10] As noted earlier, a common problem with analytical models in this area (as well those dealing with coordination failures) is the assumption that intermediates are nontradable. These models assume no trade in intermediates and then use FDI as the channel that either provides some of those intermediates or increases demand for local intermediate goods producers. As a result, they are likely to overstate the impact of multinationals on industrial development.

Mexico's experience in the automobile industry is illustrative of how FDI can

[9] The complexity of these issues is underlined by the fact that still other conclusions are reached by Bagwell and Staiger (1989) who argue that if asymmetric information blocks the entry of high quality firms, export subsidies can improve welfare by breaking the entry barrier facing high quality firms. Thus, whether or not an export subsidy is desirable hinges very much on the nature of the distortion that is caused by the presence of asymmetric information.

[10] It is worth nothing that if production is intended primarily for a protected domestic market, local suppliers, especially if there are local content requirements, may have costs above world prices, raising the possibility that greater linkages may lower the value of domestic output.

contribute to industrial development in the host country though Mexico's favorable experience was facilitated by the NAFTA agreement. (Laderman, Maloney, and Serven, 2003). Initial investments by US car manufactures into Mexico were followed by investments by not only by Japanese and European car manufacturers but also by firms who made automobile parts and components.[11] As a result, competition in the automobile industry increased at multiple stages of production thereby improving efficiency and Mexican exports in the automobile industry boomed. The pattern of FDI behavior in Mexico (i.e. investment by one firm was followed by investment by others) probably reflects strategic considerations involved in FDI decisions. Most multinational firms compete in highly concentrated markets and are highly responsive to each other's decisions. An important implication of this interdependence between competing multinationals is that a host country may be able to unleash a sequence of investments by successfully inducing FDI from one or two major firms. However, the concentration of inward FDI into a handful of LDCs suggests that only a few countries can benefit from this process – Tanzania and Egypt are not China.

A recent comprehensive case study of the effects of Intel's investment in Costa Rica by Larrain et. al. (2000) finds evidence that local suppliers benefited substantially from Intel's investment. Similar evidence exists for other sectors and countries and such evidence is discussed in great detail in Moran (1998 and 2001). For example, in the electronics sector, Moran (2001) notes that in Malaysia, foreign investors helped their local subcontractors keep pace with modern technologies by assigning technicians to the suppliers' plants to help set up and supervise large-volume automated production and testing procedures. In a broader study, Batra and Tan (2002) use data from Malaysia's manufacturing sector to study effect of multinationals on inter-firm linkages and productivity growth during 1985-1995. Their results show that not only are foreign firms more involved in inter-firm linkages than domestic firms but also that such linkages are associated with technology transfer to local suppliers. Such technology transfers were found to have occurred through worker training and the transmission of knowledge that helped local suppliers improve the quality and timeliness of supply.

[11] Extensive backward linkages resulted from FDI in the Mexican automobile industry and foreign producers also transferred technology to domestic suppliers, (Moran, 1998).

Javorcik (2004) examines backward linkages and technology spillovers using data from Lithuanian manufacturing sector during the period 1996-2000. She finds that firm productivity is positively affected by a sector's intensity of contacts with multinational customers but not by the presence of multinationals in the same industry. Thus, her results support vertical spillovers from FDI but not horizontal ones. Furthermore, she finds that vertical spillovers realize only when the technological gap between domestic and foreign firms is moderate. Blalock (2001) uses a panel dataset from Indonesian manufacturing establishments to check for the same effects. He finds strong evidence of a positive impact of FDI on productivity growth of local suppliers showing that technology transfer from multinationals indeed takes place. He also plausibly suggests that since multinationals tend to source inputs that require relatively simple technologies relative to the final products they produce, local firms that manufacture such intermediates maybe in a better position to learn from multinationals than those that compete with them.

Suppose one accepts the optimistic view regarding the effects of FDI (indeed some of the evidence discussed above suggests that there are reasonable grounds for doing so). Does this have implications for industrial policy? Our answer is a qualified yes. Basic economic theory tells us that it is optimal to subsidize an activity if it generates positive externalities -- i.e. the activity benefits agents other than those directly involved in the activity itself. The potential for positive externalities from FDI surely exists and available evidence exists that often this potential is realized. Incentives to attract FDI may be justified on the grounds of such externalities from inward FDI but the magnitude of some of the incentives being used seems difficult to justify (Moran, 1998). However, such policies are not typically what proponents of industrial policy have in mind – indeed the thrust of such arguments is typically in favor of encouraging the development of *indigenous firms*. It is worth keeping in mind that investment incentives and tax breaks to multinational investors work *against* their local competitors. Thus, if there exist local firms that could potentially compete with multinationals, the adverse effect of tax incentives to multinationals on such firms needs to be taken into account. The efficacy of investment incentives is also unclear – such policies could easily end up transferring rents to foreign investors without affecting their investment decisions.

F. Government Knowledge Requirements

This review of arguments for industrial policy suggests the enormous difficulties of implementation of industrial policies quite apart from the possibilities for rent-seeking. The range and depth of knowledge that policy makers would have to master to implement a successful policy is extraordinary. They would have to understand the relevance of, and be accurately informed about, a huge range of complex questions and have the ability to accurately evaluate very subtle differences. A subset of the issues on which policy makers would have to be knowledgeable derived from the preceding discussion includes:

- which firms and industries generate knowledge spillovers
- which firms and industries benefit from dynamic scale economies – what is the precise path of such learning and the magnitude of the cost disadvantage at each stage of the learning process
- which sectors have a long term comparative advantage
- knowledge of the size of scale economies of different firms and sectors in order to facilitate investment coordination.
- an ability superior to that of individual firms to learn about their potential competitiveness
- the nature and extent of capital market failures
- the magnitude and direction of inter-industry spillovers
- the relative amount of learning by individual firms from others and from their own experience
- the extent to which early entrants generate benefits for future entrants
- the extent of heterogeneity of firms' learning abilities
- whether consumers learn the quality of a good only after consuming rather than inspecting it
- whether firms that are trying to reduce production costs also begin a simultaneous effort to improve their product's quality to obtain a better reputation.
- the potential effects of FDI or international trade in solving some of the coordination problems, including a detailed knowledge of which of tens of thousands of intermediates are tradable

- a forecast of which firms can create new knowledge and discover better production methods.
- the spillover effects of FDI as well as the likely intensity of their purchase of domestic intermediates

It is possible that government officials might be this omniscient but the performance of the portfolio managers in developed country stock markets suggests that few of the very well trained (and remunerated) equity analysts can evaluate even much more certain and grosser characteristics of existing firms and industries with long track records. Nor do industrial firms themselves have the ability to successfully forecast such developments. Acknowledging that a first best policy would argue for the government to address such market failures or externalities, the task is daunting. Quite apart from the dangers of optimal policy being subverted by industries and firms that would benefit, the sheer knowledge and skill requirements would exceed that possessed by almost any institution including the best consulting firms. On a far more circumscribed set of tasks, measuring and explaining the sources of lower total factor productivity for a small number of sectors in South Korea and Brazil relative to the United States, McKinsey & Co., a preeminent consulting firm spent several years and employed dozens of people whose qualifications exceed those possessed by officials in most developing countries (McKinsey Global Institute, 1998a, 1998b).

No study has attempted to assess whether governments have been successful in mastering these fifteen questions (or others that can be derived from our discussion) that have to be addressed. The evaluation of industrial policy has to determine its efficacy on the basis of the realized results of either firms or industries that have been encouraged. The underlying market failures or externalities that contributed to the decision to foster a firm or sector cannot be identified from the policy such as subsidized directed credit, only the effects of the policy can be assessed. We now turn to this task.

3. Does industrial policy work?

As noted earlier, it is impossible to offer a single agreed upon counterfactual to evaluate the past success of industrial policy targeted to individual industries. Thus there have been a number of research strategies pursued to provide an empirical evaluation of

industrial policy. These have been reviewed in Noland and Pack (2003). Researchers have examined, inter alia, the impact of: (1) trade protection; (2) subsidies to R & D; (3) general subsidies; and (4) preferential lending rates on the evolution of productivity, capital accumulation, and sectoral structure. Few of the empirical analyses find that sectoral targeting has been particularly effective.

Consider some of the evidence. In Japan, more than 80 percent of on-line budget subsidies were devoted to agriculture, forestry, and fisheries in the 1955-80 period, the peak of Japan's industrial policy efforts.[12] Implicit tax subsides for investment were highest in the mining sector, and quite low in the high technology sectors. Government subsidies to R&D were also small. Unless elasticities of investment and R & D with respect to subsides were implausibly high, their effect was limited. Industries that were encouraged did not experience significantly faster rates of TFP growth than others and R & D subsidies were largely ineffective.

Beason and Weinstein (1996) examined the connection between industrial policy and sectoral TFP growth in Japan. Working with a 13 sector sample for the period 1955-1990, they failed to uncover evidence that preferential policies (measured by the effective rates of protection, taxes, or subsidies) targeted sectors with increasing returns to scale or that they contributed to the rate of capital accumulation in sectors or their TFP growth. They did find some evidence that prior to the first oil shock, industrial policy targeted sectors with high labor usage. Lawrence and Weinstein (2001) extended this research employing a slightly different data set and found that differential corporate tax rates had an impact on sectoral TFP growth, while direct subsidies and subsidized loans did not. Moreover, they find the paradoxical result the effective rate of protection was *negatively* associated with sectoral TFP growth and that imports, not exports, were positively associated with TFP growth.

The latter result can be explained by noting that there are at least two channels through which imports could contribute to increasing productivity. The first allows domestic producers to use new, improved, or specialized intermediate inputs to which they would not otherwise have access. The second is imports compete with domestic products and their availability acts as a constant spur to domestic producers to cut costs

[12] The following paragraphs are based on Noland and Pack, ibid. Chapter 2.

and improve quality. Lawrence and Weinstein divide imports into "competitive" and "noncompetitive" imports and in the case of Japan, find evidence to support the second hypothesis. From this they conclude that Japan's growth would have been even faster if it had cut tariffs and exposed a greater share of its domestic producers to foreign competition![13]

Lee (1996) following a method broadly similar to Beason and Weinstein finds a similar lack of impact of Korean industrial policies on sectoral capital accumulation or TFP growth. Pack (2000) follows a different strategy, assuming that TFP in favored manufacturing sectors was in fact increased in both Japan and Korea and estimates how much of an impact even an *assumed* successful policy could have had on the growth of gross domestic product. The most favorable estimate is a roughly .5 percentage point increase out of a total GDP growth rate of roughly 10 percent over the relevant periods. While this is significant, it is hardly the magical key to accelerated growth.

It is possible that the impact of industrial policy is manifest largely in sectors that purchased inputs from the promoted sectors, even if the latter did not themselves benefit. However, Pack (2000) finds that sectors that were encouraged in Japan and Korea had few linkages with non-favored sectors via input-output relations and there is little evidence of labor flowing from favored to neglected sectors, a likely mechanism for the transmission of knowledge.

Nevertheless, as noted at the beginning of this paper, the difficulty of constructing a single agreed upon counterfactual precludes a robust conclusion. Moreover, all of the empirical analysis examines the contemporaneous impact of policies, for example, did Korean industries that were encouraged experience greater TFP growth in the period during which major promotion occurred, 1973-85. Someone doubting these results could point to the performance of some Korean firms such as Samsung and LG in the following two decades in such diverse product lines as plasma TVs, RAM chips, and cellular phones, and attribute these later successes to the earlier stimulation the firms received for other product lines. These more recent efforts by the firms that allowed them

[13] Japan's Ministry of Finance apparently agrees. In a June 2002 report issued by its Policy Research Institute, it maintains that "the Japanese model was not the source of Japanese competitiveness but the cause of our failure" and specifically argues that sectors sheltered by MITI became bloated and inefficient,

to succeed could be attributed, in this interpretation, to their earlier growth in other product categories. In this view, learning to perform R & D on microwaves, had future carryover effects on plasma TV. Fully resolving divergent views is impossible. Detailed firm histories by Kim (1997) or Hobday (1995) do not suggest such carryover.

Nevertheless, even if it should be shown that the success of a few firms could be attributed to earlier encouragement by the government, the aggregate effects just cited suggest there was not a major impact at the national level during the main period of growth acceleration. And any such effects would have to be weighed against the negative long run impacts in the financial sector cited by those skeptical of industrial policy. For example, the Asian financial crises of the late 1990s and Japan's stagnation since 1990 can be interpreted as partly the result of the earlier government direction of lending that minimized the need of banks to learn modern techniques of evaluating individual projects and managing the riskiness of their overall portfolio.

4. New industrial policy

Recent discussion of "new" industrial policy including the desirability of fostering learning and obtaining benefits from agglomeration economies offered by industrial clusters has received little systematic empirical evaluation.[14] In principle, the development of clusters could facilitate growing productivity through the provision of overhead services by the organizers plus the interaction of the firms choosing to enter the cluster. Thus clusters could offer an alternative to dependence on either buyer or manufacturer led networks.

The benefit of clusters may arise from face-to-face interactions that are productivity enhancing (interactions between software writers and chip manufacturers), a pool of workers with the relevant skills, or reduced transportation costs. Individual market agents may not be aware of the externality they generate for others and this provides an additional market failure that could in principle be addressed by public intervention. The major example usually cited is that of Silicon Valley in California

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while those exposed to international competition tended to be more market-aware, efficient, and profitable (Issei Morita, *Financial Times*, 27 June 2002).

[14] See Rordiguez-Clare (2004a) for an extensive discussion and (2004b) for a formal treatment of clusters.

which most accounts suggest arose spontaneously. Similarly, the rapid development of the software sector in Bangalore and other cities in India, discussed below, appears to be the outcome of the existence of a large group of well educated English speaking students and the entrepreneurial abilities of a small group of residents combined with activities of the large Indian expatriate community, particularly in Silicon Valley. Government participation was non-existent – for example, a critical communications satellite was financed by Hewlett-Packard. Positive government efforts followed the "takeoff" of the sector. Of course, publicly financed education institutions generated the fundamental resource, educated workers. This might be considered a generic policy not specifically targeted to the software sector but there was no explicit effort to galvanize the agglomeration economies that have since developed.

There are interesting descriptions of a number of clusters in OECD nations but few normative evaluations of their success employing social cost benefit analyses or even grosser measures such as growth of exports relative to firms outside of the cluster but in the same sector.[15] However, some insights can be obtained about whether some recent success stories in Asia conform to the contours of the new industrial policy. We consider in detail the evolution of the Indian software sector centered in Bangalore.

The development of the Indian software sector was attributable primarily to activities of private actors. Its achievement reflected a complex set of interactions between domestic and foreign responses to perceived opportunities. Many of the same patterns, with different details, can be documented for other success stories such as the Hsinchu Science Park in Taiwan (Saxenian 1999, 2001), the Special Economic Zones in China (Rosen, 1999, Huang, 2002), and Bangladesh's rise as a clothing exporter (Rhee, 1990). In the Indian software sector and the Bangladeshi garment sector, the initiating force was private, the government playing almost no role except for the fundamental one in India of providing good education, a policy that does not fall into the domain of selective industrial policy.

In Taiwan (China) the establishment of a science park and legislation in China to allow special economic zones to attract FDI were due to an initial government stimulus.

[15] Humphrey and Schmitz 2002 provide an extensive survey of the empirical literature on clusters as well as a useful discussion of whether they offer a locally controlled alternative to participation in networks.

A critical input for the success was foreign participation that dealt with some of the roles cited above as requisites of industrial policy (source of new technology, facilitation of learning, source of new product ideas, centralized marketing allowing economies of scope, coordination of entry of complementary firms). In China, the SEZs mimicked the effect that would have arisen from a free trade policy, i.e., it negated previous adverse public policies. It did not discriminate among sectors. The decision to foster a science park by Taiwan (China) comes closer to a proactive industrial policy. Unfortunately, the experience at Hsinchu has not been systematically evaluated. Many nations have attempted to use export-processing zones of one form or another to catalyze foreign direct investment and perhaps generate agglomeration economies. Evaluation of these suggests that while potentially a useful instrument, they have had indifferent results.[16] Success stories can be pointed to in Korea and Taiwan (China) in the 1950s and early 1960s, and of course in the special economic zones of China. But there have been more than a thousand such efforts. There are few clues in the existing literature about why some EPZs have been successful, while most have failed.[17]

A. The Indian software sector

In India, the preconditions for the development of the software sector were high quality education in junior colleges and universities financed by the government. A critical role was played by university graduates who went abroad for further training, remained as expatriates in the high tech sector, and later returned home or interacted intensively with newer Indian firms. The lamented brain drain became, with some lag, a source of strength and a critical catalytic input (this was also true in the case of Hsinchu).

In the 1980s there were a growing number of programming graduates and many were underemployed. There were a large number of graduates at levels ranging from post secondary technical schools to those trained at the Indian Institutes of Technology. Almost all of the students trained in programming had been educated in English. The government's continuing investments in education had resulted in over 1,800 educational institutions and polytechnics producing 70,000 to 85,000 computer science graduates

[16] An extensive set of references is provided in World Bank (2004).
[17] A careful evaluation of the Philippine experience is provided by Calanog (2006).

every year.[18] Many Indian graduates also had a second university degree or post-graduate degree from the United States or the United Kingdom, often in computer technology.[19] Other Indian software programmers received training in private software institutes to keep abreast of latest developments in the software industry and acquired a breadth of software skills. Hence, many were familiar with major computer hardware systems (IBM, UNISYS, DEC, HP and DG[20]), computer-aided software engineering tools, object-oriented programming, graphical user interface and client networking.[21]

The major impetus to demand came from abroad from of a set of "accidents." In the 1990s the ratio of world prices for programming services relative to those in India increased due to a global shortage of programmers and the demands for solutions to the anticipated Y2K problem. Enterprising businesses in India capitalized on this opportunity by setting up firms that were essentially employment agencies. Indian software programmers were hired by local firms on behalf of clients in the United States on short-term contracts (either for a fixed period of time or on a project basis) to provide onsite services. 'Bodyshopping', as this practice was called, became the predominant mode of Indian software exports because the development work was performed on the client's premises, saving software firms the high costs of acquiring computer hardware. NASSCOM, the software trade association reported that the software sector earned $2.5 billion from Y2K billing from 1996 to 1999, a critical period in the growth of the industry. As late as 1988 software exports had been less than $200 million but rose to $3.6 billion by 1998, accounting for over 10 percent of total Indian exports.

Indian software firms also benefited from another serendipitous event, the European Union's move to the Euro. Many Indian software professionals were actively involved in adapting existing computer systems and databases to accommodate the Euro. Between 2000 and 2002, it is estimated that India earned approximately $3 billion in revenues from these Euro-related IT projects. Clearly a contributing factor was the low relative level of programming costs in India that conferred a Ricardian comparative advantage in some sub-sectors of software. As late as 1995, after substantial wage

[18] James (2000).
[19] Deshmukh (1993).
[20] Lakha (1990).
[21] Lekshman and Lal (1998)

increases because of a rising demand for Indian software, the annual wages of Indian software professionals were only 14% to 59% that of their counterparts in Switzerland, USA, Canada and the UK. Given the skills of Indian programmers, these cost savings led firms in some of the industrial countries to outsource their software development requirements to India.

The circumstances just described suggest that idiosyncratic events - the Y2K problem and the shift to the Euro - exerted positive feedback and generated a succession of mutually reinforcing benefits. In terms of industrial policy, of whatever form, it seems unlikely that any government could have foreseen and acted upon these serendipitous demands. The government's main contribution had been to provide high quality university education.[22]

B. The foreign role

One of the major contributors to the Indian software sector was the large number of expatriate Indian IT professionals located in Silicon Valley. The prominence of Indian expatriates in Silicon Valley has been remarkable. In 1998, 774 (or 9%) of the high technology firms were led by Indian CEOs.[23] Many of them helped to convince large firms such as Oracle, Novell, and Bay Networks to establish operations in India.[24] Aware of the obstacles some Indians face in raising capital for their software startups they actively raised venture capital from U.S. investment firms and organized conferences in the U.S. to heighten the awareness of the potential of India's software industry.[25] Finally, some of these expatriates were actively involved in lobbying efforts urging the Government of India to revamp its telecommunication policies and other regulations that had impeded the growth of the Indian software industry[26].

FDI accounted for a large percentage of early investment in the sector. For example, in 1996, foreign companies accounted for 70% of the investment in software

[22] Some observers felt this was an incorrect allocation of education funds and the returns would have been greater to more extensive and higher quality primary and secondary education. The success of the software sector does not disprove this earlier view. For example, the favorable effect on the adoption of the green revolution package on the income of Indian farmers of even lower levels of education are well established.
[23] James (2000).
[24] Saxenian (1999).
[25] Kripalani (2000).
[26] Kirpalani (2000).

development in Bangalore.[27] And this contribution understates the true impact. Texas Instruments (TI), the first foreign firm to establish an offshore software facility in Bangalore in 1984 augmented Bangalore's inadequate land-based telecommunication infrastructure by investing in its own satellite communications network, in conjunction with Videsh Sanchar Nigam (VSNL), the government's overseas communication agency.[28] Some of TI's lines were later leased to other software firms, enabling them to expand their India-based operations instead of relying solely on onsite services abroad. Until the government built software technology parks in the 1990s linked to earth stations and other telecommunications infrastructure, TI's satellite network remained an important driving force behind the offshore development of software exports.

Once U.S. based firms had become interested in India, Bangalore's reputation for technical excellence and its abundant supply of IT graduates from its 3 universities, 14 engineering colleges and 47 polytechnic schools made it a natural choice for foreign companies to locate their software business there.[29] The foreign role has been of major importance as it provided much of the infrastructure and international knowledge that allowed Indian firms to exploit international opening. In addition, Indian software firms also benefited from foreign joint ventures and partnerships because they create markets for Indian software exports. At the same time these firm provide distribution networks for Indian firms attempting to move upstream. Moreover, partnerships with foreign firms add to the credibility to an Indian firm and act as endorsements of its quality and reliability without government encouragement. The advantage seems to have been firm specific ala Grossman-Horn rather than Mayer. Thus, other foreign firms looking to outsource their software development would invariably choose a software firm with a proven track record with another foreign company. Lastly, for small Indian firms attempting to move out of the low-end of the software business by venturing into software packages, having foreign partners is an asset because of their established distribution networks, knowledge of the recent trends in the software market (due to proximity to the demand in the U.S.) and significantly lower marketing costs. Since as

[27] The Economist (1996).
[28] The telecommunications industry in India is state-controlled, hence the need for TI to procure the services of VSNL instead of a private firm.
[29] Stremlau (1996a).

much as 70% to 80% of the final price of a software package arose from marketing costs (Lakha, 1994), small Indian firms without a known brand, an extensive sales network or sufficient revenue found it more profitable to sell its packages via a foreign collaborator.

How does this experience of a very successful sector square with the many strands of new industrial policy. All of it was privately initiated, governments at various levels became involved only after the success of the sector was evident, ratifying the success rather than catalyzing it. The industry expanded on the basis of comparative advantage and never needed any protection. Indeed, one advantage of the software sector was that its inputs, largely downloads from satellites and its output, uploaded to satellites, could not be easily taxed by the Indian authorities. A symbiosis of foreign and domestic firms was critical. Though there was clearly an agglomeration of firms in Bangalore this was achieved spontaneously without government direction. Foreign contracts rather than government subsidies provided the basis for international exploration of markets. There is no evidence of government initiation or preference.

5. Is industrial policy still relevant?

From Hamilton and List to contemporary discussions of industrial policy, the implicit framework has been that of a firm producing tradable goods at an initial cost disadvantage given the limited industrial history of the country, learning to become more efficient, and then competing with imports in the local market or successfully exporting. The marketing of the efficiently manufactured product was implicitly assumed to be routine. Reduction of production costs whether through internal learning-by-doing or through spillovers within industrial clusters was viewed as paramount. In discussions of post-war Asian experience some attention was given to the catalytic role of Japanese, Korean, and Taiwanese trading companies in assembling large quantities of goods and achieving scale economies in marketing but this activity was not given center stage (Lall and Keesing, 1992). Even if countries could now pursue the export oriented policies of four decades ago in Korea and Taiwan (China), it is not clear that they would be efficacious given the changed nature of both retailing and production networks.

In the last two decades there has been a shift in the institutional mechanism of international trade. Two types of organization have evolved: (a) international production

networks, IPN, in which a producing firm organizes large numbers of suppliers in a number of locations; (b) buyer-led networks in which large retail chains provide specifications for the desired final product and encourage suppliers in developing countries to organize their own production system that most often includes large numbers of local subcontractors.[30] These networks have become increasingly important, and are dominant in clothing and electronics and growing in importance in other products such as automotive components. In East Asia in recent years components "constitute at least a fifth of manufacturing exports and … have typically grown 4-5 percent faster than overall trade in East Asia." (Yusuf et. al., 2003, p. 272).

One effect of the growing importance of IPNs is their efficiency at organizing production and continuously reducing costs so that the global price that non-member firms must compete with shifts down rapidly. Infant firms undergoing learning face other hurdles: rapidly improving quality; changing characteristics of existing products and an array of new goods that compete with existing ones (Ernst, 2002). For firms attempting to enter export markets, it cannot be assumed that simply achieving low cost is sufficient to realize foreign sales. There is no guarantee that lead firms will be able to identify one or two firms in a small African nation. The existence of supply networks imposes a significant challenge to LDC firms that are not embedded in such a network as the lead firms usual succeed in generating higher performance in design, engineering, the effective use of information and communication technology, and the ability to coordinate production in several locations. (Yusuf et. al., p. 278).

Further militating against the classical view of infant industries is the change in the nature of retailing. Consider a mundane product such as socks that can be produced efficiently with relatively labor intensive technology. Huge retailers such as Walmart and Target buy these in quantities that typically exceed the production capacity of small (by international standards) industries. The special economic zones in China have become a series of clusters that produce enormous quantities of socks, ties, and other clothing. Retailers and wholesalers place very large orders that are well beyond the production capacities of smaller firms even if these have learned sufficiently rapidly to become cost

[30] A good description of these alternatives and evidence on their quantitative importance is given in Gereffi, 1999. See as well Yusuf et. al. (2003) Chapter 7. Sturgeon and Lester (2002), and UNCTAD, 2001

competitive in relatively small quantities. “These days buyers from New York to Tokyo want to be able to buy 500,000 pairs of socks all at once, or 300,000 neckties, 100,000 children’s jackets…” (Barboza, 2004). European firms buy smaller, more varied products but expect local suppliers to provide “in-house design and sample making capabilities that would allow them to translate and adapt the design from Europe.” (Sturgeon and Lester, 2002, p. 49).

In textiles, clothing, electronics, auto parts and other sectors, being a part of an IPN is critical to exporting and upgrading of quality. Firms that are not part of such networks may not succeed even if they are as efficient as members in production costs. Local participants in the network must “label track, respond to product orders in real time on the basis of style, color, fabric, and size; exchange information on an ... electronic basis, provide goods to a retailer’s distribution center that can be efficiently moved to stores … including containers with bar codes concerning contents” (Yusuf, p. 283). These requirements, now fairly standard in many product areas, suggest that successful penetration of OECD markets will become increasingly difficult for nations that have not yet industrialized.

In electronics, an important efficient, labor-intensive growth sector in the past for many of the Asian countries, much of the production is now carried out by contract manufacturers whose size has grown enormously in the last decade. Firms such as Solectron and Flextronics now undertake activity that was formerly under the aegis of major developed country firms who have outsourced the activity. Examining the location of several activities: headquarters, manufacturing, materials purchasing and management, new production introduction centers, and after sales repair centers, Sturgeon and Lester (2002) show that most of these activities of Solectron, the largest of the contract manufacturers, take place in developed countries or the more advanced semi-industrialized nations contiguous to them such as Mexico, Puerto Rico, Romania, and Turkey. Ernst, 2002 (p. 24) confirms these results and points out that specialized clusters in countries such as the Nordic nations, the U.S., France, and Germany are major sources as are Singapore, Hungary, Israel, Korea, and Taiwan (China). Poorer countries even if

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provide evidence on the empirical importance of the IPNs.

they have a potential cost advantage after a long learning period will have trouble breaking into these existing networks.

Moreover, China and India present formidable competitors as demonstrated by the concern over the termination of the multi-fiber agreement and the potential losses incurred by nations that formerly had guaranteed access to OECD markets. While it might be argued that the two giant nations will encounter rising wages and thus enter more capital and technology intensive sectors, providing room for new countries, both still have hundreds of millions of workers, largely in the rural sector, who remain poor and will keep a lid on the real wage faced by industrialists over the next decades, implying a continuing supply of low cost products in many sectors. While in principle poorer nations can find a niche in which they have a comparative advantage, finding them is likely to require a vector of skills that are best nurtured by membership in a production network or direct interaction with large retailers.

Viewed from the perspective of potential government policies the growing importance of production networks suggests an array of potential interventions. Korea and Taiwan (China) had numerous trading companies that aggregated orders of local manufacturers, following the Japanese model of the shosha soga. Most of these arose spontaneously from private efforts. Governments could attempt to encourage the development of trading companies as there may be a market failure given the characteristic that setup costs for such a firm may be significant but marginal costs of adding firms to the network may be small. Such trading firms would operate across clusters of manufacturing firms. Again, this assumes that there are capital market failures that preclude a nascent trading firm from obtaining finance.

Other policy questions arise. Will government sponsored clusters be as effective in generating sustained improvements in product development, quality upgrading, and growing efficiency in order to continue to compete on the world market or will firms within clusters improve faster by becoming part of networks. There is some anecdotal evidence that international networks attempt to limit the extent of upgrading, especially in higher value added segments of design. If this is so, one is back to a situation of deciding whether to promote specific activities within the entire production nexus but this

is beyond the capacity of all but the most competent of governments.[31] Taiwan's experience in the Hsinchu Science Park may be provide a counter-example, so far unconfirmed by systematic evidence.

5. Concluding remarks

Does the current policy landscape of the multilateral trading system even permit developing countries to pursue industrial policy? Should it? It is clear that developing countries today have to contend with several multilateral agreements that the rich countries did not have to when they themselves were developing. Have the constraints and disciplines imposed by WTO agreements such as TRIPS and the TRIMS become too restrictive to allow developing countries to chart their most preferred course to economic development? This is a difficult question but it cannot be dismissed out of hand. Certainly the international policy environment today imposes constraints on the use of national policies that were absent even 15 years ago and the constraints are backed by the potent dispute settlement procedure of the WTO.[32]

The experience in a number of countries in the last two decades suggests that private firms have often been successful in pursuing learning strategies that earlier analysts were advocating. The growth of the Indian software sector, Bangladesh's clothing industry, and China's special economic zones was driven primarily by private sector agents (often from abroad). In the first two the main role of the government was benign neglect while in the latter the Chinese imitated the earlier success of Singapore by enabling the location of foreign investment in enclaves that were well provided with infrastructure. Much of the earlier investments came from overseas Chinese.

There was not a government policy in any of these cases that identified individual firms or industries with high learning potential and likely spillovers. In Bangladesh and China foreign firms brought standard technology but importantly extensive marketing networks. Standard comparative advantage can explain the pattern of sector choice. Compared with the exceptionally complex process of either picking sectors (or firms) or the process of allowing firms to identify their own competitive advantage, it seems much

[31] A good discussion of this issue is contained in Humphrey and Schmitz (2002).
[32] For further discussion see Noland and Pack (2003), Chapter 5.

more efficient in the current state of intensifying world competition and the growing importance of extensive and complex supply networks to allow foreign firms to facilitate the reduction of costs in the host economy. This would suggest a change in focus from even the new industrial policy to one that focused on negotiation with multinational firms on issues ranging from environmental regulation and taxes to efforts to insuring local learning. The difficulty with this approach is the limited amount of FDI going to LDCs – many countries in Africa, the Middle East, and Latin America continue to receive very little. This may be due to their overall economic prospects given their policies. But in these economies hewing to some of the major tenets of the Washington Consensus while recognizing some of its weaknesses, might prove a better investment of limited government competence and legitimacy, than the extraordinarily complex strategies required by either the new or old industrial policy.

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